Cultural Ecosystem Services and the Avifauna of the Western Cape: a social-ecological systems investigation

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I know the meaning of plagiarism and declare that all of the work in the dissertation, save for that which is properly acknowledged, is my own.

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Chapter 1 – "Assessing the Fitness of the Economic Valuation of Ecosystem Services"
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ABSTRACT
The ecosystem services concept has become inextricably linked to the economic valuation approach. Such an approach rests upon a triple incoherency, inadequately accounting for relationships between natural components, social and natural components, and within society itself. These incoherencies have distracted the ecosystem services concept away from its initial grounds: the reliance of humans upon the natural world. The faults of these three arenas are reviewed and found to be insuperable – ecosystem services must be re-imagined if they are to support positive conservation efforts. Such re-imagination here takes place within the framework of Social-ecological Systems (SES) theory. Founded upon the unifying concept of change, SES theory introduces a needed awareness of the dynamic interactions which characterize the process by which ecosystem services are realized by people. This introductory chapter sets the premise from which the rest of this thesis will operate: that the ecosystem services concept must account for the temporal dynamics of social-ecological interactions. Once an element of change becomes linked to ecosystem services only then can the concept may speak meaningfully to the co-constitution of the social and ecological arenas.

Keywords: ecosystem services; social-ecological systems; Millennium Ecosystem Assessment; economic value; change

1. INTRODUCTION

The transformation of our biosphere is diversely manifest. Not since the dawn of the Holocene has the planet risked such possible climatic shifts, losses of biodiversity, and alterations of chemical composition. The very systems sustaining life as we know it are characterized by uncertainty.

Welcome to the Anthropocene (Steffen, Crutzen, and McNeill 2007). While it may once have been intellectually admissible to posit our own, purely social sphere as entirely separated from, yet framed by a dark and foreboding wilderness, humanity's global impacts necessitate the admission that we too are situated, interactive entities on an ecological stage. Simultaneously we are transformative of, and created by our surroundings; we co-produce context, as it co-produces us (Whitehead 1929; Norgaard 1994). As mathematician and philosopher Michel Serres writes, "humanity has become a natural force… he is being-everywhere" (1990).

Our newfound fragility and obvious interactivity suggest novel conceptual approaches. The ecosystem services concept speaks to humanity's reliance upon the biosphere. Highlighting the value humans derive from ecosystem structure and function (Daily 1997), ecosystem services have become the pre-eminent vocabulary of social and ecological exchange (Wilson and Howarth 2002; Potschin and Haines-Young 2011; Voosen 2013).
Defined as "the benefits people obtain from ecosystems" (MA 2005, 53), ecosystem services are a form of lexical and conceptual bricolage highlighting the importance of ecological structures and functions to individuals and society (Daily 1997). Yet the environmental processes ('ecosystem') and human well-being ('services') characterized by the term have become obscured through its often inappropriate applications. The ubiquity of the ecosystem services approach has tethered to it divergent implications which threaten to minimize the concept's effectiveness in addressing unsustainable interactions between humanity and the natural world.

To support the ecological processes which undergird human well-being, the ecosystem services approach is in need of conceptual re-imagination. I begin with an assessment of the economic valuation, or simply valuation, of ecosystem services; it is through this approach that the ecosystem services concept has achieved its greatest discursive power. Yet herein the inadequacies of the ecosystem services concept as a comprehensive framework are most on display. Economic valuation can prove valuable as *one tool* for integrating ecological concerns into decision-making arenas. However, economic measurements represent an incomplete accounting of how people and the natural world interact. While the measurement of ecosystem services may aid in sustainable decision-making at the human-environmental nexus, the ecosystem services concept has been found wanting as an ontological position. Reviewing the conceptual inadequacies of the ecosystem services concept highlights its predominant shortcoming: the concept inadequately accounts for change over time. The application of Social-ecological Systems (SES) Theory provides a framework within which the heuristic value of the ecosystem services concept can meet the practical complexity of an uncertain world (Rogers et al. 2013).

A review of the economic valuation of ecosystem services reveals a triple incoherency. Insufficiently characterizing interactions between ecological phenomena, between people and the world, and those taking place between social actors, the economic valuation of ecosystem services suffers from three shortcomings which I respectively label natural-natural, social-natural, and social-social problems. This applied organizational structure both highlights the extent to which the economic valuation of ecosystem services is untenable as a comprehensive framework, and provides clarity for somewhat tangled arguments. Such typologies are not premised upon *a priori* separations. Rather, they express the different character of interactions being assessed. First, contemporary ecological science reveals that ecosystem component interactions are insufficiently addressed in economic value quantifications (Kosoy and Corbera 2010; Norgaard 2010; Soule 2013). Market logics threaten to abstract ecosystem services from their spatial-temporal foundations (Tansley 1935; Colyvan et al. 2009; Peterson et al. 2010), rendering the economic valuation of ecosystem services 'un-ecological' in execution (Leopold 1934; Carpenter et al. 2009; Gowdy et al. 2013). Misjudging ecological properties we enact unsupported theory. So-called *natural-natural problems* are the result, wherein the conceptions of ecological interactions which are used to inform ecosystem science, do not match how ecological interactions are conceived in ecosystem service valuation. Second, ecosystem services are realized through mediated and contingent social-natural relationships amenable to transformation (Latour, 1999; Farber, Costanza, & Wilson, 2002; Diamandis & Kotler, 2012). Within our specific social *and* natural context diverse valuations, economic among others, take place (Maler, Aniyar, and Jansson 2008; Norgaard 2010). Different types of social-natural relationships variously transform ecological processes (Cronon 1983; Ludwig 2000; Foster 2002) and incomplete understandings of social-natural interactions cast doubt upon our sociotechnical present and future (Heal 2000; Cumming et al. 2012; Soule 2013). Economic valuations inadequately account for the significant impacts which sociotechnical structures and contexts have on the valuation of ecosystem service benefits (Hardin 1968; Vatn 2000; Norgaard 2008), breeding *social-natural problems*. Third, the extension of economic logic to ecosystem services runs afoul of problematic economic assumptions. The role of human values, the operation of actors, and the incompleteness of information within uncertain systems forces us to question the fitness of the economic approach (Harvey 1996; Martinez-Alier, Munda, and O'Neill 1998; Norberg and Cumming 2008; Gómez-Baggethun et al. 2010). Market valuation is always an incomplete accounting (Heal

2000), and prices are not sufficient for comparisons across incommensurable types of value (Norgaard 1989; Martinez-Alier, Munda, and O'Neill 1998; Gomez-Baggethun and Ruiz-Perez 2011; Soule 2013). While the economic valuation approach takes centre stage within the values discussion (Kosoy and Corbera 2010; Norgaard 2010; Peterson et al. 2010), it is unclear how prices will be weighed in a changing world. The ever-present possibility of transformation creates *social-social problems*, rendering economic valuation approaches incoherent (Vatn 2000).

These three incoherencies can be generically described as an inadequate accounting for the temporal dimension. Anchoring human well-being in both the social and natural arenas, the ecosystem services concept nevertheless requires the incorporation of history into our ecological methods. Recognition that change is an ever-present factor within these linked systems will spatially ground and temporally contextualize both the components and the relationships which compose ecosystem services (Levins and Lewontin 1985; Cronon 2000; Cumming 2011). The dynamic interplay which occurs between natural-natural, social-natural, and social-social components, reorients the ecosystem services concept towards a discourse of praxis, whereby relationships across social and natural arenas are seen to be an *interactive and creative* process co-productive of *one linked world.* This is the world we inhabit. A re-imagination of the ecosystem services concept within a broader theoretic framework resting upon a foundation of change, reveals novel ways of addressing both components and systems. Social-ecological[1] Systems Theory (SES) is one contemporary school of thought which can provide a framework to ground the ecosystem services concept. Within SES theory disparate insights, not just from the ecological sciences, but from across the academy, can cohere to speak in fruitful conversation. Short of such reorientation the ecosystem services concept remains susceptible to misappropriation, potentially exacerbating, rather than addressing, human-environmental difficulties. Only through a theoretic re-founding can the concept be transformed into a tool for sustainable environmental decision-making, and support the broader goal of the Millennium Ecosystem Assessment for a future in which both environmental and human well-being is possible.

This chapter interrogates and attempts to rectify the conceptual inadequacies within the ecosystem services concept. Re-envisioning ecosystem services within the SES framework provides the foundation for applying the ecosystem service concept to productive scientific research. Though I thoroughly break-down the economic valuation of ecosystem services, I do so to rebuild the concept from its foundations. Subsequent chapters will apply the ecosystem services approach to conservation science – in particular the category of cultural services – as a linked series of studies integrating the SES theoretic framework. Chapter Two begins with a survey method founded largely within the social sphere. These surveys investigate a set of responses assessing the stated interest of ecotourists in certain ecological features, particularly focused on interactions with bird life. Examining the different cultural service provisioning of human-avian interactions begins the work of

[1] Throughout this chapter I differentiate between the social and natural arenas being targeted for investigation, and the Social-ecological Systems approach. Though different associations are suggested by the terms "natural" or "ecological" I employ the terms synonymously when discussing nonhuman biophysical interactions. The application of the term "natural" versus the term "ecological" merely differentiates between whether or not a social-ecological framework is being employed. Once the incoherencies of the economic valuation approach to ecosystem services have been reviewed and dismissed, and we are engaged in the social-ecological systems theoretic, I drop the use of the term natural entirely, relying instead on reference to the ecological, which is a less charged and historically difficult concept for discussing interactions between humans and the nonhuman world (Latour 1993; Cronon 1995).

wedding together the social and the ecological. Chapter Three demonstrates the creation of a novel tool – "Wow Factors" – to measure the relative interest birders have in viewing different bird species. Here we are situated at the formative point of social-ecological interactions: what is the quality of different interactions with birds, for birders? Chapter Four applies these "Wow Factors" to point counts measuring avian species composition for a sub-set of private protected areas in the Western Cape Province, South Africa. The application of our social-ecological tool within the realm of more traditional ecological science demonstrates one manner in which social-ecological approaches augment scientific research. By this chapter's closing we have moved across the social-ecological continuum, and, if successful, I have demonstrated both the interconnectivity of these three studies, as well as the power of the SES approach in addressing ecosystem services, and conservation concerns.

2. THE ECONOMIC VALUATION OF ECOSYSTEM SERVICES

(a) *The Millennium Ecosystem Assessment and a brief history of the concept*

In 2005, the Millennium Ecosystem Assessment (MA), a cross-disciplinary, multinational effort, attempted to define not only the state of the interrelationship between people and the natural world, but also the prospects for a future in which the global environment might support human well-being. Bringing together more than 1300 experts from 95 countries, the MA sought to provide an authoritative voice on the state of earth's ecosystems and their relevance for people, now and into the future. The MA highlighted such issues via the application of ecosystem services, both as a measurement tool and focus of concern.

Stressing an approach to environmental governance predicated upon human well-being, the MA identified ecosystems as the locational nexus of the human and the non-human world. Assuming that a "dynamic interaction exists between people and ecosystems" the MA conceptual framework operates from the premise that changing human conditions both directly and indirectly drive changes in ecosystems, while changes in ecosystems likewise impact social prospects (MA 2005, 7–8). As a document founded upon the imperative of transforming policy, the MA sought pragmatic approaches to integrating ecosystem concerns into decision-making processes. "Firmly [placing] the ecosystem services concept on the policy agenda", the MA gave the concept its greatest voice to-date (Gómez-Baggethun et al. 2010, 1214). This voice was founded primarily upon an economic approach to valuing ecosystem services. Though ecosystems are initially identified as valuable "because they maintain life on earth and the services needed to satisfy human material and nonmaterial needs" the manner of measuring this value may not be readily apparent (MA 2005, 128). Because economic markets guide individual and group, public and private decisions, an economic valuation of ecosystem services has been conceived as the premier method of integrating environmental concerns into decision-making arenas (Costanza and Daly 1992; Costanza 2000; MA 2005; PCAST 2011). Through the measure of price economic valuations are seen to provide the 'common metric' for assessing ecosystem services (MA 2005, 128).

Price as a measurement has been a latter-day addition to the ecosystem services concept. Initially the term was meant to raise an awareness that environmental degradation undermines humanity's ability to persist into the future (Ehrlich and Ehrlich 1981). Specifically the ecosystem services concept highlighted human reliance upon the environment, and the unaccounted-for benefits we receive from environmental processes (Daily 1997; Mooney and Ehrlich 1997; Norgaard 2010). Whereas ethics of stewardship and conservation were predicated upon humanity's duty to protect nature, the ecosystem service concept attempted to invert this logic by demonstrating the reliance of people upon the natural world (Soule 1985; Goulder and Kennedy 1997;

Sekercioglu 2010; Kareiva and Marvier 2012). In response to the population concerns and resource shortages of the 1970s, a developing utilitarian paradigm placed human benefit at the forefront of concern for ecosystems (Hardin 1974; Gómez-Baggethun et al. 2010). At this juncture a narrative of conservation *for* development slowly began to sub-plant concerns pitting conservation *against* development (Folke 2006). Though it has long been acknowledged that "human beings may depend utterly on the continuation of natural cycles for [our] very existence" (Daily 1997, 5), more than forty years since the emergence of the modern conservation movement, alarming trends of environmental degradation continued (PCAST 1998; Gómez-Baggethun et al. 2010). Ecosystem services were initially another attempt by conservation scientists to arrest global environmental degradation.

Increasing awareness of environmental degradation throughout the 1980s and into the 1990s gave rise to large-scale institutional reviews addressing global environment conditions (UNEP 1972; IPCC 1988; Brundtland 1987; Gómez-Baggethun et al. 2010). In 1997 the ecosystem services concept moved beyond the narrow concerns of a few specialists and into the mainstream of ecological scholarship. With the publication of Gretchen Daily's edited volume *Nature's Services* (1997) and Costanza et. al.'s paper, appearing in the journal *Nature* (1997), the concept began to take on a paradigmatic pre-eminence across the ecological scientific and policy realm (Mooney and Ehrlich 1997; Peterson et al. 2010). While Daily's volume brought together noteworthy environmental scientists around the theme of ecosystem services, Costanza et al.'s paper pegged global ecosystem services to an average value estimated at $33 trillion per year. Comparatively measuring global GDP to be roughly $18 trillion per annum, this synthesis sought to convey the global economic value of ecosystem services, and proved to be a "watershed" in the burgeoning fields of environmental and ecological economics, as well as the environmental sciences (Parks and Gowdy 2013, e4). This analysis made evident that the global economy could never properly substitute for widespread ecosystem services shortfalls (Solow 1974). While, predictably, many voices arose to cry foul at measurements supposing to convey the value of global ecosystem services, variously labelling Costanza et al.'s approach as "audacious," "futile," and "a serious underestimation of infinity" the efficacy of the approach in stirring the scientific and political pot cannot be ignored (Masood and Garwin 1998). In its ascendance, the ecosystem services concept became linked to an economic valuation of nature. Though the economic valuation of ecosystem services is acknowledged not to be "an end in itself" it has become widely recognized as "the first step in integrating these services into public decision-making and ensuring the continuity of ecosystems that provide these services" (Sekercioglu 2010, 65).

Within this paradigm the MA sought to bring ecosystem services to the forefront of environmental governance concerns. Since the release of the MA an explosion in ecosystem services research has taken place, with the economic valuation approach maintaining pre-eminence (Fisher, Turner, and Morling 2009; Voosen 2013). Yet many researchers contest both the process by which economic valuations occur (Heal 2000; Boyd and Banzhaf 2005; Kosoy and Corbera 2010), as well as the moral appropriateness and impacts of applying economic logic to the natural world (Ludwig 2000; Robertson 2006; Soule 2013). As one tool for incorporating ecological concerns into decision-making arenas, the economic valuation of ecosystem services is potentially powerful indeed (Liu et al. 2007; PCAST 2011; Voosen 2013). However ecosystem services valuation threatens to undermine the key insight of the concept: that humanity is reliant upon the natural world.

(b) *Nature-nature problems*

Foremost among critiques of the economic valuation approach are that its latencies inadequately address the functional and interactive nature of ecosystems. Such valuations are criticized for favouring a reductionism which does not match contemporary ecological understandings. Ecosystems are both heterogeneous and in a continuous process of evolutionary change (Leopold 1933; Golley 1993; Maler, Aniyar, and Jansson 2008). It was in his 1935 article, "The Use and Abuse of Vegetational Concepts and Terms," that Arthur Tansley set forth the notion that the whole physical universe, from the vast expanse down to the tiniest atom, is simultaneously composing and being composed of a hierarchy of interacting, nested systems (Golley 1993). "These *ecosystems*," Tansely wrote, "are of the most various kinds and sizes" (Tansley 1935, 299). Characterized by multi-scalar interactions which yield the creation of complex, emergent entities, ecosystems are both the basic unit and primary product of ecology (Limburg et al. 2002). Component relationships are the drivers of ecological processes (Golley 1993). Tracing relationships across and within organisms and physical environments, the ecosystem perspective recognizes these complex entities as both composed by and transcendent of their constituent parts. Scientific consensus also recognizes that ecosystems themselves exist as discrete entities. Co-produced within evolving contexts, ecosystems are measured both across and within spatial and temporal scales (Cumming 2011) – it can be accurately stated that ecosystems contain ecosystems. Inherently place-based, ecosystems are simultaneously linked to, and differentiated from, their neighbours through differing processes of interaction. Measures of ecosystem extent frequently depend upon which aspect of the system is being examined. The ecological sciences endeavour to study these complex systems in their various forms and expressions (Colyvan et al. 2009).

The place-based interactions of ecological processes suggest that components and interactions cannot be meaningfully separated from their environments without sacrificing crucial aspects of identity (Levins and Lewontin 1985; Harvey 1996; Vatn 2000). Though it may be feasible to value one fish separately from its habitat, how can we hope to value a stock of fish without simultaneously being assured that they will have water to live in? Similarly, would we value flowers differently if there were no pollinators, crops without soil, or cattle without rangelands? Economic valuation approaches inherently abstract ecological relationships from their spatial and temporal contexts. A Cartesian approach by which parts become separable from the whole addresses only the end-products of natural processes (see Panel 2, pg. 15), threatening to impose a factory-logic onto the natural world (Boyd and Banzhaf 2005; Maler, Aniyar, and Jansson 2008; Rogers et al. 2013). While it has been supposed that ecosystem services align economics with conservation concerns (Daily and Matson 2008), the converse seems to be increasingly the case: ecology is being straight-jacketed by economic dictates (Robertson 2004; Peterson et al. 2010). An imposition of market logic threatens to mask ecological complexity and the processes by which services are created (Kosoy and Corbera 2010). Such over-simplification involves considerable risks to both people and the environment (Beck 1992; Muradian and Rival 2012).

"Bringing earth into the balance sheet" suggests a narrowing-down of ecological function to outputs comparable across time and space (Foster 2002, 16; *Economist* 2005). As ecosystem functions are transformed into deliverable ecosystem services, natural processes become more susceptible to logics of commodification and exchange (Vatn 2000; Daily et al. 2009). One-sided human valuation models of economics marginalize the interactive and multi-functional nature of ecosystem processes (Myrdal 1953; Gowdy et al. 2013). The environmental sciences suggest that there is no single, ideal state of nature. Rather evolution and ecosystem processes are always adapting to changing inputs and conditions (Darwin 1859; Tilman et al. 1997; Gowdy et al.

2013). In contrast, economic values threaten to freeze ecological interactions in-place. When ecosystem services are decoupled from ecosystem processes, concerns of ends subsume an awareness of means. A spatially explicit accounting of ecological processes must accompany ecosystem service valuations (Beckerman and Pasek 1997). Unsupported simplifications of how natural processes interact within one another breed inadequate assessments of *nature-nature* interactions.

When market logics dictate desired ecosystem function the central thread of the ecosystem services concept, that of humanity's reliance upon ecosystems, is in danger. While it has been imagined that the ecosystem services concept aligns economic forces with conservation (Daily and Matson 2008), the inverse is more accurate: conservation becomes increasingly beholden to economic forces (Peterson et al. 2010; Soule 2013; Voosen 2013).

(c) *Social-natural problems*

A comprehensive understanding of natural processes must recognize that ecosystems consist of human components. Indeed, any ecosystem output must be mediated through human effort to be properly thought of as an ecosystem service (Potschin and Haines-Young 2011). The influence of ecosystems on human well-being has been central to the ecosystem services concept. We may likewise assert that human action impacts the environment, and the two realms feedback upon each other in dynamic, and sometimes transformative, processes (Gunderson and Holling 2002; Cumming 2011; Mann 2011). It is via the interactive capacities of people and nature that ecosystem services become diversely manifest (Marx 1867; Gómez-Baggethun et al. 2010; Reyers et al. 2013). So-termed 'social-natural problems' highlight the extent to which ecosystem service valuation exists within, and reinforces, certain socio-technical ways of being.

Interactions between any phenomena will modify spatial and temporal context (Levins and Lewontin 1985). The transformative impacts of social-natural interactions suggest four distinct types of social-natural problems with ecosystem service valuation. First, the valuation of environmental processes occurs in relation to a society's technological capabilities. Second, the unsustainability of our socioeconomic present suggests that ecosystem services valuation will reproduce unsustainable economic priorities. Third, a disregard for scientific uncertainties ignores the persistence of the unknown (Norberg and Cumming 2008). Finally, the economic valuation approach reproduces human-dominant philosophic conceptions which continue to breed debate within socio-political discourse.

Ecosystem service valuation occurs within a particular socio-technical present. Natural phenomena can only be *realized as services* to the extent that people derive benefit from them. The transformations of nature are co-produced relative to the *status quo*. Certain benefits are realized with little or no technical mediation, e.g. sunlight or fresh air. Others, such as medicines derived from plants, timber for building construction, or the oil which drives our global economy, require vast assemblages of social and physical technologies to transform and deliver natural products across time and space. Our ability to derive valuable products or experiences from the natural world is reliant upon an innumerable list of tools and social organizations (Foster 2000). It is only through transformative mediation that ecological phenomena *become* resources (Marx 1867; Henderson 2009); such mediations likewise alter social-natural relationships. There is no teleological guarantee that any element, process, or ecological phenomena will serve as a resource. Our ability to fix a price to any phenomenon relies upon a host of social and contextual ties which are often obscured in the application of the ecosystem services concept (Kosoy and Corbera 2010).

Case and time sensitive, our ability to value ecosystem services occurs within a framework of unsustainable practices (Maler, Aniyar, and Jansson 2008). Global assemblages of people and things have fostered social-natural relationships typified by the degradation and transformation of life-supporting ecosystems (Daily 1997). Economic valuation risks extending the very present which the MA asserted threatens to diminish the prospects of future generations (Foster 2002; MA 2005; Norgaard 2010). Destruction of natural habit, pollution of fresh- and salt-water resources, the increasing impacts of global climate change, along with a host of other everyday realities, demand a reflexive examination of the socio-economic *status quo* (Serres 1990; Levin 1999; Diamond 2006). Technology and social value co-evolve alongside a society's relationship with the natural world (Rolston 1982; Rhodes 1988; Foster 2000); it must be questioned whether or not ours is a society which, as currently constructed, can breed sustainable values (Costanza 2000; Foster 2002). The more serious our current environmental difficulties, the less adequate current valuation approaches will be in moving towards a sustainable future (Norgaard 2010).

Given the complex nature of social-natural interactions, uncertainty and the unknown are omnipresent in our valuations of ecosystem services (Beck 1992; Cumming et al. 2012). Measurement difficulties and the poor quality of environmental and social data for much of the globe means that ecosystem service markets operate from a position of incomplete information (Norgaard 2008). Even the most widely-recognized ecosystem service markets have not reached a level of maturity expected of commodity markets (Robertson 2004). Natural resource measurement requires a synthesis of numerous information types, many of which contain notable errors and variability (Carpenter and Turner 2000). Such difficulties threaten to place certain ecosystem services beyond market parameters, thus marginalizing their ability to impact environmental policy (Robertson 2006; Kosoy and Corbera 2010). The persistence of unforeseen outcomes demands an incorporation of uncertainty into forecasts of social and natural transformations (Leopold 1933; Funtowicz and Ravetz 1994; Martinez-Alier, Munda, and O'Neill 1998). Assuming that persistence and equilibrium characterize the natural order of things speaks volumes of our insistence in operating from positions of ignorance (Levins and Lewontin 1985; Farley 2012). Technical limitations and our consequent uncertainty imply that both our economic and moral priorities are susceptible to radical alteration.

As human values respond to coupled social-natural transformations, the importance placed upon different ecosystem services is liable to change (MacIntyre 1981). The rights and obligations humans exercise regarding the natural world have come under frequent critique. The extension of market logic into the arena of environmental problems, further subsumes the world to free-market dictates (Polanyi 1944; Gómez-Baggethun et al. 2010). As the discursive power of ecosystem services grows it is incumbent upon us to recognize that scientific understandings reinforce certain social-natural relationships (Robertson 2006; Heydinger 2011).

Our rights to ownership have been long contested. Though woven into the foundations of capitalism, the 'triumphalist' attitude implying that natural entities and processes shall be subject to human ownership is both historically contingent and variously contested (Hughes 1983; Gill 1987; Callicott and Ames 1989; Harvey 1996, 131). At least as early as Jean-Jacques Rousseau the problematic aspects of owning the natural world were being raised:

> *The first man who, having enclosed a piece of ground, bethought himself of saying This is mine, and found people simple enough to believe him, was the real founder of civil society. From how many crimes, wars, and murders, from how many horrors and misfortunes might not any one have saved mankind, by pulling up the stakes, or filling up the ditch, and crying to his fellows: Beware of listening to this imposter; you are undone if you once forget that the fruits of the earth belong to us all, and the earth itself to nobody.* (Rousseau 1762)

As Rousseau evocatively points out, ownership rests upon our ability to exclude others from equal access to, or enjoyment of, particular phenomena. Whether exercised by an individual or group, ownership implies a specific character of the relationship between the natural world and some person, or persons. The necessity of exclusion was given its most full-throated endorsement by American ecologist Garrett Hardin, in his "The Tragedy of the Commons" (1968).

Establishing that you can never simultaneously maximize antagonistic variables, Hardin outlined his now famous theory in response to rising global population. This critique, primarily executed as a broadside across Jeremy Bentham's utopian pursuit of the greatest good for the greatest number, would become the "dominant paradigm" within which resource assessments have taken shape ever since (Gómez-Baggethun et al. 2010). Taking issue with the economic emphasis on agglomerating individual utility into a broader social good (Smith 1776), Hardin argued that selfish, though economically rational, actions will degrade common-pool resources. Though individual actors make rational choices, such choices will not always yield the greatest good – a position known as "soft-utilitarianism" (Goulder and Kennedy 1997; Martinez-Alier, Munda, and O'Neill 1998). The impositions placed upon our resource-base, exacerbated by a burgeoning population crisis, led Hardin to echo Hegel in defining freedom as the "recognition of necessity" (Hardin 1968, 1248). Because ours is a society founded upon an outdated pattern of ethics, we inadequately balance the rights and obligations dictated by our global environmental present. Alert to the prospect of societal collapse, Hardin held that our social ethics are "poorly suited to governing a complex, crowded, changeable world" (ibid., 1245). Asserting that an action's moral fitness ought to be assessed in regards to desired outcomes, Hardin held that the privatization of natural resources, backed by the power of coercion, could arrest environmental degradation. By sacrificing outmoded freedoms at the altar of social preservation resources might become appropriately valued, and thus protected.

Crucially for our study, Hardin's work fails to recognize the contingency of his ethics, and the adaptive capacity of social and natural systems. There is no guarantee that the division of natural capital will occur equitably (e.g. Matthiessen 1984; Beck 1992; Harvey 1996). The creation of markets bred by resource ownership has been shown to be problematic (Funtowicz and Ravetz 1994; Robertson 2006; Kosoy and Corbera 2010) and the extension of property rights conceptually and physically transforms natural entities and processes (Cronon 1983; Ludwig 2000; Foster 2002). The economic valuation of ecosystem services, in expanding the economic realm, threatens to reinforce extant economic inequalities and social injustices. Claims of ownership are reified only within a particular socio-political sphere. Though accounting for natural capital reinforces the linkages between environmental and economic concerns (Costanza and Daly 1992), this does not imply that it can, or should, drive human relationships with the world.

Changing knowledge and technologies reorient the social-natural interface (Farber, Costanza, and Wilson 2002; Diamandis and Kotler 2012). Resources are an achievement of differing social, technological, and scientific transformations (Henderson 2009). Technical interdependencies have been shown to feedback, suggesting transformed social and moral implications (MacIntyre 1981; Vatn 2000; Foster 2002). Principles of complexity and non-linearity suggest a guarded approach to forecasting ecosystem service futures (Limburg et al. 2002; Groffman et al. 2006; Farley 2012). The ubiquity of transformations demands a reflexivity to our approaches (Norgaard 2010). The economic valuation approach to ecosystem services harnesses an interactive dynamic and leads it down a one-way street of human benefit.

(d) ***Social-social problems***

Lest the so-termed natural-natural and social-natural problems provide inadequate evidence to question the fitness of the economic approach to ecosystem services, the internal inconsistencies of economic approaches further damn such efforts. Value as derived in "neoclassical" economics (Veblen 1900) has been variously weighed in economic, environmental-economic, and conservation literature, and found wanting. The implications of these shortcomings breed our final highlighted incoherency – what I label social-social problems. As noted before, though the social and natural arenas are coupled, the shortcomings of the approach are here most directly manifest within the social sphere.

The MA clearly grounds valuation approaches within a framework of "strong utilitarianism," whereby individual values aggregate to form a broader social good (Goulder and Kennedy 1997; MA 2005). The fitness and completeness of this approach is addressed in literature critiquing neoclassical economics. Gowdy et al. (2013) identifies three primary features of western economic thought central to an assessment of humanity's relationship to nature. First among these features is the premise that each individual is an entirely rational and self-interested actor. Such actors proceed based upon his or her ability to maximize their own individual *utility*, or the benefit he or she derives from a given action or experience. Crucially, such "want-regarding" decisions are made with total relevant information. Second, a well-functioning society arises through agglomerated self-interest. Such a society will satisfy not only individual, but also communal welfare. This principle was famously termed 'the invisible hand,' by Adam Smith (1776). Third, the existence of market equilibrium is both possible and optimal. The functioning of price as a comparative measure requires the potential or real existence of market equilibrium. These three premises – the "holy trinity" of economics (Colander, Holt, and Rosser 2004) – are believed to guide the choices of both individuals and groups, and compose the dominant arena of social power within which ecosystem service valuation takes place.

The rational, self-interested actor concept states that all people seek to maximize their utility, and, through the application of full and relevant information, apply this measure in all possible scenarios (Jevons 1888; Ludwig 2000; Colander, Holt, and Rosser 2004). The utility function has been employed as the formative variable for understanding "how and why economic actors use ecosystems as they do" (MA 2005, 130). While it has been believed that the concept of utility comprehensively accounts for human values (Gomez-Baggethun and Ruiz-Perez 2011), it is unconcerned for other than pure self-regard (Beckerman and Pasek 1997; Gowdy et al. 2013). Though the utilitarian approach can be parsed into use and non-use values, as in the MA, either application rests upon the premise that results drive actions: value is, entirely, realized as value *in consequence*. (This is most frequently contrasted to Kant's notion of the *a priori*, where good is a pre-existing factor (Kant 1781.) Even as the divinely-inspired moral strictures of right and wrong were largely abandoned by utilitarians in the late 19th century, neoclassical economics retained the utilitarian method of assessing choice only in regards to value derived from outcomes (Myrdal 1953).

For our purposes the most problematic facet of the rational-actor concept is the notion of the fully-informed utilitarian. The diverse development of complexity theory across the fields of mathematics (Hofstadter 1979), the computer sciences (M. Mitchell 2009), philosophy (Cilliers 2000; Nicolescu 2012), and the biological (Lewin 1993) and ecological sciences (Norberg and Cumming 2008) has highlighted characteristics of uncertainty and emergence across our three arenas of the natural-natural, social-natural, and social-social. Complexity studies aim towards a multi-disciplinary manner of investigating how differing interactive components give rise to unforeseeable asymmetries and complex behaviours; responding to different inputs to create unique outputs (Limburg et al. 2002; Norberg and Cumming 2008). The concept of emergence within complex systems, referring to the formation of novel and coherent structures, patterns, and properties, suggests the existence of thresholds, and the possibility that transformation will result in radical novelty (Goldstein 1999; Berkes, Colding, and Folke 2003). Complex systems are both nested and multi-scalar – complex systems are contained within, and contain, complex systems (Cumming et al. 2012; Guerrero et al. 2013). The inherent uncertainty of complex systems begs the question of whether or not the completely informed individual could ever exist. The presence of uncertainty may foreclose our ability to act in a perfectly rational manner.

The impossibility of complete information similarly forecloses our ability to internalize all aspects of market value (Heal 2000). This questions whether agglomerated social interest can arise from self-regarding concern. Utilitarian judgment relies upon the existence of "a single comparative term by which all different actions can be ranked" (Martinez-Alier, Munda, and O'Neill 1998, 278). Even if we grant that a hierarchy of values is possible, this does not imply that one measure of value is sufficient for assessing all actions (Martinez-Alier, Munda, and O'Neill 1998; Gomez-Baggethun and Ruiz-Perez 2011). There is no guarantee that the free-market will benefit the common good; indeed, it was never meant to (Marx 1867; Polanyi 1944). Rather, it is the mix of self and other-regarding behaviours which allow for the functioning of the market in the first place (Gowdy et al. 2013). The existence of value beyond the confines of market price is essential for the continued functioning of the socioeconomic sphere (Martinez-Alier from Parks and Gowdy 2013). Though money is seen to function as *the* common metric with which to asses value, the reduction to a single (monetary) valuation minimizes the diversity of human concerns and threatens to conflate values which may be in opposition (Bookchin 1990; Harvey 1996; Soule 2013). Whether we are concerned with the benefits of charity or valuing ecosystem services, the quantitative measurements of economic value have proven inadequate to addressing moral concerns. Differing value types cannot be dismissed for the sake of expedient conformity (Norgaard 1989).

Finally, the MA identifies the purview of ecosystem services as assessing the marginal value of differing management approaches. The notion that prices are applicable beyond the margin of economic decision-making runs afoul of the inadequacies of the pricing mechanism (Heal 2000). Price can assess change only at the margin of equilibrium. Economic valuation is the comparison of small differences (Limburg et al. 2002), and marginal utility measures the utility of the 'last unit,' or, the utility derived from an additional increment amount (Myrdal 1953; Carpenter et al. 2009). Whenever they are meant to serve as *the* decision-making rubric prices step beyond their intended purpose (Gomez-Baggethun and Ruiz-Perez 2011). Though it may seem tautological to condemn economic valuation for assessing value *qua* price, we must recognize that the development of the ecosystem services discourse within an exchange-value paradigm implies a stable market equilibrium (Norgaard 2010). Value at the margin assumes a system's persistence into the future (Kosoy and Corbera 2010). Yet ecosystems have been shown to be highly non-linear and the occurrence of threshold crossings is uncertain (Limburg et al. 2002; Groffman et al. 2006); small events can be the catalysts for large changes (Levin 1999; Farber, Costanza, and Wilson 2002; Farley 2012). In braiding together market dictates and ecosystem research (Robertson 2004; Gómez-Baggethun et al. 2010) the ecosystem service concept risks being able to account only for small shifts in ecosystem services, limiting the applicability of the concept.

The very premises of the MA assert the tenuousness of our ecological present and the uncertainty of its future. Prices are thus assessed in regards to a social order already identified as problematic, giving lie to any possibility of market equilibrium in the first place. Reflecting the existing social and economic *status quo* (Harvey 1996; Heal 2000), it is unclear how monetary evaluation of ecosystem services can meaningfully assist in addressing global human and environmental difficulties. "[T]he more significant one thinks our environmental problems are, the more inappropriate has been partial equilibrium model and project-by-project approach for utilizing the concept of ecosystem services" (Norgaard 2010, 1220). In all of the ways reviewed in the preceding pages (and more), the economic valuation of ecosystem services is an approach found wanting.

3. A WAY FORWARD

(a) *The application of social-ecological system theory*

In light of contemporary natural and social scientific understandings, the shortcomings of the economic valuation approach to ecosystem services prove insuperable. The application of the natural-natural, social-natural, and social-social typology places the focus squarely on the interactions of system components – this shall be our way forward within the ecosystem services concept. These various interactive inadequacies are bound by a common failure to recognize *the temporal component of change*. Natural-natural problems disregard ecological dynamics, social-natural problems ignore the role of sociotechnical transformations, and social-social problems rely upon outmoded notions of equilibrium while miscasting the imperatives of uncertainty. In their turn, each of these incoherencies misrepresent the transformative element which accompanies interaction (Whitehead 1929; Levins and Lewontin 1985; Serres 1990; Foster 2000).

Anchored in both social and natural arenas, the ecosystem services concept remains a crucial tool for identifying, assessing, and managing social and natural interactions (Daniel et al. 2012). This tool can regain its proper purview only if grounded within a broader theoretic framework. Crucially, change and transformation are ever-present, and our ecological thinking must reflect this. As a framework for assessing both human and non-human interactions, both together and separately, Social-ecological Systems Theory (SES) provides the clearest integration of change as a dynamic constant. Application of a broader SES framework situates the ecosystem services concept as an interpretive and measurement tool supporting the broader goal of sustaining ecosystem processes and human well-being. Integrating temporal change reveals history as a formative component of ecology (Cronon 1983; Reyers et al. 2013). This review has already touched upon the theoretic implications resulting from linked social-ecological interactivity; I now proceed to examine the foundations of SES theory and the implications of its conceptual applications.

Conceptually interdisciplinary, SES theory links the social and natural realms through their constitutive co-production, providing further insight into the substance-relation dichotomy (Harman 2009). Its ontological commitments render the SES approach well-suited to describe the contingent contexuality of ecosystem services and their linkage to human welfare concerns (Potschin and Haines-Young 2011). Derivative of systems ecology and complexity theory, and initially receiving widespread notice in the late 1970s and 80s, within the past decade SES theory has been broadly applied as a method of addressing coupled social-ecological difficulties, and the uncertainties inherent therein (Gunderson and Holling 2002; Norberg and Cumming 2008). Recognizing that change is at the heart of variable feedback, SES theory provides an approach both descriptive of how the world functions, and a heuristic lens to assess coupled social and natural interactions and transformations (Cumming 2011). The SES approach begins by identifying the components of complex systems which characterize social and natural relationships, and synthesizes them across spatial and temporal localities (Cumming et al. 2005). As a descriptive tool SES theory poses the world as a "fully integrated system of people and nature" (Cumming 2011), in which people depend upon nature, and nature is influenced by people (Berkes, Colding, and Folke 2003). Much as the ecosystem services concept instantiated novel ways of thinking about social and natural interactions, new frameworks might construct novel arenas of knowledge and author deeper understandings both within and across disciplines (Goulder and Kennedy 1997; Carpenter et al. 2009).

In 2003 and 2004, a working conference of the Resilience Alliance (www.resalliance.org) set forth five preliminary heuristics to describe patterns of change in SESs (Walker et al. 2006). These heuristics have evolved into a group of fundamental concepts addressing SESs, with an eye towards resilience-based study and governance (Panel 1). Such concepts are the pith of SES theory and represent the basis of novel methodologies for addressing the co-production of linked social and natural systems. These concepts, and the propositions derived thereof, orbit around the central understanding that SESs are phenomena in which change is an inherent characteristic. Contrasting these heuristics with the four primary ontological commitments of the Cartesian approach (Panel 2) brings the insights of the SES approach into stark relief.

Panel 1 – Key Concepts in Assessing Social-Ecological Systems

i) **Non-linearity, alternate configurations, and thresholds** – Any system is composed of a roster of variables manifesting different 'states' or values. As these variables interact in space and time, their values will change in ways both foreseen and unforeseen. The dynamics of any system are displayed as the system moves through a three-dimensional space, delineated by the possible combinations of its constituent variables. Social-ecological systems are demonstrative of different characteristics emergent from the interactions of both biophysical and social variables in response to one another. At any given time social-ecological systems will display certain configurations. Such systems can exhibit more than one configuration. The interactions of variables over time can lead to changes in variable function and therefore system structure. When the character of interactions is transformed systems are said to have crossed a 'threshold.' Threshold crossings can occur both within systems and can yield new systems.

ii) **Adaptive cycles** – SESs exist in constant, dynamic interaction, demonstrating the characteristics outlined above. These characteristics lead to four distinct phases of system dynamics. They are: 1) growth or exploitation; 2) conservation; 3) collapse or release; and 4) reorganization. Nested within different hierarchies across space and time, these adaptive cycles can generate novel recombination, which may be the catalyst for widespread variation, potentially leading to system transformation. The inclusion of the collapse (or release), and reorganization phases, links a system's organization and resilience to its dynamics.

iii) **Multiple scales and cross scale effects**/"**Panarchy**" – Initially conceived in antithesis to hierarchy, panarchy is a framework evoking unpredictable change in the dynamics arising from multi-scalar interactions and transformations. Here adaptive cycles and the linkages between levels play a crucial role. The interplay between continuity and novelty reflects the necessary balance found in sustainable development: the need to maintain possibility while addressing present demands. Here part and whole interactively define one another and cross-pollinate change both upwards and downwards. Nested adaptive cycles foster opportunity through their transformations, while maintaining integrity across scales.

iv) **Adaptive capacity** – Systems with high adaptive capacity are typified by a heterogeneity of variables and diversity of functional possibilities. Highly adaptive systems are amenable to reconfiguration when necessary. Adaptive capacity can be thought of as the existence of possibility for re-invention within a system. Resilience is key to enhancing adaptive capacity.

v) **Resilience** – Resilience is the capacity of a system to tolerate perturbations and disturbance without being forced into a qualitatively different state. Resilient systems are able to change and respond through self-organization, learning, and adaptation. A decline in resilience can mean that small shocks can cause larger shifts. The ability to recover and remain flexible ensures that as systems become more complex and interactive they do not simultaneously become more fragile. Resilience in social-ecological systems is often a function of that systems' diversity.
(adapted from: the Resilience Alliance 2014)

Panel 2 - Four Ontological Commitments of the Cartesian Approach

1) There is a natural set of units or parts of which any system is made.
2) These units are homogenous within themselves, at least insofar as they impact the whole of which they are a part.
3) The parts are ontologically prior to the whole; that is, the parts exist in isolation and come together to make the wholes. The parts have intrinsic properties, which they possess in isolation and which they lend to the whole. The whole is nothing but the sum of its parts. The participation of parts within the whole does nothing to alter the parts.
4) Causes are separate from effects, causes being the properties of subjects, and effects the properties of objects. There is not ambiguity about which is which.
(adapted from: Levins and Lewontin 1985).

For failing to account for the crucial dynamic of change which composes the heart of SES theory, contemporary SES theorists fault the ecosystem services concept as overly simplistic; seemingly more reflective of the Cartesian approach. The occurrence of change across differing spatial and temporal scales highlights an important application of SES thinking within the linked iterative cycles of the ecosystem services arena. Both the social and natural spheres are multifaceted and have the potential to be parsed in many ways (Cumming 2011). Across all three interactive frontiers – natural-natural, social-natural, and social-social – SESs have been theorized as multi-scalar, co-evolutionary, non-linear, emergent, and complex-adaptive. SESs are potentially spaces of great plurality (Norberg et al. 2008). The ecosystem services concept is a powerful descriptive and heuristic concept for relating human and environmental well-being (Reyers et al. 2013). Where it can be shown to explicitly link the social and the ecological this concept can play a crucial role in ecological conservation and human well-being.

(b) ***Interactivity of the natural and the social***

The human-created environmental difficulties which motivated the MA prove the extent of our global impacts. The environmental reactions visited upon the human prospect are, likewise, diversely manifest. As was noted by Karl Marx: "Man lives from nature, i.e. nature is his body, and he must maintain a continuing dialogue with it if he is not to die. To say that man's physical and mental life is linked to nature simply means that nature is linked to itself, for man is a part of nature" (Marx 1867). Gendered pronouns aside, Marx's insight is universally supported within the ecological sciences. People and the world share physical space; SES thinking recognizes this unique ensemble (Serres 1991; Walker et al. 2006). The diverse implications of our novel global predicament (Serres 1990; Steffen, Crutzen, and McNeill 2007) suggest that traditional disciplinary approaches will not match our needs (Leopold 1933). An SES approach which weds the social and the ecological under the ecosystem services concept might support sustainable social-ecological interactions. Social-ecological linkages are crucial to service formation (Reyers et al. 2013); to assess the diversity of social and ecological players our methods shall account for diverse and interactive variables.

Figures 1 and 2 visualize the coupling of social and ecological arenas. Figure 1 visualizes the feedback mechanisms between ecosystems and society. In this visualisation ecosystem services are the bridge which crosses this divide. Figure 2 situates this interaction within a common spatial context. Such a contextualization highlights how the ecosystem services concept, in isolation, may misconstrue the character of social-ecological interactions. Taken on its own Figure 1 suggests that humans rely entirely upon a pre-existing stock of natural capital for the provisioning of ecosystem services, such conceptualizations have been shown to be problematic (Norgaard 2010; Peterson et al. 2010). Our possible responses therefore become limited to the sustainable management of ecosystem service stocks. Absent from this schematic is a recognition that the two spheres engage in transformative interactions which will impact their subsequent possible identities and future interactions. It is the tendency towards obscurity of these subsequent interactions that has led different critics to denigrate the different applications of the ecosystem services concept (e.g. Norgaard 2010; Peterson et al. 2010; Gomez-Baggethun and Ruiz-Perez 2011; Soule 2013).

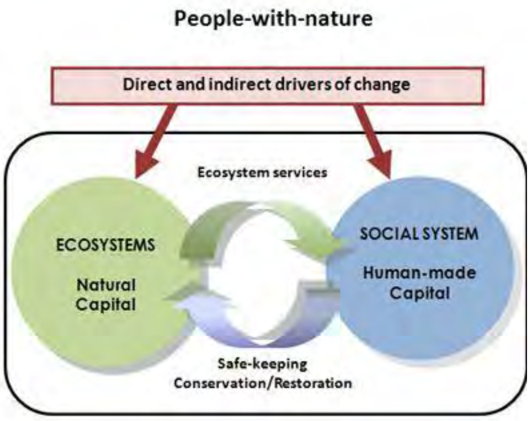

Image credit: (González et al. 2008)

Image credit: (Clifstock 2008)

Figures 1 & 2. Figure 1 visualizes ecosystem services as linkages between natural and human capital. Figure 2 provides an anecdotal glimpse at a shared landscape of humans and the natural world. Both illustrate the coupled and interactive tendencies of SESs. Within both figures we should conceive each arrow not simply as denoting unidirectional pathways or location, but as a process situated in time and space. The interactivity which these arrows highlight gives rise to evolving social-ecological contexts, which in turn will influence future interactions.

Interactions between the social and the ecological suggest a need to rationalize the interplay between change and persistence (Holling 2001). Figure 1 accounts for unidirectional interactions across spheres – this is the familiar manner in which the ecosystem services concept has been applied. However, it is via interaction that entities and systems are transformed, and through events that change is realized and further change becomes possible (Darwin1859; Serres 1995; Gunderson and Holling 2002). In effect we would visualize either the social or ecosystem sphere within Figure 1 as constantly changing in response to variables, not only from interactions with the opposing sphere, but also interactions internal to itself. While science is primarily a search for consistency (Serres 1991; Stengers 2010), it is difference which renders scientific understanding necessary (Levins and Lewontin 1985). If the social and the ecological did not change over time scientific understanding would grow stagnant and dull. Because change and transformation are continuous an understanding of linked social and ecological interactions will account for the interactive capacity of differing variables and process.

The omnipresence of change means that systems seldom tend towards a strict equilibrium (Cilliers 2000; Beinhocker 2007; Norgaard 2010). Equilibrium concepts typified economic and ecological thinking for at least a generation (Gowdy et al. 2013). Only recently is scholarship beginning to look towards more dynamic models and theoretics. Whether social, natural, or some combination, components and systems are increasingly understood to be in flux – such an awareness is recognized via differing epistemologies and is at home in both classical and contemporary modes of thought (Lucretius; Serres 1995; Gunderson and Holling 2002). The work of integrating the dynamics of change into the ecological sciences has begun the process of highlighting how the social and the ecological are linked across both spatial and temporal frontiers (Leopold 1933; Harvey 1996; Cronon 2000; K. M. A. Chan et al. 2012).

Much contemporary research conceives of social and natural components as arrivals of contingent circumstance (Rolston 1982; Harvey 1996; Maler, Aniyar, and Jansson 2008; Carpenter et al. 2009). The social and ecosystem spheres of Figure 1 are defined by their preceding interactions. The historical contingency and local specificity of such interactions are latent in the ecosystem services concept (Norgaard 2008). Circulating capital is embedded in a "qualitatively diverse world of flora, fauna, minerals, bodies and ecologies" (Robertson 2004, 372); human values have been shown to be similarly constituted within a nested context (MacIntyre 1981; Rolston 1982). Concepts of the natural and the social have similarly been shown to be co-constitutive (Cronon 1995; Caudwell, from Foster 2000). Figure 2 suggests an integration of the social and the ecological within one common landscape. The arrows here denote different manners in which social-ecological interactions impact the landscape. Airplanes flying overhead, cattle grazing upon rangelands, people moving through diverse assemblages of urban and rural, each of these are constitutive of coupled SESs. Whereas the economic valuation approach to ecosystem services seeks to exculpate services from the processes which compose them, admitting history to the ecosystem services concept regards entities as emerging from relationships (Whitehead 1929; Harvey 1974). Rather than retreat to problematic equilibrium concepts, an SES assessment of ecosystem services will account for how humans and ecosystems influence and change in regard to one another.

(c) ***Transformation and uncertainty; towards the social-ecological***

The repercussions of interactions across the social and ecological arenas are uncertain (Norgaard 2008). The social-ecological world is a never finalized, evolving adventure (Stengers n.d.). Considering society in-light of the wider environment both locates nature in history, and history in nature (Whitehead 1929; Cronon 1983). The indetermination of scientific assessments suggests that we must become comfortable with surprise (Serres 1991; Beck 1992; Norgaard and Baer 2005). We are forced to admit that the unknown far surpasses the sum total of the known (Cumming et al. 2012).

When the ecosystem services approach is separated into its own realm of assessment, without further theoretic backing, there is no guarantee that conservation will take place. Need we look further than the historical and contemporary destructive impacts of the oil, gold, natural gas, or various other extractive industries, to recognize that simply integrating nature's bounty into the economy is no guarantee that we will conserve it for future generations – for what are all of these resources if not part and parcel of "the benefits people obtain from ecosystems" (MA Synthesis 2005, v)? Rather than reproduce the threats to natural systems by an expansion of economic thinking (Foster 2002), the ecosystem services concept can support both ecosystem and human well-being. Numerous past theorists have made great strides towards accounting for the co-evolution of the human and the natural world – their work has been the foundation of this review. Statements and frameworks confronting our environmental difficulties have been scattered across the disciplines – each has its role to play in wedding our diverse knowledges with our judgment (Serres 1990). Because we recognize that no way of thinking about the world will summarize reality in all its complexity (Levins and Lewontin 1985; Cilliers 2001), our frameworks must remain unfinished and open to re-imagination. The implications for the application of SES theory are far-reaching. This review is simply a point of departure: how can we reassert the strength of the ecosystem services approach within the SES theoretic? The following chapters of this thesis engage conservation difficulties and broaden the application of the concepts introduced herein. In bringing together social and ecological factors I hope this project will create practical linkages between conceptual approaches attenuated to both the intellectual and lived complexity of an interconnected world (Rogers et al. 2013). As the tools to assess human impacts become more finely honed, we come to recognize that our presence is both essential and irreversible (Cronon 2000). SES Theory provides one step towards a broader recognition of linked ecologies. The social and the natural are linked within the SES theoretic framework; because change is at the heart of SES theory (Cumming 2011) infusing the ecosystem services concept with the spirit of an SES approach will help to overcome the incoherencies this review has outlined. While the economic valuation of ecosystem services cannot be recovered, the ecosystem services concept can nevertheless play a crucial role in linking ecological processes to human well-being. Reinforced by diverse ways of knowing, SES thought helps us to recognize our own interactivity. This project will be successful if it demonstrates a rigorous social-ecological approach to ecosystem services, and helps to foster further, similar, investigations.

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Chapter 2 – "The Cultural Services of Birds: social perceptions of ecological components"
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ABSTRACT
The importance of cultural services in supporting conservation efforts is little understood. To-date cultural service research has largely highlighted the problematic nature of the ecosystem services concept. The application of a Social-ecological Systems theory (SES) approach to coupled interactions which cross the human and non-human spheres both fleshes-out the cultural services concept and supports SES thinking. This chapter examines the cultural services of birds through a social-ecological lens. Surveys quantifying the impacts of birds on tourist decision-making, and the importance of cultural service benefits provided through interactions with birds, are here analysed. Results from 108 surveys provide a proof of concept for this pilot-study. Assessing the cultural service benefits of birds ties one aspect of human well-being to the natural world. Results indicate a strong interest in different birding experiences; these support not only the cultural services concept, but provide evidence that birds might be fruitfully integrated as a priority into conservation decision-making.

Keywords: cultural services; tourist surveys; ecosystem services; birds; social-ecological systems; South Africa

1. INTRODUCTION

Since its publication the Millennium Ecosystem Assessment (MA) (2005) has set the tone for much of conservation research. Primarily relying upon the ecosystem services concept to link human well-being to natural processes, the MA has helped push ecosystem services to the forefront of the conservation dialogue. As a bridge between ecology and economics (Chan, Satterfield, and Goldstein 2012), ecosystem services are seen to bring ecological concerns into the political arena (Voosen 2013); though this approach is highly contested (Soule 2013). While the previous chapter highlights some of the conceptual shortcomings, and latent possibilities, of ecosystem services as typically mobilized, this chapter employs the ecosystem service concept. In so doing it both recognizes the paradigmatic importance of the concept within the conservation discourse (Potschin and Haines-Young 2011), and develops methods towards identifying, assessing, and managing one particular category of ecosystem services: *cultural services*.

The specific delineation of cultural services within the MA suggests the importance of accounting for interactions between the social and ecological spheres (Chan et al. 2012a). Because cultural services are an explicit manifestation of social-ecological relationships, research methods must recognize and interrogate their relational character. The continued failure to do so suggests that ecosystem services inadequately address the suite of human-environmental interactions. Simply retreating to monetary and contingent valuation reproduces problematic separations of the social and the ecological (see Chapter 1). The growth of the ecosystem services concept requires the full expression of these different arenas.

While the MA states that "human cultures, knowledge systems, religions and social interactions have been strongly influenced by ecosystems" (MA 2005: 9), the extent to which ecological-scientific methodologies are adequate to assessing cultural service provision is untested. This shortcoming was manifest even within the MA:

> "*Cultural [ecosystem services] are almost entirely unquantified in [MA] scenario modelling: therefore, the calculated model results do not fully capture losses of these services that occur in the scenarios. The quantitative scenario models primarily capture the services that are perceived by society as more important – provisioning and some regulating [ecosystem services] – and thus do not fully capture trade-offs of cultural and supporting services*" (Rodríguez et al. 2006).

The impacts of cultural services on human well-being are nevertheless of vast importance. Because they are thought to greatly influence the willingness of different stakeholders to engage in conservation activities, the status of cultural service research is somewhat paradoxical: tracing the subjective motivations for conservation, as informed by the objects and processes of ecological phenomena, demands a recognition that the social and the ecological are interrelated, and that subjectivities are inextricably linked to objective understandings (Medawar 1982; Latour 1993). Despite their abstractions – an issue not helped by their brief treatment within the MA – cultural services are clearly situated at what has proven to be a conceptually difficult place: where humans interact with and are co-produced alongside the world. This context suggests that cultural service research will provide unique insights into many of the coupled social-ecological concerns outlined by the MA. Though "the impact of the loss of cultural services is particularly difficult to measure" (MA. 2005, 9), it may be that their specifically interactive character will speak to unique approaches and understandings.

This research seeks to address the cultural aspect of ecosystem services through our relationship with birds. As a taxon which has significant ecological roles, e.g. pest control, seed dispersal, as scavengers, and ecosystem engineers, birds are crucial in supporting various consumptive (subsistence, commercial, and recreational) and non-consumptive interactions between humans and the natural world (Filion 1987; Sekercioglu 2006). If nothing else, an ecosystem services perspective will appreciate the human benefits of avian ecological functions (Bonta 2010). Ongoing declines in avian diversity necessitate further research into birds as ecological *inter*-actors (Sekercioglu 2006), and the need to quantify the ecosystem services provided by birds is a pressing concern. While the applicability of birds as an arena of research is not, simply, confined to their cultural impacts, research into the ecosystem services provided by birds has largely overlooked cultural aspects (Sekercioglu 2006; Wenny et al. 2011) – though this has begun to change (see: Mynott 2009; Tidemann and Gosler 2010; Cocker 2013).

Social-ecological Systems (SES) theory alerts us to the growing importance of social concerns in addressing conservation difficulties. Because results premised upon strictly ecological approaches to conservation have been wanting in effectiveness (Kareiva and Marvier 2012; Voosen 2013), the imperative of techniques which wed the social and the ecological into a singular arena of investigation has become widely recognized. The growing domination of the ecosystem services paradigm threatens to disregard unquantified ecological processes in both academic and on-the-ground conservation research and management (Robertson 2006). The application of the social-ecological framework places the cultural service concept within a unified social-ecological reality.

How our psychological, cultural, and social relationships to birds can influence our decision making, is here examined via surveys of tourists engaged in nature-based tourism ('ecotourists'). These surveys identify and assess the importance of birds as ecological features, and the types of benefits people receive from engaging in birding. In so doing this research provides an initial demonstration that regard for birds can influence ecotourist choices. While traditional conservation research might examine the responses of bird species to human impacts (e.g. deforestation, urban sprawl, pollution), this project inverts that approach and tries to better understand the responses of people to birds. Investigating human interactions with birds takes the SES approach of identifying components and their relationships and synthesizing them to better understand how cultural services are integrated within, and formative of SESs. In so doing this project adheres to calls for a "systematic scientific approach towards understanding natural resources" (Baron et al. 2009, 1034). Non-material interactions with ecological phenomena are interactions nonetheless.

Cumming (2011) has outlined five ecological themes of complexity to be considered within SES research. In 1) understanding the behaviour and functional components of individual systems components; and 2) understanding interactions between components, the approach of this research follows the first two of these themes. Better understanding the manner of cultural service interaction people have with avian species speaks to the formation of birdwatchers as components within the linked social-ecological system where conservation occurs. The first objective of this chapter will be to quantify the impacts of birds on the decision-making process of surveyed tourists. It is hypothesized that possible interactions with birds will prove a significant factor tourist decision-making. How people experience avian species, and the importance they place upon those experiences, will dramatically impact different species affect numerous conservation concerns (Latour 1988). As an initial foray into the substantive field of SES, this research provides the groundwork of identification needed before assessment and management of coupled ecological and social phenomena and processes can take place. The manner of such interactions have been assessed via the cultural services concept. The second objective of this chapter is to characterize and quantify, through surveys of tourists, the different cultural services provided by birds. It is hypothesized that tourist responses will be differentiated by cultural service type. Successful research within this realm will not only provide greater insight into the SES framework, but also more coherently characterize both the present of human interactions with the natural world, and our future prospects for the same. Identifying and assessing the interactions between avian and human components within SESs reinforces a more comprehensive appraisal of system functions and component interactions. As this arena of scholarship grows, further research might address Cumming's final three themes of 3) documenting scaling relationships and cross-scale feedbacks; 4) understanding the role of the external environment and its interactions with complex systems; and 5) understanding how disturbance affects system-wide properties and is propagated across the landscape.

This chapter begins with a brief review of the cultural services concept and research to-date, highlighting the problematic relationship between the cultural services category and the broader ecosystem services concept. Grounding culture services research within the broader rubric of SES theory the applicability of birds as an ecological phenomenon to assess human-environmental interactions is explored, including, for context, an overview of the multiplicity of ways in which people and birds interact. Surveys of cultural services are employed to examine the broader nature of relationships between cultural service experience and interactions with birds. Results yield a proof of concept: surveys indicate that cultural services are experienced through interactions with birds. The discussion integrates insights from the coupled cultural service and SES approach. If this study is successful it will engender further, similar research. Examining cultural services through the lens of SES theory will continue to be necessary if conservation efforts are to address social-ecological interactions.

2. STUDY REVIEW

(a) *The Millennium Ecosystem Assessment and cultural services*

This project's broader focus on the relationship between bird life and the experience of cultural services is primarily motivated by the outcomes of the MA. An international, scientific effort to assess the status and possible futures of human well-being as supported by the natural world, the MA has had an outsized impact upon conservation research and policy since its publication in 2005 (Gomez-Baggethun and Ruiz-Perez 2011). Recognizing that human well-being within the global environment is of a multifaceted nature, the MA relies upon the conceptual tool of ecosystem services to explore relationships at the social-ecological nexus. Regardless of income, geography, location, culture, or creed, social-ecological interactions reflect a dynamic relationship of spatial and temporal feedbacks (Groffman et al. 2006; Steffen, Crutzen, and McNeill 2007). "The benefits people obtain from ecosystems," e.g. the air we breathe, the water we drink, or the materials we harvest, ecosystem services are both the direct and mediated benefits humans receive from a multitude of resources and process supplied by natural ecosystems (Daily 1997; MA 2005). Examining the state of such services, the MA also projects the possibility of different future scenarios.

To further differentiate, and measure, the benefits realized by people from the natural world, the MA delineates ecosystem services into four categories. These are labelled as *provisioning services* (e.g., sustenance and clean water), *regulating services* (e.g., temperature and climate moderation, and toxin purification from the biosphere), *cultural services* (e.g., spiritual, aesthetic, and recreational experiences), and *supporting services* (e.g., chemical processes in support of agriculture and physical forces underlying economic structures). Since the publication of the MA, research into ecosystem services has increased rapidly, to the extent that the concept has become essentially paradigmatic within the fields of ecology and conservation biology (Potschin and Haines-Young 2011; Voosen 2013). Yet the category of cultural services remains particularly problematic and under-examined within the scientific literature. These "non-material benefits people obtain from contact with ecosystems [including the] aesthetic, psychological and spiritual" (IPBES 2012) are deemed to be of equal importance to that of other ecosystem services (MA. 2005), yet their identification, assessment, and management are rife with conceptual difficulties. The MA identifies six types of cultural services central to the holistic understanding of the relationship between people and the biosphere. The types are *(i)* cultural diversity and identity; *(ii)* cultural landscapes and heritage values; *(iii)* spiritual services; *(iv)* inspiration; *(v)* aesthetics; and *(vi)* recreation and tourism (Panel 1). Covering a broad scope of topics, these are bound together in being non-tangible, non-monetary, moral concerns both formative of, and resulting from, aspects of individual and societal well-being realized through natural processes.

Panel 1 - Cultural Services Categories

(i) **Cultural Diversity and Identity**: Ecosystem diversity is one factor influencing cultural diversity (Diamond 1997). As all human societies are located within an environmental context, social interactions with natural phenomena and processes will influence societies. Diverse landscapes and diverse landscape interactions give rise to a diversity of cultures. Similarly, cultural identity can be tied to landscapes and ecosystem phenomena and processes (Callicott and Ames 1989; Gwynne 2011).

(ii) **Cultural Landscape and Heritage Values**: The structure and values of a culture can be both a manifestation of, and in turn influence, that society's interaction with natural phenomena and/or processes. Many societies place high value on the protection of culturally significant landscapes or species (e.g. Matthiessen 1984; Fairhead and Leach 1996). Feelings of sense-of-place identification within a culture, society, or environment can be related to natural phenomena and/or processes within that location. Landscapes and ecosystems have been shown to be deeply interwoven with cultural resilience (e.g. Lear 2006).

(iii) **Spiritual Fulfilment**: Many different religions and ethno-cultural groups ascribe significant spiritual and emotional value to different ecological phenomena and/or processes. The existence of sacred species, forests, lakes and rivers, and landscapes is well-documented around the world. A number of the MA global sub-assessments found that the spiritual and cultural aspects of ecosystems were as important as other services for communities both within the developing and industrialised world. Spiritual values have been shown to provide a strong incentive for ecosystem conservation (MA. 2005).

(iv) **Inspiration**: Ecosystems are seen to provide a "rich source of inspiration for art, folklore, national symbols, architecture, and advertising" (MA. 2005, 40) along with many other realms of human creation. As a cultural service experienced by people, inspiration from the natural world can foster novel creations and new ways of thinking. The manner in which any physical phenomena might imbue people with a sense of inspiration remains obscure.

(v) **Aesthetics**: While often narrowly conceived as "the pleasurable human response that results from perceiving the properties of environmental stimuli" (Gobster et al. 2007), aesthetics are also a highly contested realm of philosophical inquiry concerned with the character and experience of beauty or 'taste' in the world (Pirsig 1974; Child 2009). Access to beautiful natural landscapes is seen to play a crucial role in people's willingness to engage in environmental conservation and protection. In primarily limiting aesthetic conception to a focus upon the perception of beauty, cultural service research suffers from an incomplete understanding of the extent to which critical reflection has been thought to influence human aesthetic experiences and subsequent decisions touching numerous aspects of people's lives

(vi) **Recreation and Tourism**: By far the most thoroughly explored aspect of cultural services, recreation and (eco)tourism pursuits engaging with various natural spaces and phenomena are frequently assessed in relation to a 'willingness to pay' for such experiences (Martin-Lopez, Montes, and Benayas 2007; DTI 2010; Biggs et al. 2011). Whether it is access to remote wildlands for adventure travel, safaris to hunt or view big-game, or standing before awe-inspiring natural landforms, such experienced benefits have long been a rallying point for conservationists. This cultural service aspect is, also, potentially problematic as it may simply express the manner in which the other five categories are consumed, whether through use or non-use, of natural phenomena and processes.
(adapted from: the Millennium Ecosystem Assessment, 2005)

(b) *Cultural service research to-date*

While cultural services are almost uniformly recognized to be crucial to conservation concerns, they have not been comprehensively defined, nor suitably integrated into ecosystem service frameworks (Chan et al., 2012; Daniel et al., 2012). The explicit identification of cultural services is premised upon the MA's delineation of cultural services into the highlighted six different types. These differing types span the extent of the intangible benefits people receive from the natural world. Consequently there is a sense that the cultural service category serves as a sort-of catch-all for human-derived benefits from natural processes which do not easily fit into the three other ecosystem service categories. Alternately, it has been suggested that the cultural dimension of ecosystem services interconnects the ecosystem service categories (Musacchio 2013). Attempts to comprehensively measure cultural services are in the nascent stages.

Cultural services are seen as being of potential importance specifically because of their intangible and subjective character (Daniel et al. 2012) – this also makes standardized methods of identification and assessment difficult. How can we compare psychological, cultural, and social benefits experienced by differing individuals and groups of people across time and space? Foremost among measurement approaches have been attempts to quantify different manifestations of contingent value (Parks and Gowdy 2013). Through survey-based approaches, various rankings have been designed to measure a person's preference for different types of goods. Where monetary valuation is not immediately possible, contingent valuation approaches replace cardinal measurements with ordinal ones (Martinez-Alier, Munda, and O'Neill 1998). Contingent valuation measurements, however, have been shown to fall victim to many of the same difficulties as monetary valuation approaches, e.g. assumptions concerning relative scarcity, a specifically situational reliance upon social constructs, absence of market parallels (Diamond and Hausman 1994), and inadequate differentiations between interconnected natural phenomena (see Chapter 1). A 'willingness to pay' (WTP) for different types of cultural service experiences, though ascendant as a method of assessment (Goulder and Kennedy 1997; Martin-Lopez, Montes, and Benayas 2007), is inadequate for determining the full scope of personal and social priorities. Attempts to classify and measure experiences deemed religious or spiritual, or those touching on other deeply-held beliefs and feelings, are particularly unsuited to the monetary valuation approach to cultural services. Critics of WTP approaches note that monetary valuation is incapable of assessing broader moral frameworks (Ludwig 2000). Though the butcher, the brewer, or the baker may provide our supper for their own economic benefit (Smith 1776), it does not follow that the economic definition of humans comprehensive accounts for a person's motivations. As Geoffrey Heal writes, "[v]aluation is neither necessary nor sufficient for conservation. We conserve much that we do not value, and do not conserve much that we do value" (2000, 29). Economic measures are never a complete decision-making framework (Chan, Satterfield, and Goldstein 2012). The inadequacy of WTP approaches has diversely manifested itself in certain respondents' *unwillingness* to engage in monetary valuation of natural processes and phenomena from the outset (Martin-Lopez, Montes, and Benayas 2007), and has even resulted in calls for the total separation of cultural services from the ecosystem service concept (Fisher and Turner 2008). This raises concerns that the category will remain unaddressed within policy-making arenas (Robertson 2006; Chan et al. 2012). If cultural services are going to productively influence conservation efforts, methods to assess the impact of cultural services upon human well-being must be developed. Cultural service concerns must become more broadly integrated into environmental decision-making processes (MA. 2005; Chan et al. 2012).

Although their use has continued to grow, ecosystems are believed to be increasingly incapable of providing cultural services similar to those experienced in years and decades past. At the three steps of service identification, assessment, and management (Daniel et al. 2012), information relating to cultural services is lacking – though it is thought that they are globally in decline (MA. 2005). While the interaction between scientific research and policy must be grounded in rigorous and thorough investigations of ecosystem functioning, meaningful changes at the social-ecological nexus cannot be ignored, whatever form they may take (Carson 1963; Levin 1999; Latour 2004). Cultural services are crucial to the formative and transformative interactions of humans and their environment.

(**c**) ***Grounding cultural service research in SES theory***

SES theory is both a descriptive and heuristic approach for integrating the social and the natural world into one dynamic and evolving system. SES theorists have been critical of the ecosystem services concept for its failure to account for the presence of *change over time* within a system. As a descriptive tool SES theory poses the world as a "fully integrated system of people and nature" (Cumming 2011). Thus, people depend upon nature, and nature is influenced by people (Berkes, Colding, and Folke 2003). As an interpretive lens, SES theory regards the temporal aspect to be at the heart of social-ecological thinking. Only by making the dynamic linkages between social and ecological structures and process explicit can the ecosystem services concept reassert its own descriptive and heuristic power relating human well-being to natural processes (Reyers et al. 2013). In any evaluation of ecosystem services, the temporal element must be accounted for. Applying SES theory to the ecosystem service concept highlights the importance of measuring a linked, iterative cycle of components anchored in the social and the ecological.

Re-framing the problem of cultural services within a social-ecological approach, the importance of cultural services, and the subsequent importance of better understanding their formation and impacts, becomes clarified. Anchored in both the social realm of human value, and the ecological realm of natural processes and phenomena, cultural services are characterised less by discrete entities than by interactions. Tracing such interactions may speak to broader characteristics of social-ecological relationships. As cultural services play an important role in motivating support for the protection of ecosystems (Daniel et al. 2012), understanding their formation can provide insight into normative environmental ethics. When individual entities become transformed through dynamic interaction, then we are placed at the heart of social-ecological theory: an awareness of change over time (Cumming 2011).

Because the arena of cultural services is so poorly understood, this work is limited to the initial steps of investigation, with brief subsequent forays into the assessment stage, of cultural services. The analysis of SESs is itself a social process containing three arenas. These are identified as 1) the problem-framing arena; 2) the research arena; and 3) the action arena (Cumming 2011). If this project helps frame the problems to be assessed in SES research then it will be successful – identification must precede assessment. While a broad outline of cultural services has been provided by the MA, cultural service literature has primarily assessed the validity of the concept, rather than the issues to be resolved. I hope to propel the cultural services concept forward, towards the largely unrealized arena of action.

(d) *Birds as social-ecological components and cultural services archetype*

Finding meaning in, questioning our relationship to, and wondering about the natural world characterizes the human condition across space and time. Watching, interacting with, and responding to bird life is among the more universal of human experiences (Armstrong 1958; Tidemann and Gosler 2010). Archaeological evidence of archaic societies the world over conveys depictions of birds. For as long as societies have been recognizably human, people and birds have inhabited, and interacted within, shared landscapes. These interactions are not simply gastronomic or utilitarian. Interactions between people and birds, given the depth of their history and widespread experience, have been, in the main, primarily non-economic and non-scientific (Podulka, Rohrbaugh, and Bonney 2004). Symbolically birds have diversely manifested human joys and wonders; our hopes and fears. The ability to fly has, for many cultures, symbolised the potential freedom of the human spirit (Jarvis 1983), both in this life and the next. 'Free as a bird' is a sentiment familiar to so many people. As avian migrants come and go with the seasons, these global travellers might suggest a world open to each of us. Different species and types of birds elicit varying impressions. Raptors symbolize power and authority; doves peace. Eagles adorned the Roman standards. Owls have been conceived as both wise, as well as portents of mystery and evil (Cocker 2013). Flight suggests travel, and this movement pervades language. Colloquially we render distance 'as the crow flies.' A restless person might be said to 'flit' and 'flutter' from place to place. As advertisements (the toucan of Guinness beer) and status symbols (American Indian headdresses), birds have helped to define not only our relationships to the world, but also to each other. The prospect of flight even suggests an ability to transcend our earth-bound sphere. Swifts roosting at the Wailing Wall in Jerusalem are imagined to take the prayers of the faithful up to the Lord. Horus, human-bodied, falcon-headed, and one of the oldest of Egyptian gods (Metzler 2003), is the literal embodiment of birds and people. In Icarus' failed escape from Crete, the sky burials of the Plains Indians, the owl of Athena, the resurrection of the phoenix, or the Holy Spirit visualised as a dove (Matthew 3:13-17, Mark 1:9-11, Luke 3:21-23), the *mythos* of birds has connected the everyday of our lives to the uncertain prospects of the next one. "Part of the very language we use to express ourselves about life", what it means to be human is linked to our encounters with birds (Cocker 2013). As the venerable anthropologist Claude Lévi-Strauss remarked, "birds are good to think with" (1973).

> "*Our concern for birds is an unbroken link with our earliest ancestors; it is a major theme in mankind's cultural, aesthetic and spiritual development as well as a source of vital insight into the contemporary environments which we share with birds*." (Diamond 1987, 107)

Birds thus provide a useful bridge from our cultural inheritance to contemporary experiences anchored in both the social and the ecological. Thinking broadly about cultural services and our relationship to birds is not an unexplored realm. Rather it is an ancient one that has perhaps become foreign due to its unexamined familiarity.

3. MATERIAL AND METHODS

(a) *Study Sites*

The diverse climatic and biome types within the Western Cape – remnants of cape endemic forest along the coast, the renosterveld/succulent karoo ecotone in the north, coastal lagoons and estuaries, as well as the unique fynbos biome – are home to a broad diversity of endemic, near-endemic, and rare bird species. This makes the region an especially sought-after destination for birders (DTI 2010). An assessment of the cultural services people experience from interactions with bird species may thus be especially germane to the Western Cape.

The set of eight private protected areas (PPAs) where surveys were undertaken were selected based upon three criteria: 1) the presence of charismatic megafauna, particularly the so-called 'Big Five' (African lion (*Panthera Leo*), Cape or African buffalo (*Syncerus caffer*), African bush elephant (*Loxodonta africana*), Leopard (*Panthera pardus*), and White rhinoceros (*Ceratotherium simum*)); 2) perceived high amount of tourist visitation – selecting those with the highest public profile; and 3) proximity to the city of Cape Town (Appendix 1). These criteria were developed to ensure that study sites would represent as large a segment of the Cape Town ecotourism population as possible. The initial number of hoped for private protected areas was pared down based upon willingness to participate, park closures, and logistical issues surrounding access. Parallel social and ecological research approaches linked survey results to avian species composition. In further research (Chapters 3 and 4) I assessed the importance of cultural service experiences derived from different bird species and the avian species composition for each of these same PPAs. The marriage of such methods synthesizes relationships between cultural service provisioning and the avian species composition for this sub-set of Western Cape PPAs.

(**b**) ***Cultural services of birds surveys***

Surveys of tourists were designed to better understand the cultural services of birding experiences within the selected PPAs. Questions focused upon demographic background and consumption habits of tourists initially built upon research by Ryan and Turpie (1998) which assessed the economic value of birding in South Africa. Cultural service information was collected as an addendum to this initial survey. These surveys sought to create linkages between stated amounts that tourists were willing to spend in pursuit of birding experiences, and the cultural service provision realized through different types of interactions with birds. Focusing upon the monetary value implicated by potential birding interactions, this survey aimed to link birding interest with a willingness to consume resources which PPAs might provide. This first survey proved impractical given concerns voiced by reserve managers and staff members that the length and depth of the surveys would prove a daunting, and eventually insurmountable, obstacle for guests. No data from this initial survey were collected. Subsequent communication with reserve managers and staff gave rise to what would become known as the "two-minute rule." If a typical reserve tourist could not complete a survey in two minutes or less the survey was deemed too time-consuming.

A second round of surveys was created to meet this time constraint (Appendix 2). This took the form of tri-fold paper "survey-cards" as well as web-based electronic surveys. These were designed and made available using the online survey software "Survey Monkey" (www.surveymonkey.com). The online version contained identical verbiage and question order as the "survey cards."

This second attempt at the cultural service surveys began with basic background demographic data. Respondent age, gender, and race were queried. "What is your highest level of educational attainment?" was broken down into different categories.

Respondent's self-classification as a birdwatcher was assessed using a four-level classification. These were quantified from 0 (representing "non-birder") to 3 ("fanatical" birder) (Ryan and Turpie 1998).

The surveys continued with a fixed list of five-point Likert scale questions (adapted from Wright 2011) assessing the varying levels of importance placed upon different ecological features, and cultural service benefits experienced via interactions with birds. These questions were designed in adherence to Likert's selection of statements in surveying groups (Likert 1974). While it was impractical, given the lack of background research, to devise statements placing modal responses within the middle of possible responses, as outlined by Likert, the questions were geared towards the impacts of attitude – focusing upon the need for assessing behaviour rather than fact – and specifically kept simple, clear, and concise. Compound questions were avoided where possible; issues with language abstraction are attributable to the categorizations within the MA, from which the cultural service categories were taken. The inclusion of zero in this scale is important to note as it allowed the respondent to attribute no value to a particular category. This approach provided quantitative measurements for the levels of importance typically conveyed in qualitative assessments. It should here be noted that a reviewer has highlighted that with survey information there is no guarantee that questions will be interpreted properly. While some of the survey verbiage may have struck respondents as unclear there was no indication, either through personal communication with reserve staff and managers, nor in the 'additional comments' section of surveys that respondents had trouble interpreting survey language.

The first set of Likert scale questions queried the importance of different ecological features in selecting which protected area to visit. A response scale from 0 (not important) to 5 (very important) allowed respondents to comparatively rate twelve different ecological features. Respondents were provided space to indicate whether or not they consider themselves hunters. Different cultural service benefits were rated for their varying levels of importance. The importance of birding in developing a conservation ethic was also rated for level of importance. Additional background information assessing birders investment in different birding activities, such as amount spent on equipment and courses was quantified.

Surveys were distributed to the following private protected areas of the Western Cape: African Game Lodge, Badshoek Hunting Experience, Buffelsfontein Private Game Reserve, Gondwana Game Reserve, Lemoenfontein Game Lodge/KoKa Tsara Bush Camp, Plettenberg Bay Game Reserve, and Sanbona Wildlife Reserve[2]. While game-drive guides were encouraged to advertise the surveys to tourists, in practice this did not occur. Links to the electronic surveys were made available on reserve websites and Facebook pages (where available). Over the course of November 2012 to December 2013, protected area contacts were asked to provide a link to the survey on the reserve's website and/or Facebook pages no fewer than three, and no more than six times. There were no incentives (monetary or otherwise) provided to encourage survey responses.

Data were analysed and visualised using *Microsoft Excel* (Microsoft 2010), and *R* statistical software (2013). Mean, standard deviation, skew, and excess kurtosis were calculated both for the reported importance of different ecological features when deciding which protected area to visit, and the different cultural service categories. Tests for variation among response categories were performed for a suite of variables (One-way ANOVA). Relationships between respondent's level of education ("What is your highest level of educational

[2]Sanbona Wildlife Reserve, though gazetted as one protected area is divided into two management areas, a north and a south. Each management area has different management practices (e.g. the southern management area contains no predators) and different biomes (the northern management area is succulent karoo, while the southern is primarily renosterveld). Analysis for ecotourist surveys are not differentiated by PPA. Bird count analysis in later chapters treats these two management areas separately.

attainment?") and their stated interest in birds as ecological factors ("How important are [Birds] when selecting which protected area to visit?") were examined, necessitating the assignment of numerical values for education category responses (1 = primary school, to 7 = other further education, e.g. diploma). As noted above, self-reported classifications as a birdwatcher similarly necessitated the assignment of numerical values for responses. A boxplot was used to represent self-classification as a birdwatcher and the importance of birds in deciding which protected areas to visit; relationships between these two categories were assessed using a correlation coefficient. Similarly, a boxplot was used to represent the importance of birds and the role that birds have played in developing a respondent's conservation ethic; a linear regression was similarly employed to assess the significance of this relationship. Comparisons between self-reported birdwatching level and responses to different cultural service categories were assessed for significance (One-way ANOVA). Similarly, comparisons between birds as an ecological feature and responses to different cultural service categories were assessed for significance (One-way ANOVA).

4. RESULTS

I obtained a total of 108 completed surveys. Not all returned surveys included responses for every question. Responses to the question "How important are [Birds] when selecting which protected areas to visit (0 = not important, to 5 = very important)" ("Birds" question), returned the highest mean (μ = 4.206) and median responses (n = 5), with a standard deviation of 0.983. This suggests that birds are an important feature for some people when deciding which protected area to visit (Figure 1). Although these responses were not differentiated by bird species, this result suggests that the availability of birding opportunities can, to some degree, support the persistence of protected areas. Given the self-selected nature of respondents, this result did not convey the impact of birding experiences on the behaviour of the tourist population at-large. Possible conflating factors for how and why people chose to visit protected areas may be present, e.g. schoolchildren will likely be traveling with their parents.

Responses did not differ significantly across reported education categories, (One-way ANOVA, F (5, 100) = 0.284, p = 0.921), suggesting that a person's level of educational attainment provided little insight into the importance of birds when selecting which protected area to visit. A post-hoc Tukey test showed that levels of education were not significantly different from each other (p > 0.9 for all comparisons). While further research may be able to differentiate between protected area features as influenced by education level this result suggests that level of education bears no relationship to a person's stated interest in birds.

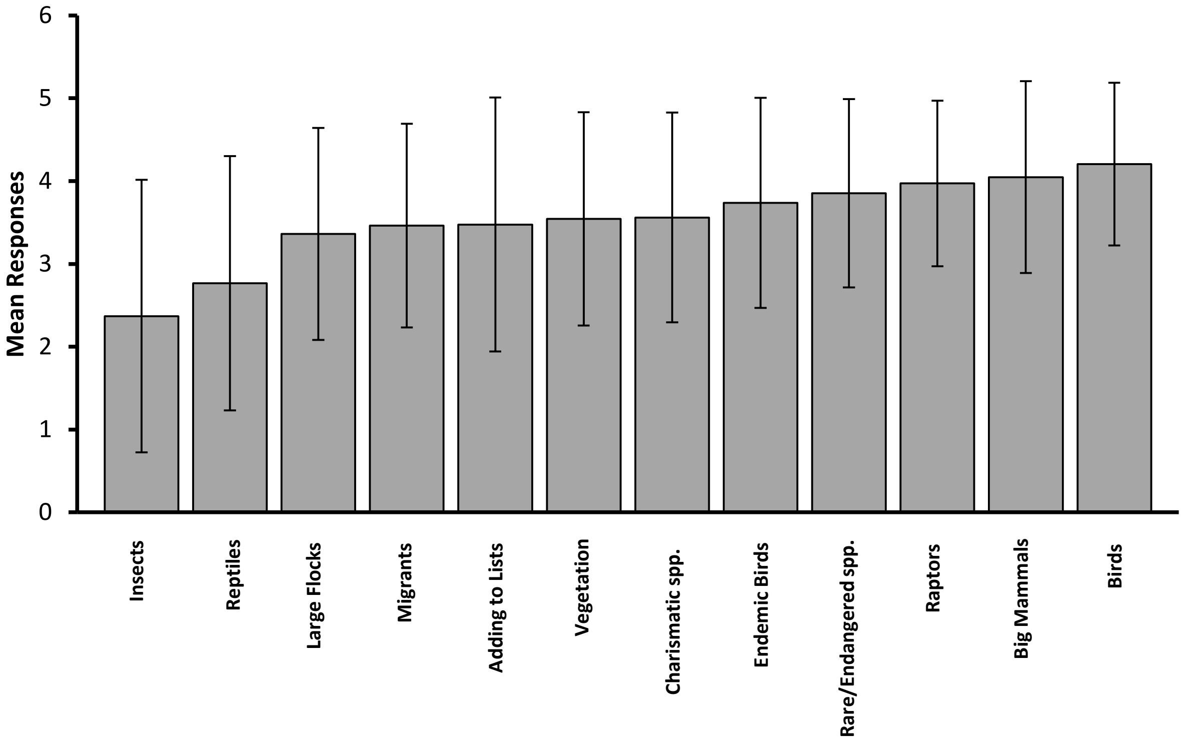

Figure 1. Bar chart showing how respondents valued different ecological features when selecting which protected area to visit. Error bars visualize the standard deviation of responses for respective ecological features. Note that seven of the response categories specifically refer to different types of birding experiences. Statistical breakdown in Appendix 4.

The mean response for self-classification as a birdwatcher was 1.33 (n = 107, s.d. = 0.61), corresponding to the category of "Casual." Figure 2 indicates that higher self-classification as a birdwatcher is correlated with a greater importance placed upon birds as an ecological feature when deciding which protected area to visit. It is important to note that the assignment of numbers to this response is for descriptive purposes only. While descriptions for each category label of birdwatcher were provided, these values cannot be compared absolutely.

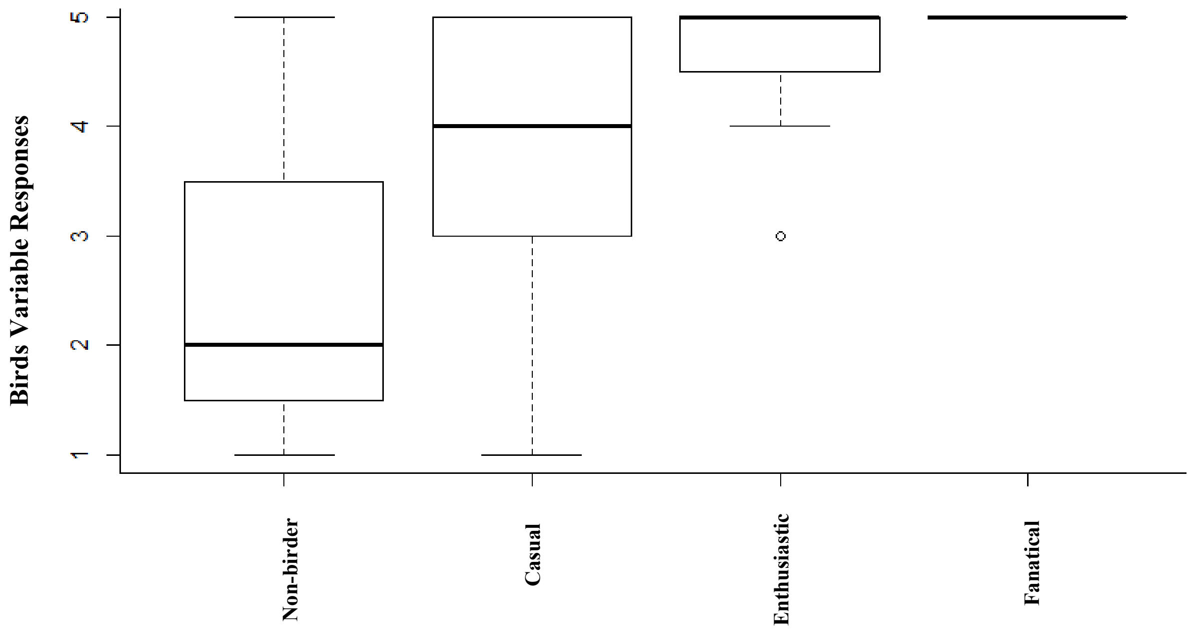

Figure 2. Boxplot displays respondent's self-reported level as a birdwatcher and the importance each places upon birds as ecological feature (*n* = 105). Birdwatching responses very significantly predicted "Birds" responses ($\beta = 0.258$, $t(103) = 4.601$, $p < 0.001$). Birdwatching responses explained a significant proportion of variance in "Birds" response ($R^2 = 0.1705$, $F(1, 103) = 21.17$, $p < 0.001$). This suggests that more committed birdwatchers are more likely to account for birds as an ecological feature when choosing which protected area to visit. High variation among returns for the "Non-birder" response represents only three returned surveys. Responses from casual (*n* = 69) and enthusiastic birders (*n* = 28) predominate heavily.

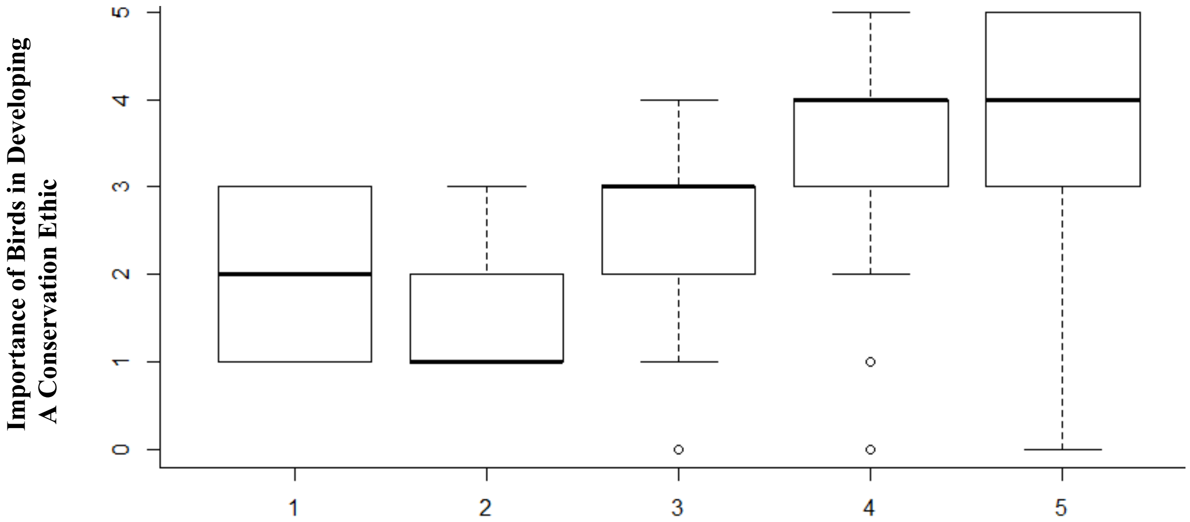

Figure 3. Boxplot displaying the relationship between interest in birds and the importance of birding in developing a conservation ethos (n = 105). "Birds" responses very significantly predicted the importance that birding has played in developing an individual's conservation ethic (β = 0.257, t (103) = 4.292, p < 0.001). "Birds" responses explained a significant proportion of variance in the same conservation ethic responses (R^2 = 0.1517, F (1, 103) = 18.42, p < 0.001). This suggests that an increased interest in birds was strongly correlated with the development of a conservation ethic, which birds play a role in forming.

Though absolute measures for a person's willingness to engage in conservation activities are difficult to come by, responses indicate a strong positive correlation between respondents' interest in birds and the role of birds in developing a person's conservation ethic (Figure 3).

Responses indicating the importance of birds in developing a conservation ethic did not differ significantly across reported education categories (One-way ANOVA, F (5, 101) = 0.241, p = 0.9434). A post-hoc Tukey test showed that the responses based upon levels of education did not significantly differ from each other (p > 0.9 for all comparisons). This result further underscores that a person's educational attainment is not significantly related to their relationship to birds.

Because a person's highest level of educational attainment was shown to have no significant correlation to their stated interest in birds, or concerning the role of birds in developing a conservation ethic – even in an ANOVA test jointly assessing the impact of the two on developing a conservation ethic – linkages between interest in birds and the role of birds in developing someone's conservation ethic most likely are not significantly influenced by a person's level of education. As before, higher response volume is required to draw definitive conclusions.

Comparisons between self-reported birdwatching level and responses to different cultural service categories returned no statistically significant relationship between the two (One-way ANOVA, most significant p value = 0.107). While more comprehensive research is required, it appears unlikely that the importance of different cultural service benefits provided by birds is correlated to a person's level of self-classification as a birdwatcher. However, given the low number of respondents indicating themselves as "non-birders," further research may find that categorizations which discretely differentiate birders from non-birders will prove useful in assessing the extent of cultural service benefits provided by birds.

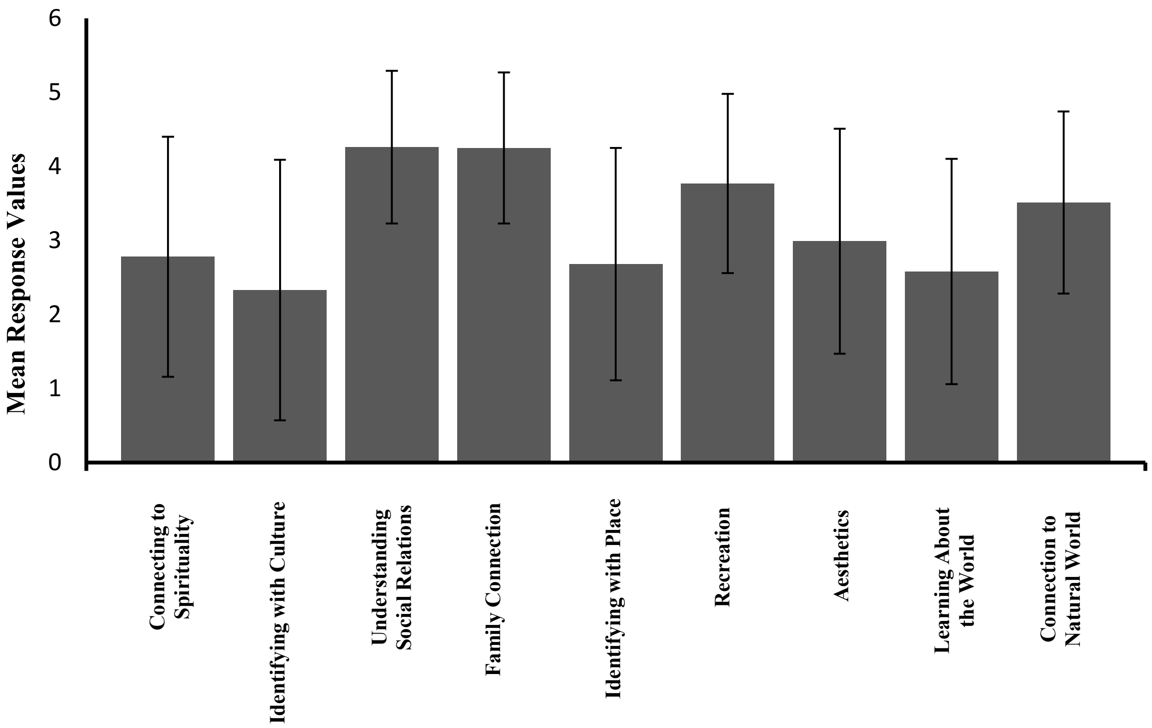

Figure 4. Bar chart showing the importance of different cultural services that respondents receive from engaging in birding. Error bars depict the standard deviation of responses for respective cultural services.

Responses to the cultural services questions (Figure 4) returned the highest mean response values for "Feeling connected to the natural world" (μ = 4.26) and "Learning about the world around you" (μ = 4.25). "Feeling connected to/identifying with your religion/spirituality" (μ = 2.33) returned the lowest mean response value. Post-hoc Tukey tests showed varying differences between responses for cultural service categories (Appendix 4). As no cultural service category proved to be significantly different from all others, further responses, and perhaps altered methods, will be needed to adequately assess differences in cultural service categories.

Cultural Services	Df	Sum Sq	F Value	p-value
“Feeling connected to/identifying with your religion/spirituality”	1	1.823	1.86	0.1755
“A better understanding of social relations”	1	1.866	1.921	0.169
“Feeling connected to your family/upbringing"	1	2.441	2.53	0.115
“A sense of place identification”	1	2.993	3.128	0.08
“Identifying aesthetic value in the world around you”	1	3.777	4.406	0.038*
“Better identifying with your culture/yourself”	1	4.66	4.944	0.029*
“Learning about the world around you”	1	4.788	5.107	0.026*
“Recreation/health values”	1	8.62	9.63	0.0025*
“Feeling connected to the natural world”	1	13.499	15.89	<0.001**

Table 1. Summary of ANOVA test between responses to “Birds” as an ecological characteristic and cultural services. Where indicated by markers of significance, variation between Birds and cultural service categories is greater than variation for responses within groups (* denotes statistical significance; ** denotes high statistical significance). (Column headings: Df, degrees of freedom, Sum Sq, sum of squared deviation of each value from its group mean, F Value, ratio denoting group mean variation, p-value, significance of variation for in-group and between-group variation.)

The importance of birds as an ecological feature when deciding which protected area to visit, was significantly correlated with five cultural service categories (Table 1). This suggests a correlation between the importance of birds as an ecological characteristic and the provisioning of a certain sub-set of cultural service benefits. These examples provide an initial empirical grounding for linking the experiences of cultural services provided by birds to a respondent’s motivations in choosing which protected areas to visit. Though weaknesses of sample size (n = 108) and respondent capture remain, these results suggest that further research will prove valuable.

5. DISCUSSION

This chapter set out from the premise that a better understanding of the cultural services of birds would inform our understanding of both the cultural services concept and the SES approach. As a pilot study exploring unknown conceptual and research terrain it has achieved a proof of concept: research examining the cultural services provided to people through interactions with birds is an arena pregnant with possibility. The results demonstrate that such cultural services can be quantified: the cultural services of birds, and the importance of birds as an ecological characteristic in protected area choice, are arenas in need of further study.

Among survey respondents, “Birds” as an ecological characteristic returned the highest response value when selecting which protected area to visit. This implies the possibility that some, as yet unknown, subset of the ecotourist population places a particularly high ordinal value on birds and birding experiences. The diverse ways in which people manifest interest in birds, and interact with them recreationally, economically, and ecologically has been a frequently explored, and is still a burgeoning arena of scholarship (e.g. Armstrong 1958; Koeppel 2005; Mynott 2009; Cocker 2013). In contrast, my study's approach has been the attempt to quantify the character of human-avian relationships. This echoes Martin-Lopez, Montes, and Benayas' examination of non-economic tourist motives when visiting the Doñana National Park in Spain (2007). Their study found that of the ecological features queried through tourist questionnaires, two avian species, Spanish Imperial Eagle (*Aquila adelberti*) and Greater Flamingo (*Phoenicopterus ruber*), returned the highest mean stated preferences. While research linking the social and the ecological, such as Martin-Lopez, Montes, and Benayas' work, as well as this study, is still nascent, it provides anecdotal information to protected area managers when advertising a reserve's ecological characteristics to the public. Such information might also provide management incentives to managers and policy-makers when assessing the importance of protecting avian species. Given the well-to-do nature of many birders, and their general commitment to birding as a pursuit (Sekercioglu 2002), it is possible that birding tourism can buffer against market volatility for both private and public protected areas (Biggs et al. 2011; Ryan 2012).

It must here be noted that the quality of the information returned in these surveys is limited, in that we do not know what sub-set of the ecotourist population engaged in responses. While both paper and electronic surveys were distributed to the study-site PPAs, response rates suggest that a marginal number of ecotourists responded to the surveys. Both sample size and the likelihood that such surveys were disproportionately completed by self-regarded birders limits the extent to which broader conclusions can be drawn. Though a majority of respondents identified as "casual/occasional" birdwatchers (n = 71), as opposed to those who responded as either "enthusiastic" or "fanatical" birdwatchers (n = 33), it is unknown to what extent this might oversell the importance of birding opportunities to the ecotourist population. While more comprehensive studies examining the realized impacts of avian tourism and birder interest across South Africa have begun this process (Ryan and Turpie 1999; DTI 2010; Biggs et al. 2011), a comprehensive accounting of how birds impact ecotourism decisions will speak more confidently about the diverse implications of possible birding experiences. Future surveys should focus on increasing response numbers.

More comprehensive surveys will help deepen our understanding of the different cultural services provided by birds. Assessed relationships between self-reported classification as a birdwatcher, and the differing levels of importance of the various cultural services did not return statistically significant results, though this was posited entering the study. However, other results linking the importance of birds as an ecological feature with certain cultural services suggest a relationship between interest in birds and the degree to which cultural services are experienced via human-avian interactions. Birdwatcher classification may be more fruitfully comparable once surveys return a higher volume of responses for the number of species seen by each respondent – this measure may prove to be a more adequate method of comparison. It is recognized within the birding community that birders are passionate, and occasionally fanatical in their pursuits. Further research should delve into the relationships between cultural service benefits and the dedication birders demonstrate.

As an empirical grounding for creating linkages between the experiences of cultural services and motivations for viewing birds, this research provides a first step towards identifying the existence of important relationships. Such research is demonstrative of Musacchio's call for ecosystem service research to shift towards the scale of human-landscape interactions (2013). Emphasizing these scales will deepen our understandings of the social-ecological nexus points which cultural services address. As cultural services are seen by the MA (MA. 2005) to inform, and possibly be formative of, a person's willingness to engage in the conservation of ecological phenomena, responses to the questions "How important a role has birding played in developing values and ethics of conservation in your life," were differentiated by responses to the "Birds" ecological characteristic. Here a strongly significant correlation ($p < 0.001$) was found, indicating that as birds more greatly influence a respondent's decision-making they also play a larger role in that person's conservation ethic. This suggests that people develop conservation concerns for phenomena they highly prize (though this need not be a one-way street). It must be reiterated that such interest, what Laura Musacchio calls "deep care" (2013) or what Aldo Leopold simply termed "the conservation ethic" (1933), is decidedly not an economic measurement; conservation concerns specifically transcend economic concepts of value and socioeconomic notions of 'progress' (Child 2009). While economic value is undoubtedly crucial to forecasting environmental change (Costanza et al. 1997; Daily and Matson 2008), it inadequately accounts for the suite of normative stances embodied by individuals and groups (Heal 2000; Peterson et al. 2010). Simply accounting for the social impact of ecological phenomena via economic valuation freezes the iterative feedback cycle between the social and the ecological (Gomez-Baggethun and Ruiz-Perez 2011; Potschin and Haines-Young 2011; see Chapter 1). Non-market values frequently determine the success or failure of conservation prospects (Chan et al., 2012). Directly experienced and intuitively appreciated, cultural services demonstrate the relationship between ecosystem structures and the non-material, non-monetary benefits people receive from natural processes (Daniel et al. 2012). These results provide anecdotal quantitative support for further research into whether or not developing an appreciation for birds will also make people more concerned with bird conservation, and possibly conservation writ large.

If the impacts of social and ecological interactions are to be adequately accounted for, ecosystem service researchers require a broader set of tools (Chan, Satterfield, and Goldstein 2012). Linkages between the social and the ecological cannot be assessed simply through the agglomeration of disciplinary approaches (B. Walker et al. 2006; Norgaard 2008). Research methods featuring a "skilful combination of the biological, physical, and social sciences" will deepen our understanding of the linkages between the social and the natural (Sekercioglu 2010, 66). These surveys demonstrate that the possibility exists for the quantification of the cultural services of birds to take place. Clearly, relationships between people and birds are given expression in non-material, non-monetary ways. Hopefully further studies will continue to identify cultural service benefits and move towards contrasting assessments so as to differentiate how cultural services are realized spatially, temporally, and in regards to other social and ecological variables. Bringing together social-ecological components, this chapter takes one small step towards more fully accounting for the related aspects of social and ecological interactions and concerns (Daily et al. 2009; Reyers et al. 2013). Hopefully this work will serve as a jumping-off point for further investigation into both cultural services broadly, and into the cultural services of birds specifically; both understood to be demonstrative of the interactions of social-ecological components.

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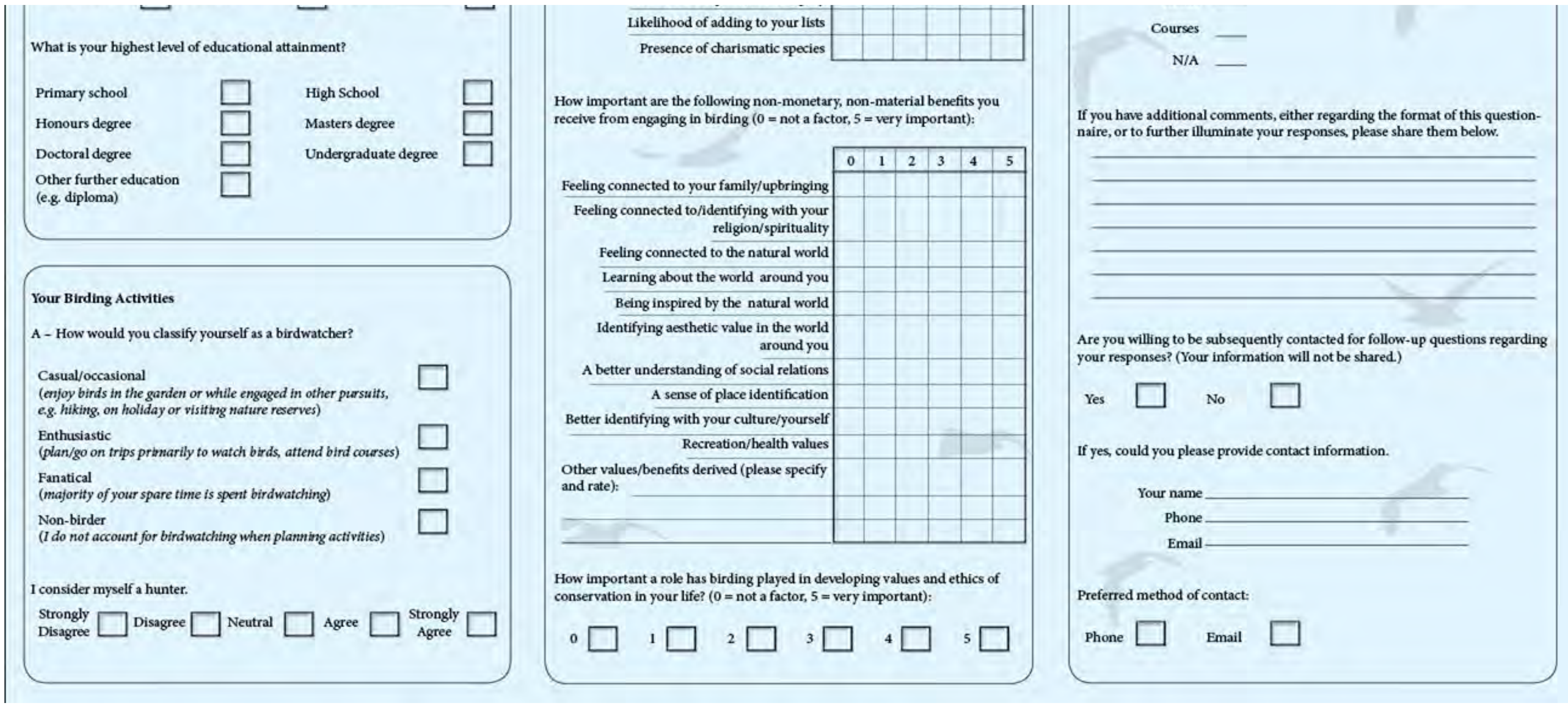
Appendix 1 – Sub-set of Private Protected Areas

(Image credit: Google, 5/3/2014)

- **African Game Lodge**
  (33°42'11.12"S; 20°21'4.90"E)
- **Badshoek Hunting Experience**
  (32°11'52.03"S; 22°46'28.36"E)
- **Buffelsfontein Private Game Reserve**
  (33°17'18.79"S; 18°13'35.66"E)
- **Gondwana Game Reserve**
  (34° 4'25.59"S; 21°54'50.94"E)
- **Lemoenfontein/Ko-ka Tsara Game Reserve**
  (32°14'50.67"S; 22°34'28.78"E)
- **Plettenberg Bay Game Reserve**
  (33°56'29.02"S; 23°20'51.60"E)
- **(north) Sanbona Wildlife Reserve**
  (33°42'46.96"S; 20°36'46.11"E)
- **(south) Sanbona Wildlife Reserve**
  (33°44'35.89"S; 20°36'23.56"E)

Appendix 2 – Cultural Service of Birds Survey Cards



Likelihood of adding to your lists
Presence of charismatic species

What is your highest level of educational attainment?

- Primary school ☐
- Honours degree ☐
- Doctoral degree ☐
- Other further education (e.g. diploma) ☐
- High School ☐
- Masters degree ☐
- Undergraduate degree ☐

Your Birding Activities

A – How would you classify yourself as a birdwatcher?

- Casual/occasional (*enjoy birds in the garden or while engaged in other pursuits, e.g. hiking, on holiday or visiting nature reserves*) ☐
- Enthusiastic (*plan/go on trips primarily to watch birds, attend bird courses*) ☐
- Fanatical (*majority of your spare time is spent birdwatching*) ☐
- Non-birder (*I do not account for birdwatching when planning activities*) ☐

I consider myself a hunter.

Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree ☐

How important are the following non-monetary, non-material benefits you receive from engaging in birding (0 = not a factor, 5 = very important):

	0	1	2	3	4	5
Feeling connected to your family/upbringing						
Feeling connected to/identifying with your religion/spirituality						
Feeling connected to the natural world						
Learning about the world around you						
Being inspired by the natural world						
Identifying aesthetic value in the world around you						
A better understanding of social relations						
A sense of place identification						
Better identifying with your culture/yourself						
Recreation/health values						
Other values/benefits derived (please specify and rate):						

How important a role has birding played in developing values and ethics of conservation in your life? (0 = not a factor, 5 = very important):

0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Courses ___
N/A ___

If you have additional comments, either regarding the format of this questionnaire, or to further illuminate your responses, please share them below.

Are you willing to be subsequently contacted for follow-up questions regarding your responses? (Your information will not be shared.)

Yes ☐ No ☐

If yes, could you please provide contact information.

Your name ______
Phone ______
Email ______

Preferred method of contact:

Phone ☐ Email ☐

Ecological Feature	μ	s.d.	n responses
Insects	2.369	1.645	103
Reptiles	2.767	1.535	103
Large Flocks	3.363	1.280	102
Migrants	3.462	1.230	104
Adding to List	3.475	1.534	99
Vegetation	3.544	1.289	103
Charismatic spp.	3.56	1.266	100
Endemic Birds	3.738	1.268	103
Rare/Endangered spp.	3.853	1.138	102
Raptors	3.972	1.000	106
Big Mammals	4.047	1.158	106
Birds	4.206	0.983	106

Appendix 3. Summary of responses for differing ecological features. (The sample size: respondents to paper and online surveys. Column headings: μ, mean response for specific ecological feature from *n* responses; s.d., standard deviation in the responses for each ecological feature; *n* responses, number of responses for the specific ecological feature.)

	Family Connect	Spirit	Natural World	Learning About World	Social Relations
Family Connect	#####	0.057	<0.001*	<0.001*	0.669
Spirit	0.057	#####	<0.001*	<0.001*	0.13
Natural World	<0.001*	<0.001*	#####	0.906	<0.001*
Learning About World	<0.001*	<0.001*	0.906	#####	<0.001**
Social Relations	0.669	0.13	<0.001*	<0.001*	#####
Aesthetics	<0.001*	<0.001*	0.001	0.002*	<0.001*
Identify with Place	0.339	0.004*	<0.001*	<0.001*	0.162
Identify with Culture	0.337	0.267	<0.001*	<0.001*	0.65
Recreation	<0.001*	<0.01*	<0.001*	<0.001*	<0.001*

Appendix 4. Post-hoc Tukey tests for significance between responses for each cultural service category. Differing relationships between cultural service categories are indicated (* denotes statistical significance).

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Chapter 3 – "Ecological Function and the Human Component: crossing the social-ecological"
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ABSTRACT
*Systems-thinking approaches are gaining currency as part of conservation toolkits. Ecosystem components must accordingly be assessed in regard to their system-wide relationships. A comprehensive accounting across linked social-ecological systems must include both an organism's biophysical and social interactions. This chapter introduces the concept of 'wow factors' (WF) as an approach to assessing organism interactions across both the social and ecological arenas. Quantifying birder interest via WF scores demonstrates one method of anchoring diversity assessments both socially and naturally. Analysis of WF responses demonstrates a proof of concept: 134 WF scores for respective southern African bird species suggest that the WF concept can ground cultural services in interactions with biophysical phenomena. Different levels of birder interest can influence the impact a species has on conservation concerns. The method described demonstrates a novel approach to linking the social and the natural. This research is driven by the insights of Social-ecological Systems (SES) theory. A sub-set of these results is briefly applied to a real world conservation issue, the degradation of Southern Ground-Hornbill (*Bucorvus leadbeateri*) habitat. This application demonstrates how WFs can serve both as a unique tool in support of SES thinking and as another step towards more comprehensively addressing the linkages which compose SESs.*

Keywords: cultural services; social-ecological systems; birds; South Africa; Southern Ground-Hornbill; wow factors

1. INTRODUCTION

Twenty-first century ecological research increasingly accounts for the anthropogenic variables which impact ecological relationships. Rather than isolating organisms from their surroundings, researchers seek to understand how both social and ecological entities are created by and alter their environments (Levins and Lewontin 1985; Norgaard 1994). This necessitates not only a more cross-disciplinary ecology, but also a recognition that human society widely impacts ecological functions (Steffen, Crutzen, and McNeill 2007; Heydinger 2011). Because humans play an ever growing role in the planet's environmental processes, our use and definitions of natural capital increasingly dictate future ecosystem viability. The development of the ecosystem services concept demonstrates that, while environmental processes undergird human well-being, the values ascribed to these interactions inform our conservation priorities (MA 2005; Gómez-Baggethun et al. 2010; Norgaard 2010). Linkages between social and natural components suggest that humans are both influenced by and help co-create ecological phenomena. The growing influence of the social component likewise means that the interactions between the social and the natural spheres become more crucial to future ecological persistence. Our anthropogenic domination results in ecology becoming an increasingly social interaction (Robertson 2004).

The specific delineation of cultural services within the Millennium Ecosystem Assessment (MA) suggests the importance of accounting for interactions between social and ecological spheres (Chan et al. 2012). Because cultural services are an explicit manifestation of social-ecological relationships, research methods must interrogate their relational characteristics. As the previous chapter reviewed, ecosystem service value has generally been quantified via the economic approach. Yet the non-material, non-monetary benefits people derive from ecological processes has been a growing subject of interest. The Millennium Ecosystem Assessment (MA) made a provision for this fact by recognizing the "non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience, including, e.g., knowledge systems, social relations and aesthetic values" (MA, p. 894). These are the aforementioned *cultural services*. An assessment of differing cultural services can greatly aid our understanding of how ecological components and phenomena influence people (Chan, Satterfield, and Goldstein 2012). If cultural services can be understood in light of their functional relationships, our ability to account for an entity's suite of social and ecological interactions will be deepened.

As the ecological sciences continue to develop there is an ever-deepening awareness that human and environmental interactions feedback upon one another. At the three steps of service identification, assessment, and management (Daniel et al. 2012), information relating to cultural services is lacking – though it is thought that they are globally in decline (MA. 2005). Although their use has continued to grow, ecosystems are believed to be increasingly incapable of providing cultural services at levels similar to years and decades past. While cultural services are almost uniformly recognized to be crucial to conservation concerns, they have not been comprehensively defined, nor suitably integrated into ecosystem service frameworks (Chan et al., 2012; Daniel et al., 2012). Specifically because of their intangible and subjective character, cultural services are seen to be a unique type of social and ecological concern; this also makes standardised methods of identification, assessment, and management difficult. To support practical conservation measures, cultural services must be able to speak not only the languages of morality, experience, and values, they must also be brought into the scientific discussion. To address these varying needs I introduce the concept of 'Wow Factors' (WFs).

I surveyed expert-level South African birdwatchers to assess the level of cultural service benefits they receive from interactions with different bird species. WFs are shown to empirically support different levels of interest in a selection of southern African bird species. The quantification of relative interest levels for different bird species creates the possibility of employing a pair-wise comparison between species, heeding calls for a clearer differentiation among cultural services (Chan et al. 2012). The creation of WFs provides the first step towards a schematized rubric of comparison – the quantifiable aspect is thought to be more practically applicable in management scenarios (Robertson 2006). Results indicate not only varying levels of interest in different species, but also suggest the application of the WF tool as an instrument for informing practical conservation decisions. The primary objective for this research was to demonstrate a proof of concept. This is a pilot study for the WF tool. While it is hypothesized that WFs will become useful conservation tools this research is oriented towards an exploration of the approach and a reflexive development of a method of measurement. In the discussion I highlight specific moments of learning and discuss opportunities for further research.

2. THE WOW FACTOR CONCEPT

Concerns that unquantified ecosystem services will remain unaccounted for in conservation policy (Robertson 2006) necessitate novel approaches to quantifying cultural services. Though they are thought to be of crucial importance, the role played by cultural services in supporting identity and resilience in linked SESs is almost entirely unaccounted for (MA 2005; Chan et al. 2012). To quantify cultural services this chapter looks at human interactions with birds. As the best known vertebrates on the planet (Wenny et al. 2011), birds pervade all recorded languages and cultures (see Chapter 2; Podulka, Rohrbaugh, and Bonney 2004; Cocker 2013). Given their global prevalence there is a "pressing need" to better account for the translation of avian functions into ecosystem services (Sekercioglu 2006). Though this need has sown the initial seeds of research examining the differing ecosystem services provided by birds (e.g. Sekercioglu 2006; Cumming and Child 2009; Wenny et al. 2011), works examining the cultural services aspect have shied away from methods of quantification (e.g. Mynott 2009; Tidemann and Gosler 2010). To support integrated conservation approaches cultural services must be able to speak not only the languages of morality, experience, and values, they must be brought into the scientific discussion as well. Into this research vacuum I introduce the WF concept.

Empirically grounding the cultural service benefits people derive from interactions with birds necessitated an examination of the perceptions of bird-life. This chapter employs surveys of expert-level South African birdwatchers to assess the cultural service benefits they receive from interactions with different bird species. WFs are shown to empirically support different levels of interest in a selection of southern African bird species. Generally studies applying a quantitative signifier to cultural services have looked to measure an individual's willingness to pay for certain environmental benefits or experiences (Goulder and Kennedy 1997; Bookbinder et al. 1998; Costanza 2000). This approach is regarded as problematic primarily due to the insufficiencies of the economic approach to valuing ecosystem services (see Chapter 1; Heal 2000; Kosoy and Corbera 2010; Soule 2013), and has thus been avoided here. Rather than conflate inappropriate economic measurements with the specifically non-material, non-monetary aspects of cultural services (Funtowicz and Ravetz 1994; Ludwig 2000; Farley 2012), a foundation by which the cultural services of birds are comparable relative to each other has been developed. The quantification of relative interest levels for different bird species creates the possibility of employing a pair-wise comparison between species, heeding calls for a clearer differentiation among cultural services (Chan et al. 2012). Though cultural services are recognized to be of equal importance as other ecosystem services (MA 2005), their specifically 'non-material' character means they remain little quantified. The creation of 'Wow Factors' is meant to provide the first step towards a schematized rubric of comparison – the quantifiable aspect is thought to be more practically applicable in management scenarios (Robertson 2006).

Results indicate not only varying levels of interest in different bird species, but also suggest the application of the WF tool as an instrument for informing practical conservation decisions. One such application of the tool is examined in the discussion. Throughout, the imperative of accounting for the human component within conservation thinking and approaches is stressed.

3. MATERIALS AND METHODS

(a) *The creation of 'Wow Factors'*

To assess the differing functinoal interactions of separate avian species I surveyed expert-level birders for their interest in encountering different bird species in southern Africa. Surveys took the form of paper response-sheets and were also completed electronically via the online survey software "Survey Monkey" (www.surveymonkey.com). Paper surveys were distributed at the BirdLife South Africa, 2013 Annual General Meeting (1-4 March); the electronic version was distributed to ornithologists and ornithology-focused graduate students at the Percy FitzPatrick Institute of African Ornithology. Birders were asked to provide basic personal birding background data by responding to "Number of birds on [your] SOUTH AFRICAN list," and to "Rank your birding experience from 1 (beginner) to 10 (expert)." Within the main body of the survey respondents were presented with the name of randomly-selected South African bird species. Species names were taken from *Robert's Birds of Southern Africa, 7th edition* (Hockey, Dean, and Ryan 2005), with each paper sheet containing 15 unique species names, and each online survey page contained up to 200 unique species names. Species names appearing on each sheet were composed of both terrestrial and pelagic birds – though only terrestrial species appear in the analysis.

Respondents were asked to give a "Ranking or 'Wow Factor' (1-10) (WF) score for each species, with one being the lowest score and 10 the highest possible score. This 'Wow Factor' measures a birder's level of enjoyment derived from spotting the species in the wild. For example a response to the species Southern Fiscal Shrike (*Lanius collaris*) might give an answer of 3 signifying a low-end average interest. In contrast the Southern Ground-Hornbill (*Bucorvus leadbeateri*), perhaps seen to be a more charismatic species, might receive a response of 6, signifying a respondent's greater interest in seeing that species in the wild.

Comparisons between recorded WF scores were undertaken in Microsoft Office Excel and the statistical program *R*, version 3.0.2 (2013). We used species receiving scores from at least 16 respondents (up to a maximum of 21 returns per species). The analysis included 134 species of South African birds (~15% of approximately 950 bird species in southern Africa; Hockey, Dean, and Ryan 2005). The mean WF score was used to compare between different bird species. The standard deviation among responses indicates the uniformity of response values. The character and distribution of responses was further interrogated using the Pearson-Fisher standard moment of skewness and sample excess kurtosis (adjusted).

4. RESULTS

Figures 1-10 display the differing distributions of WF responses for nine bird species were taken as the representative for all species grouped within a common whole number mean WF from one to ten.[3] Each of the species visualized in these histograms, and collectively in figure 10, represents the median species, based upon mean WF responses, occurring within a single numerical value for mean WFs, e.g Burchell's Coucal (*Centropus burchelli*), with a mean response of 3.53 was the eleventh of 21 species with mean WF scores falling between 3 for Helmeted Guineafowl (*Numida meleagris*) and 3.9994 for Green Wood Hoopoe (*Phoeniculus purpureus*). The purpose of selecting these nine species was to provide an anecdotal look at the values recorded and distribution of responses across different level of mean WFs. Table 1 provides summary statistics for these figures. Figures 11 displays WF mean and standard deviation values for a randomly selected sample of bird species to visualize additional WF values; species were selected via a random number generated in the R statistical program. Figures 12 -15 visualize the relationships between mean WF responses and the overall shape of the data. Analysis of mean WFs highlights how birders as a group think about different bird species and illuminates interesting trends in the response data. Table 2 provides ANOVA results, testing for differences in WF responses.

[3] Note differences in the y-axis scale for figures 1-9.

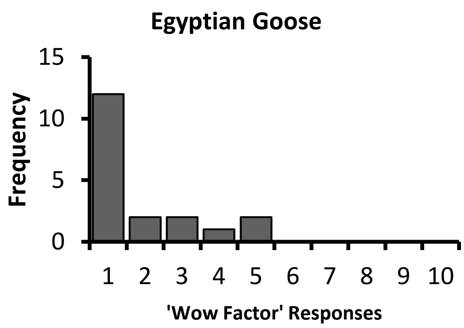


Figure 1

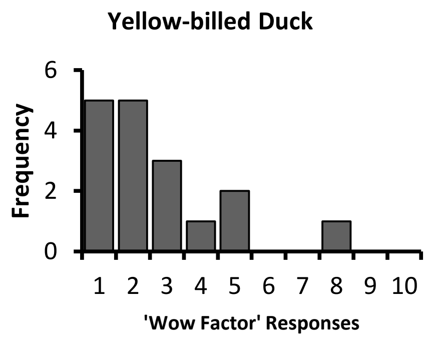


Figure 2

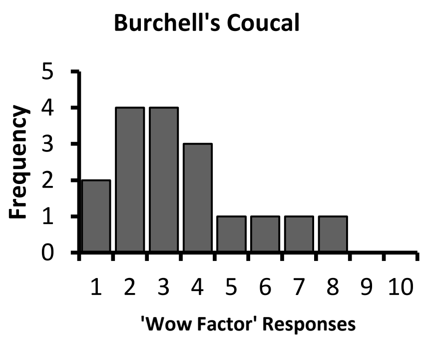


Figure 3

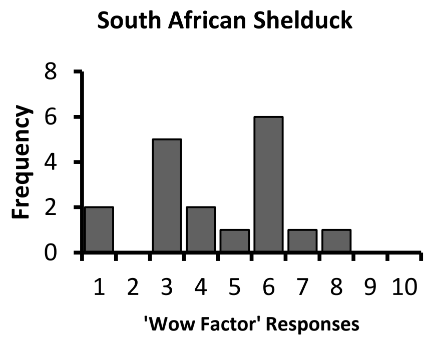
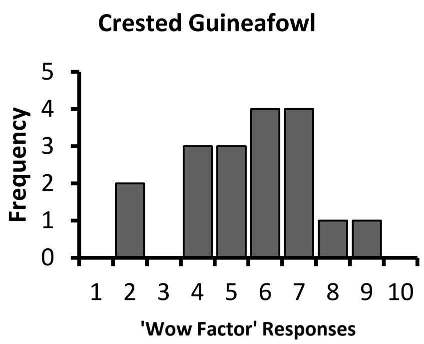


Figure 4



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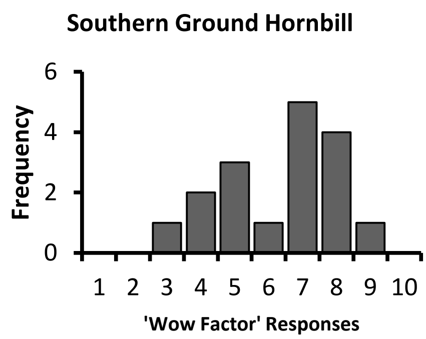

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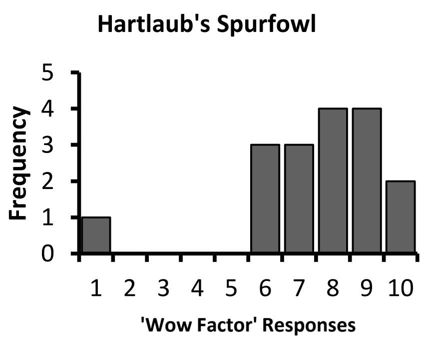


Figure 7

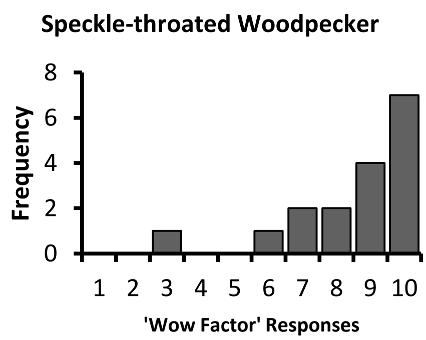


Figure 8

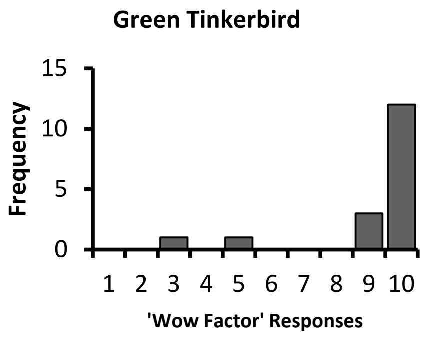


Figure 9

Species	*μ*	s.d.	skew	kurtosis	*n* responses
Egyptian Goose (*Alopochen aegyptiacus*)	1.895	1.41	1.402	0.673	19
Yellow-billed Duck (*Anas undulata*)	2.706	1.9	1.54	2.593	17
Burchell's Coucal (*Centropus burchelli*)	3.53	2.004	0.902	0.245	17
South African Shelduck (*Tadorna cana*)	4.5	2.007	-0.196	-0.798	18
Crested Guineafowl (*Guttera pucherani*)	5.556	1.887	-0.334	-0.088	18
Southern Ground Hornbill (*Bucorvus leadbeateri*)	6.353	1.73	-0.458	-0.839	17
Hartlaub's Spurfowl (*Francolinus hartlaubi*)	7.53	2.125	-1.818	4.956	17
Speckle-throated Woodpecker (*Campethera scriptoricauda*)	8.53	1.908	-1.734	3.353	17
Green Tinkerbird (*Pogoniulus simplex*)	9.118	1.996	-2.587	6.064	17

Table 1. Summary of frequency distribution histograms for 'wow factor' responses. (The sample size: surveyed birdwatchers for interest in seeing different bird species in the wild. Column headings: μ, mean 'wow factor' responses; s.d., standard deviation in the responses for each species; skew, Fisher-Pearson standardized moment measure of skewness, negative value indicates leftward skew among responses, while positive value indicates rightward skew among responses; kurtosis, sample excess kurtosis (correction included), values < 0 exhibit a platykurtic, or flattened distribution, while values > 0 exhibit a leptokurtic, or peaked distribution; *n* responses, number of WF responses for the specific species.)

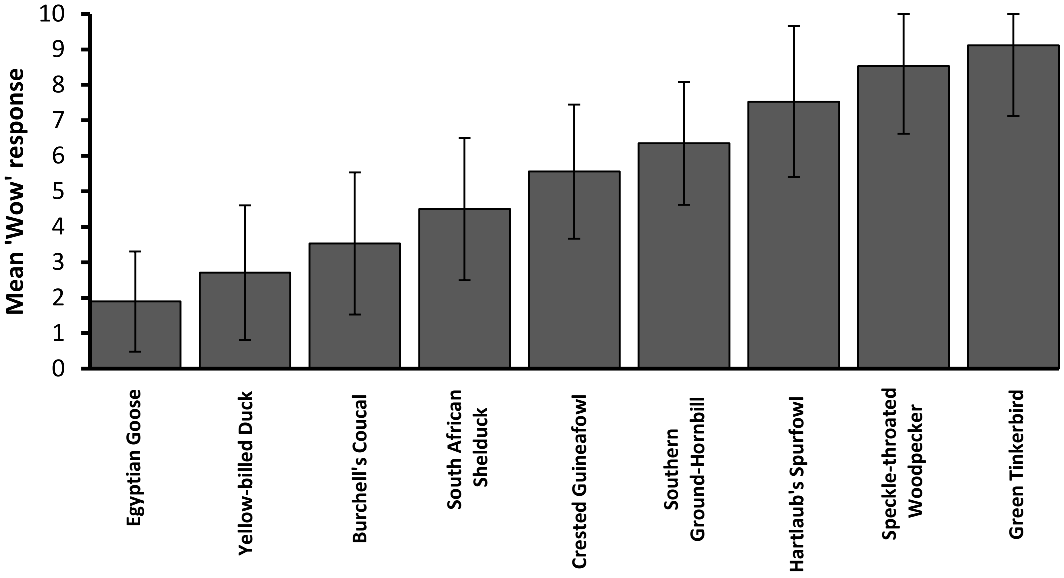


Figure 10. Histogram of mean 'wow factor' responses for selected species (one species for each mean category 1-9) with standard deviation error bars. Nine (9) species representing a total of 157 WF responses (n = 17-19, per species).

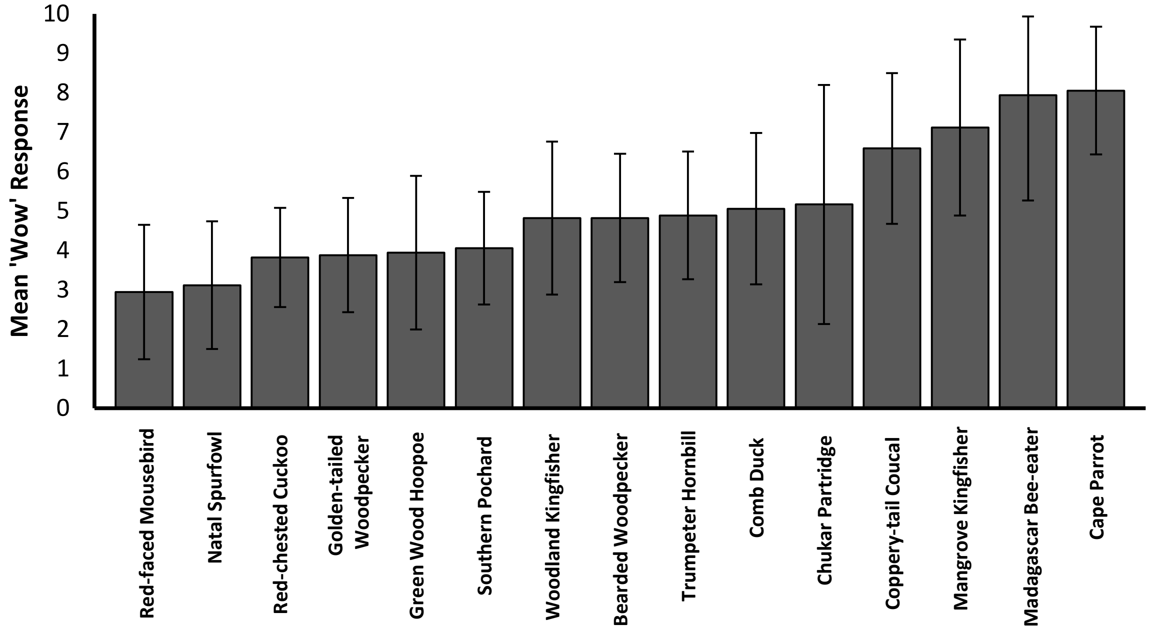


Figure 11. Histogram of mean 'wow factor' responses for fifteen randomly selected species, with standard deviation error bars. 15 species representing a total of 261 WF responses (16-19 per species).

Surveys for WFs returned between sixteen and twenty-one individual responses for each of 134 different southern African bird species. Total individual responses across all species number 2,349. Figures 1-10 display

WF responses in frequency distribution histograms. Not surprisingly, those species recording lower mean WF scores also had distributions skewing more rightward, while those species recording mean scores higher in the response range had distributions skewed more leftward. These results are included for descriptive purposes to illuminate the character of responses for different species categorized by mean WF. A comprehensive look at mean WF responses for the data-set as a whole is included below.

An examination of representative species by mean WF response points towards a relationship between higher responses and species rarity. The Green Tinkerbird (*Pogoniulus simplex*) returns the highest mean score of all the species surveyed; it is the only species whose mean WF score is greater than 9.00. The Green Tinkerbird is one of the least seen species in the region, with only a single confirmed sighting (Hockey, Dean, and Ryan 2005). Other species returning WFs at the high extreme of the value spectrum (e.g. Blue Quail (*Coturnix adansonii*), Madagascar Cuckoo (*Cuculus rochii*), and Bohm's Bee-eater (*Merops boehmi*)) though spanning the avian taxonomy, are generally typified by their rarity, limited occurrence within the region, and/or, extremely cryptic habits. This tentative hypothesis relating increased WF responses to rarity is born out in the fifteen other randomly selected species (Figures 11-26). WF distribution for each of these species provides an overview of the type of responses for differing individual species.

The mean value for WF responses spanned from a high for the Green Tinkerbird (n = 17; μ = 9.117; s.d. = 1.996) to a low for the Egyptian Goose (*Alopochen aegyptiacus*) (n = 19; μ = 1.895; s.d . = 1.41). Again, these values point towards the relative rarity of both species as important. Median values ranged from two species, Green Tinkerbird and Madagascar Cuckoo (n = 16) with a high value of "10", to a low of "1" for the Egyptian Goose and the Mallard (*Anas platyrhynchos*) (n = 17). The standard deviation was greatest for the Northern Shoveler (n = 17; s.d. = 3.562) and least for the Swallow-tailed Bee-eater (*Merops hirundineus*) (n = 16; s.d. = 1.183). Employing the adjusted Fisher-Pearson standardized moment measure for skewness returned the greatest rightward-skew for the Common Peacock (*Pavo cristatus*) (n = 18) of 1.628, with the Blue Quail (*Coturnix adansonii*) showing the greatest leftward skew (n = 18) of -3.249. Eight species WF response distributions had a skew greater than 1.00 (rightward), while 28 species response distributions skewed less than -1.00 (leftward).

The sample excess kurtosis (adjusted) returned the strongest leptokurtic (most-peaked) distribution for the Blue Quail of 12.05, and the most platykurtic (least-peaked) for the Cape Shoveler (*Anas smithii*), (n = 17) of -1.461. The Blue-cheeked Bee-eater (*Merops persicus*) (n = 18) most closely approached a Gaussian, or mesokurtic distribution with an excess kurtosis of 0.0069.

ANOVA					
Source of Variation	**SS**	**Df**	**MS**	**F**	**P-value**
Between WF Groups	6402.396	133	48.13831	12.07372	< 0.001
Within WF Groups	8831.281	2215	3.987034		
Total	15233.68	2348			

Table 2. 'Wow Factor' responses differed very significantly across bird species (One-way ANOVA, F (133, 2215) = 12.07372, p < 0.001). This analysis underscores that via the WF measure, respondents react very differently to the prospect of experiencing different species of bird. (Column headings: SS, sum of squared differences; Df, degrees of freedom; MS, mean squared variation; F, ratio of variance between groups to the variance within groups; p-value, measure of significance of variation.

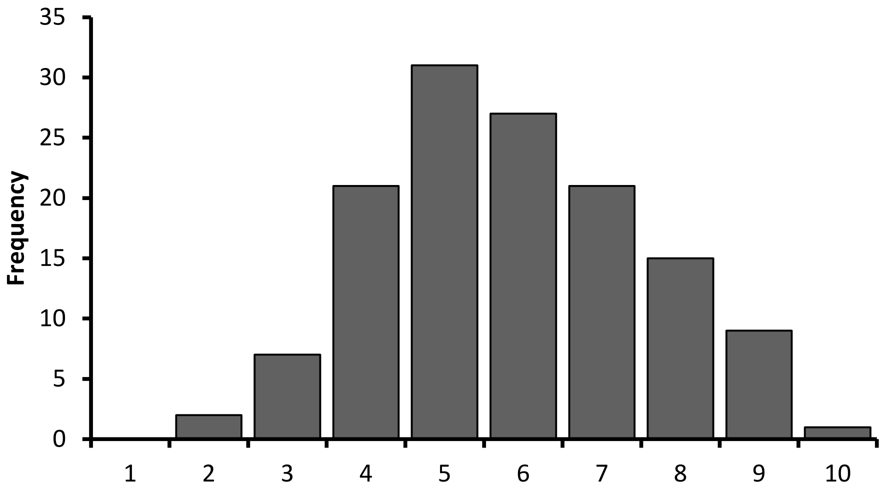


Figure 12. Frequency distribution histogram showing all 'wow factor' response means for each species returning a minimum of 16 responses (n = 134). A measurement of all mean WFs ('mean of means') returned a value of 5.384, with a standard deviation of 1.66. Values skew slightly rightward about the mean (skew = 0.207) and exhibit a slightly platykurtic distribution (kurt = -0.681). Note: scale of frequency (y-axis).

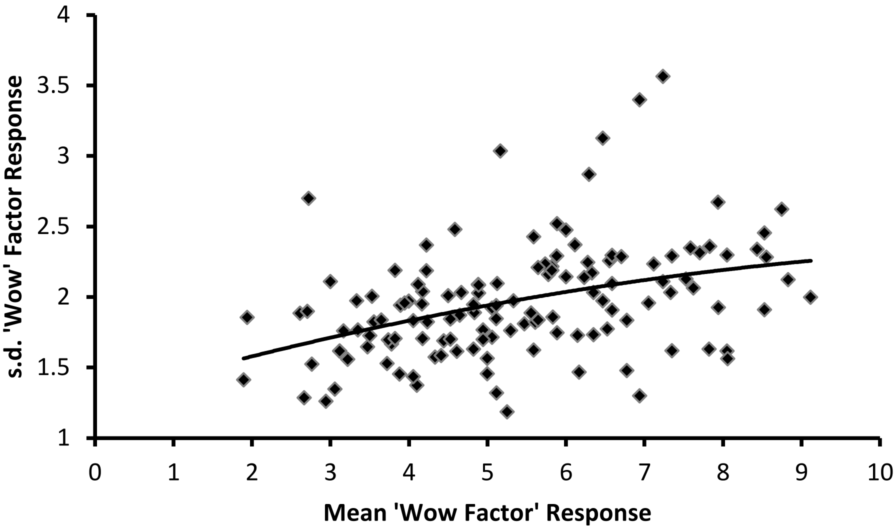


Figure 13. Scatterplot showing correlation between 'wow factor' response means for each species and the standard deviation for species response (n = 134). (Polynomial regression line: $y = -0.0061x^2 + 0.1631x + 1.277$.) Note: standard deviation scale (y-axis). This suggests more uniformly distributed WF responses for species with moderate mean WFs. The mean score for a given species was very significantly correlated with the standard deviation value associated with that same species ($p < 0.001$)

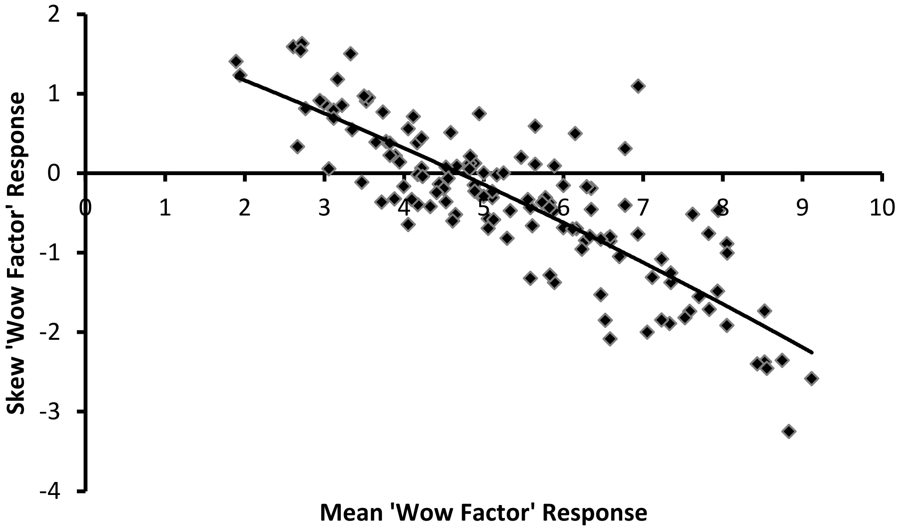


Figure 14. Scatterplot showing correlation between 'wow factor' response means for each species and skewness of distribution for species responses (n = 134). Plot suggests that skew decreases (visualized as a shift leftward) as WF score increases. (Polynomial regression line: $y = -0.0107x^2 - 0.3616x + 1.9328$.) The mean score for a given species was very significantly correlated with the skew value associated with that same species ($p < 0.001$)

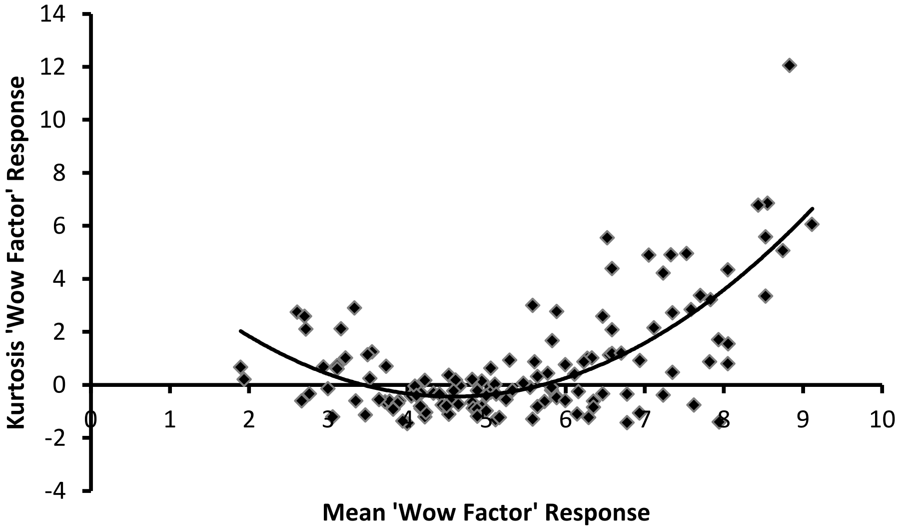


Figure 15. Scatterplot showing correlation between 'wow factor' response means for each species and the sample excess kurtosis (adjusted) for the same species (n = 134). Note relative depression in kurtosis values in the middle of response range. (Polynomial regression line: $y = 0.3431x^2 - 3.1388x + 6.7369$.) This suggests more uniformly distributed WF responses for species with moderate mean WFs. Mean score for a given species was very significantly correlated with kurtosis value associated with that same species ($p < 0.001$)

Taking the mean for all 134 individual species, a so-called 'mean of means,' returns a value of 5.384 (n = 134), with a standard deviation of 1.66 (Figures 12 & 13). Mean WF responses very significantly predicted the standard deviation in responses ($\beta = 1.637$, t (132) = 4.9411, $p < 0.001$). Mean WF responses explained a significant proportion of variance in standard deviation ($R^2 = 0.1561$, F (1, 132) = 24.414, p < 0 .001). It should be noted that the 'mean of means' falls close to the midpoint of the response range. Whether or not respondents are normalizing their answers about the middle of the data range is unclear. It may suggest the strength of this comparative approach for measuring the cultural services of birds in relation to one another. A measure of skew for all mean responses was 0.204, indicating a fair measure of balance about the mean. The kurtosis (adjusted) of all means was -0.681 indicating a slightly platykurtic distribution. The mean WF score for a given species was very significantly correlated with the standard deviation, skew (Figure 14), and kurtosis values associated with that same species (p < 0.001). While skew was negatively correlated, standard deviation and kurtosis were positively correlated. These results suggest that, while birders demonstrate a certain degree of agreement over which species they are least interested in seeing, for species returning a higher WF score birders are in less agreement concerning their level of interest. Potential reasons for this differentiation may be that, though all birders want to see rarities, they will nevertheless demonstrate differing levels of interests for different types of birds. Alternately, birders may be more or less excited to view a rare species dependent upon whether or not they have previously encountered that species in the wild. The correlation between kurtosis and mean WF responses adds nuance to this interpretation. Kurtosis values highlight a greater uniformity in mean responses closer to the lower and upper extent of the response scale (Figure 15). In effect this suggests that birders have a stronger agreement both on bird species they are uninterested in and those species they are very interested in. This, in conjunction with the correlation between mean and standard deviation, points out that while the standard deviation may be increasing with higher WF responses, this is due less to a more even distribution than a few extreme outlying data points. In analysis of such a relatively small data set the effect of outlying data points will be more pronounced.

5. DISCUSSION

Results demonstrate that the quantification of cultural services can further the cause of conservation approaches which account for both social and ecological factors. The creation of WFs for the bird-life of southern Africa set out to perform a proof of concept: not only can a (primarily) social perspective enrich our understanding of the diversity of biophysical entities, but the WF approach can robustly quantify the cultural service impacts of different avian species for birders.

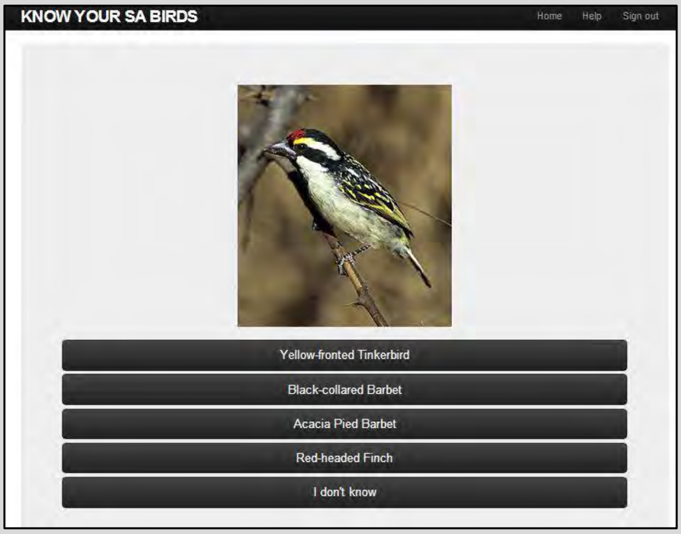
As noted in the results section, a relationship between species rarity and WF scores is apparent: those species with a mean WF at seven (7) or greater are typified as being less common within South Africa (largely occurring only as vagrants, or occurring within an extremely limited range). This begs the question of whether or not respondents give higher WF scores to species they are yet to see in the wild. Given the rarity of those species with mean WF scores approaching the maximum mean score for the Green Tinkerbird, it is supposed that many respondents have not seen these high-scoring species in the wild. The relationship between species rarity and the WF response should be incorporated into further WF research. It is hypothesized that a significant relationship will exist between WF scores and whether or not the respondent has seen the species in question. Taking this to its logical extreme, we might wonder what type of response a passenger pigeon, dodo, or species of moa (all famously extinct) might receive. More realistically a species' WF number might be considered both a blessing and a curse. As a signal of interest in viewing the species, a high score is at least demonstrative of a certain concern for that species' continued persistence. Were the WF concept to garner widespread interest as a viable measure of cultural services, and attain a greater currency, high scores might become part of the decision-making calculus in environmental policy. The curse is that if high WF scores are correlated with a decreased number of individuals, then as conservation efforts promote species' increase, a decreasing interest might yield lowered scores, again marginalizing this recently rebounded species. In the longer term such a negative feedback cycle could aid a species, but never truly guarantee its viability. However, we are a long ways off from needing to worry about this possibility.

The examples drawn from the South African bird community are by no means exhaustive of the possibilities, nor the potential difficulties, facing the WF and cultural service concepts. With little to judge a survey respondent's values against, save their other WF responses, we have only the most remote sense of how birding experiences stack-up against other conservation, normative, and economic values (to name just a few). How cultural services are realized and understood remains primarily a subject of wonder (Daily et al. 2009; Chan et al. 2012; Chan, Satterfield, and Goldstein 2012). An abandoned aspect of this research was the development of a roster of cultural-functional groups describing the variety of ways respondents associate together and interact with different bird species. These cultural-functional classifications build on research assessing the ecological functions of different avian species (Sekercioglu 2006; Cumming and Child 2009). The grouping criterion is envisioned as the first step towards a cultural-functional typology. The survey methods recounted above proved not suitable for the task. A subsequent effort is underway to better understand how birders group different bird species together (see Panel 1).

Panel 1 – Future Approaches: "Know Your SA Birds"

Differentiating between cultural service intensity suggests that service type might similarly be assessed. Attempts to classify bird species into cultural-functional groups was marginalized by structural issues in survey design. Survey forms suffered from issues relating to species included, survey depth, and uncertainties of survey purpose. Though anecdotal returns suggest the cultural-functional concept can become a useful and consistent one, further work is required to tweak the approach. As with the creation of any new arena of knowledge, whether scientific or otherwise, research venturing into uncharted territory will suffer through false starts. The revealed shortcomings of this approach have been a source of reflexive learning, and have given rise to new techniques for assessing cultural-functional groupings. It is hoped that these efforts can serve as another small founding stone for further social-ecological systems research.

Points of learning gleaned from the paper and electronic surveys have led to the creation of an online birding game, "Know Your SA Birds" (http://kysabymf.herokuapp.com/games). This online tool encourages birders and non-birders alike to sharpen their birding identification skills in a semi-competitive environment, while simultaneously collecting information on the cultural services of bird species.



Provided with a picture of one bird species, respondents are given multiple-choice options to correctly identify that species, they are also given the option of admitting "I don't know." For example, provided a picture which would correctly be identified as an Acacia Pied Barbet, respondents could either admit ignorance, or choose from among the Yellow-fronted Tinkerbird, Black-collared Barbet, and Red-headed Finch. Once an answer has been selected respondents are informed whether or not they are correct. Each correct answer is worth three points, each incorrect answer subtracts a point, and an admission of "I don't know" yields no change in score. As players move through the game they can either accumulate or lose points depending upon their skill in identifying bird species. After providing an answer for each photo, and being informed of the correct answer, respondents, whether correct or incorrect, are then prompted to categorize the species displayed into two, different, cultural-functional groups of their own creation, and to provide a 'wow factor' response. Following the Acacia Pied Barbet example, a respondent might provide the cultural-functional labels of "common vocalizer" and "forest bird." Given an adequate number of responses, trends concerning how people categorize different bird species, and the WF interest they have in them should begin emerge. The "gamification" of this approach is meant to increase return rate and stimulate user interest ("Gamification" 2014). It is believed that this interactive survey will both serve as incentive for birders to complete cultural-functional birding surveys, and provide the birder community with a tool to sharpen, and a measure for, their identification skills. As an arena of research, the cultural services provided by birds remain wide open to a host of assessment techniques and theories. It is our hope that this work will serve as a jumping-off point for further investigation into both cultural services broadly, and into the cultural services of birds specifically – both understood to be demonstrative of interacting social-ecological components.

Viewing organisms relationally, our purview logically extends across the system, and the interactions which compose it (Harvey 1974; Levins and Lewontin 1985; Gunderson and Holling 2002). The cultural services concept rests at the intersection of social and ecological components. The quantification of cultural services both spatially and temporally grounds the concept. The demonstrated interest of birders in different bird species clearly has the potential to realize these species as social (human) (inter)actors. To what extent each species will be influential may be signified by its WF. As assessed in SES theory, the growing importance of the human component suggests that the cultural services perspective speaks the language of both species' function and resilience (Hahn et al. 2008; Norberg et al. 2008). Much more research and further refinement of the WF concept is required before substantive conclusions can be drawn. However, this research does provide one direction towards linking taxonomic and ecosystem functional concerns. Articulating such biophysical components into the social sphere demonstrates how our methods can address relationships encompassing various facets of the social-ecological world we all inhabit.

The relative level of agreement on the WF for each species serves as initial proof for the further application of the concept. Applying these values to a species' persistence on the landscape raises the possibility of a host of applications for linking WFs to ecosystem function. Take as one such application the case of the Southern Ground-Hornbill (*Bucorvus leadbeateri*). Distinguished by its large size (90–130 cm; ♂ 4.2 kg, ♀ 3.3 kg)[4], striking black coloration, tendency towards ground-dwelling, and "turkey-like" appearance (McLachlan and Liversidge 1957, 1972, 1982), the Southern Ground-Hornbill (hereafter hornbill), is both well-studied and of general interest to birders. The latter statement is supported by the species returning a mean WF of 6.353, with a standard deviation of 1.73 (Figure 6). When we combine this information with hornbill natural history and examine it through a SES lens, we can add a unique perspective to hornbill social and ecological function.

Primarily inhabiting savannah and miombo woodlands hornbills have seen as much as a 20% decrease in suitable habitat over the past 15 years. This threat is exacerbated by the species' slow reproductive rate (avg. one fledgling per nine years) and maturation, longevity, and social structure. It is estimated that the past 94 years (representing approx. 3 generations) have seen as much as a 74% population decline of the species in South Africa. Such a slow, significant decline has been primarily attributed to loss of nesting sites due to natural system modifications for agriculture and aquaculture, and resulting from erosion of suitable soil due to livestock grazing (though this latter concern has only been studied in the Kenyan context). While extensive conservation efforts are being undertaken in the South African context it is unclear if the species has a local future outside of protected areas; it is estimated that the South African population numbers approximately 1400-1600 individuals. Given the species' sparse distribution, the destruction of suitable habitat may foreclose species residence for a wide swath of the landscape. This history led the International Union for Conservation of Nature (IUCN) to add the species to its "Red List of Threatened Species" in 2010, down-grading the species' conservation status from "least concern" to "vulnerable." While these transformations spell trouble for hornbills and the other organisms dependent upon hornbill ecological functions, their impacts upon birders remain elusive. Enter the WF information. Viewing the hornbill's WF (μ = 6.353) as a comparative measure in light of ecosystem transformation prospects, suggests the possible degradation of cultural service benefits derived by people.

[4] Southern Ground-Hornbill biological information from Kemp 2005. Distribution and conservation information from Mabula 2014 & BirdLife 2014. Mapping information from (Hockey, Dean, and Ryan 2005; BirdLife 2014; SABAP2 2014).

Taking the example of landscape modification for agriculture, we can substitute the presence of hornbills with other avian species typically found in farmland and surrounding farm houses and gardens. Species typically inhabiting these ecosystems, such as the Egyptian Goose (μ WF = 1.895), Klaas's Cuckoo (*Chrysococcyx klaas*) (μ WF = 3.824), Spur-winged Goose (*Plectropterus gambensis*) (μ WF = 2.667), African Hoopoe (*Upupa epops*) (μ WF = 3.474), and the Giant Kingfisher (*Megaceryle maxima*) (μ WF = 4.333) return scores falling greater than one standard deviation below the mean WF for the hornbill. In effect such an ecosystem transformation can result in quantifiably lower cultural service benefits for birders. While this hypothetical scenario glosses over a multitude of other potential variables, it suggests that the WF approach can link the cultural services of people to biophysical landscape and organism functions, and provide an analytic rubric through which to asses potential land-use change. Tying these socially-derived designators of species importance to biophysical occurrence offers a glimpse of the role WFs can play in the development of conservation efforts. We can posit a scenario in which the WF for each avian species inhabiting an ecosystem has been quantified. Discussions surrounding land-use change might then apply the cultural service profiles for different suites of birds in assessing possible scenarios for action. In effect this draws not only the bird life, but the cultural services it provides, into the social arena of conservation decision making. Such an outcome would incorporate the social element in our conceptions of different species. This application speaks to the very heart of the SES approach to conservation and ecological research (B. Walker et al. 2006; Cumming 2011).

Hopefully the WF concept can be extended to include more species, deepened by an increased number of responses, and adapted to other applications. The results herein suggest that this is possible. Given the increasing role that humans play in the transformation of the biosphere, it is imperative that the social and the ecological are understood to interact on one undifferentiated plane. If this research has helped move us towards a more coherent understanding of the interdependencies which characterize the social and the ecological, then it has been a success.

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APPENDIX 1 – Wow Factors Survey Cards

Percy FitzPatrick Institute

Universiteit van Kaapstad • University of Cape Town • Yunivesithi yaseKapa

We'd like your help in developing a birders' classification of South African birds!

Your answers, in combination with altasing data and existing species lists, will help us to identify ways in which conservation areas can better market themselves and cater to the needs of birders. We also hope to identify the ways in which conservation goals and the needs of birders can be better aligned.

How you can help us

Please enter up to 4 additional birds' names into the box next to each bird name. These should be species that as a birder, you would consider to be similar to the given species. After that, add a ranking ('wow factor'), from 1 to 10, and a brief descriptive label for the criterion by which you grouped the birds. If you are not familiar with the bird, or do not feel comfortable grouping it please move on to the next bird.

Returning the Survey

Surveys can be returned to one of the UCT students (Christine Moore or John Heydinger) directly, or via 'Return Boxes' which will be present at every Bird Life AGM event. After the cruise we can be contacted at: fitz.resilienceses@gmail.com or 021 650 3298

Personal Information

Name (Optional)	Year of Birth	Number of birds on SOUTH ARICAN List	Rank your birding experience from 1 (beginner) to 10 (expert)

		Species you would group with this species (up to 4 species)				Ranking or 'Wow' Factor (1-10)	Grouping Criterion
A	**EXAMPLE: House Crow**	European Starling; Common Myna; Feral Pigeon; Mallard Duck				1	Introduced Species
B	**EXAMPLE: Fiscal Shrike**	Laughing Dove; Olive Thrush; Cape Wagtail; Cape White-eye				3	Garden Birds
1099	Black-rumped Buttonquail						
1100	White-crested Helmet-Shrike						
1101	Reed Cormorant						
1102	Barn Swallow						
1103	Monteiros Hornbill						
1104	Rock Pipit						
1105	Swallow-tailed Bee-eater						
1106	Gentoo Penguin						

APPENDIX 2 – Wow Factors, Survey Monkey

Bird Grouping Exercise

I'm done, exit survey

1. Birds species 1-200

We'd like your help in developing a birders' classification of South African birds.

Your answers, in combination with atlasing data and existing species lists, will help us to identify ways in which conservation areas can better market themselves and cater to the needs of birders. We also hope to identify the ways in which conservation goals and the needs of birders can be better aligned.

In the survey below, you will find a list of bird species names. We are interested to know what OTHER species you associate with the given species name. This grouping can be based upon any type of classification you see fit; we are working to understand HOW YOU associate different groups of birds.

Next to each bird name given, add a ranking ('wow factor'), from 1 to 10, indicating your own perceived enjoyment from spotting such birds. Then please enter UP TO four additional species names of birds with a similar 'wow factor' that you would group with the focal species. These species names are important (please don't just give a wow factor).

Alongside the additional species please add a brief descriptive label telling us how you grouped such birds; i.e. were you associating rare understorey species, or, western cape endemics. This label helps us to understand the manner in which you associate bird species together.

You can enter data into as many (or as few) cells as you like. Around 30 would be a good target to aim for (obviously, more would be great!). Please only complete entries for birds that you are familiar with. There are 6 different pages (this survey tool only allows us to list 200 birds at a time); you can save your responses and if you like, return to the survey to do more on it at a later date. The more entries you complete, the more your responses will assist our research. Please distribute your efforts evenly between pages. Note that this survey contains a list of options - we certainly don't expect you to fill out every cell.

Once you have completed as many cells as you have time for, please submit your answers.

Your responses will assist our research in linking perceptions of birds and conservation efforts. We couldn't do it without you.
Thanks!

1. About you:

Your name (optional)

John Heydinger
Chapter 4 – "Bird Counts and 'Wow Factors': towards an ecological application"
Percy FitzPatrick Institute of African Ornithology, University of Cape Town
Advisor: Professor Graeme Cumming

ABSTRACT
This final chapter applies the developed social-ecological tools to a more traditional realm of ecological study: avian point counts. Surveys of avian species composition for eight private protected areas (PPAs) within the Western Cape Province, South Africa, were completed. These counts returned species abundance lists to which the 'wow factor' (WF) concept was applied. Across 1405 different samples 28 species with WF scores were recorded. Composite WFs across different PPAs were standardized and compared. Three resulting measures of cultural service experience were derived from the application of the WF concept. They are Wow Presence, Wow Abundance, and Wow Service Provision. The first two speak to the relative cultural services of birds differentiated by PPA, while the third quantifies a species' WF across the various PPAs. Results highlight a proof of concept: the application of WFs creates new arenas of knowledge and new decision-making possibilities for conservationists and ecotourists. Bringing the social-ecological approach of this research into the ecological sphere, while tying it back to social imperatives, completes the multi-method social-ecological arc of this project. Concluding remarks briefly touch on lessons learned and reiterate the necessary grounding of the ecosystem services concept within the social-ecological systems (SES) theoretic.

Keywords: birds; cultural services; social-ecological systems; ecotourism; private protected areas; South Africa; wow factors

1. INTRODUCTION

Unsustainable social-ecological interactions require both physical and conceptual transformations. The social and the ecological co-evolve in relation to one another (Norgaard 1994). Our understanding that the world is a place where social and ecological systems are neither parallel, nor strictly determinate of the other grows daily (Gunderson and Holling 2002; Walker et al. 2006). Rather, entities such as forests, cities, protected areas, and multi-national corporations are, each of them, emergent beings composed of interactions and actors, with feet and hands in both the social and ecological arenas (Norberg and Cumming 2008). Throughout the preceding chapters, this work has sought to empirically ground Social-ecological Systems (SES) Theory. This has been primarily achieved via an exploration of the social arena of linked SESs. This final investigation continues our shift towards the non-human world, highlighting how an SES approach deepens traditional arenas of ecological study, and can support conservation management and decision-making. In focusing on the first of Cumming's five ecological themes of complexity – understanding the behaviour and functional components of individual system components (2011) – this chapter seeks to operationalize a series of ecological components within linked SESs. This is accomplished through a study of the avian species composition for a sub-set of private protected areas (PPAs) within the Western Cape Province of South Africa. Indeed, the first objective of this research was to simply provide a baseline survey for avian composition within the selected PPAs of the Western Cape. The results of avian composition surveys are combined with a sampling of 'Wow Factors' (WF; see chapter 3) to quantitatively contrast the cultural service benefits of birding experiences within and between a sub-set of PPAs. The second objective of this chapter is to characterize three different WF measurements for the PPAs. Finally, the third objective is to develop a proof of concept for the WF values as applied to avian composition surveys. By combining ecological data with a created measurement of social values, this research embodies the SES approach to conservation.

2. STUDY FOCUS

(a) *Private protected areas*

As linked SESs, protected areas set aside for the conservation of ecosystems and ecological phenomena are seen to be crucial to the conservation of Earth's biological heritage and natural resources (IUCN 2003). The sheer enormity of the southern African landscape designated as protected areas (roughly 17%; nearly two million square kilometres) demonstrates the pervasiveness of the protected area approach to conservation concerns across the region (Heydinger 2011). Though clearly spatial entities of ecological interaction, protected areas are also social and cultural phenomena (e.g. Beinart and Coates 1995; Carruthers 1995; Bunn 2003; McGregor 2003) where people and ecosystems exist in dynamic interaction. As we look towards a future of not only different, but more variable environments, there is a greater uncertainty as to how ecosystems will respond to change (Elmqvist et al. 2003). Ecosystem resilience is defined as "the capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes" (Resilience Alliance 2014). The extent to which protected areas, and by extension many of the ecological phenomena they contain, are resilient rests not only upon ecological factors, but on social ones as well (Castree and MacMillan 2001).

It has become widely acknowledged that economic development and the conservation of the natural world cannot be strange bedfellows (e.g. Hulme and Murphree 2001; Folke 2006) – this is particularly on-display in the developing world (Grove 1995; Neumann 1998; Ramutsindela 2004). While the "fence and fine" approach to national park building has long been the dominant paradigm in African conservation (Brockington 2002), there is an unabated concern that "official nature conservation institutions don't have the necessary budgets to maintain all the natural landscapes" (Provincial Government official, Gauteng Nature Conservation; Cousins, Sadler, and Evans 2008). Conservation scholarship increasingly acknowledges the need for large networks of protected areas, including buffers, corridors, and links to adjacent lands (Figgis 2004); the model whereby conserved lands are walled-off from the rest of society, literally and figuratively, is an idea now roundly panned in both conservation and development circles (e.g. Brockington 2002; Dzingirai 2003; Ramutsindela 2007). In the interest of trying to wed socioeconomic concerns with those of ecological integrity differing approaches to conservation are in ascendance (e.g. Maser 1992; Daily 1997; Hulme and Murphree 2001). As protected areas are increasingly embedded in a "matrix of human-dominated ecosystems" (Sinclair and Walker 2003, xv) PPAs represent alternative approaches to the conservation of natural spaces. These intertwined social and ecological spaces answer the call for a need to diversify society's capacity to respond to ecosystem change while not diminishing ecosystem services (Hahn et al. 2008). In South Africa the amount of private land protected under the guise of environmental conservation is more than double the amount of land set aside in formally protected areas (Kreuter, Peel, and Warner 2010). Globally nearly half of all threatened species reside on private lands (Knight 1999). PPAs are seen as a growing and necessary compliment to nationally-protected areas (Langholz and Lassoie 2001; B. Mitchell 2005). In 2003 the International Union for the Conservation of Nature (IUCN) World Parks Congress defined a private protected area as: "a land parcel of any size that is 1) predominantly managed for biodiversity conservation; 2) protected with or without formal government recognition; 3) is owned or otherwise secured by individuals, communities, corporations, or

NGOs." This broad definition provides for a multitude of approaches to nature conservation. Yet the ecological and social sustainability of PPAs is little understood. While PPAs have been shown to provide conservation benefits in certain instances (Jones, Stolton, and Dudley 2005), greater research is needed to assess their conservation impacts (Gallo et al. 2009) and potential resilience.

(b) ***Avian Tourism***

Acquainting the social and the ecological within the arena of PPAs necessitates a look at nature-based tourism, hereafter referred to as ecotourism. The existence and continued success of commercial PPAs in South Africa is driven by ecotourism (Cousins, Sadler, and Evans 2008). In this burgeoning economic arena both the social and the ecological are of crucial importance (Reyers et al. 2013; De Vos et al., in press). Ecotourists invest millions of dollars pursuing interactions with the nonhuman world, in the hopes of seeing wild animals and pristine landscapes, perhaps unencumbered by society's obscuring lens. On display in these pursuits is the category of ecosystem services known as *cultural services* (MA 2005). These "non-material benefits people obtain from contact with ecosystems [including the] aesthetic, psychological and spiritual" (IPBES 2012) are on-display in the interactions between people and birds (see Chapters 2 & 3).

South Africa serves as platform to explore the ecotourist arena which has been shown to be crucial to the country's economy, yet little understood concerning the drivers of ecotourist behaviour (DTI 2010; Biggs et al. 2011). As such, ecotourist destinations are rife with the possibility to empirically ground SES theory and study how cultural service benefits are derived. Research exploring the importance of ecotourism has examined differing contexts and management approaches (Carruthers 1989; Wells, Brandon, and Lee 1992; Thompson 2002; DTI 2010). However, information concerning the contributions from differing segments of the ecotourism population remains of a coarse-scale (Sims-Castley et al. 2005). A perusal of advertisements, websites, and guidebooks enticing tourists to South African protected areas suggests that the so-called 'Big Five' (African lion (*Panthera Leo*), Cape or African buffalo (*Syncerus caffer*), African bush elephant (*Loxodonta africana*), Leopard (*Panthera pardus*), and White rhinoceros (*Ceratotherium simum*)), are the primary drivers of visitation. Though such charismatic megafauna are conservation showpieces across much of sub-Saharan Africa, not all protected areas are ecologically or organizationally suited to contain such beasts (Castley, Boschoff, and Kerley 2001). As such, a study examining their impacts on ecotourism is of limited value to the vast majority of PPAs.

As the premier specialised sub-set of ecotourists, birders are generally a well-to-do, highly educated, and influential group of conservation supporters (Sekercioglu 2002). Though birders comprise a substantial segment of the ecotourist population, and though it has been shown that bird resources can be used to build constituencies for conservation (Brooks and Thompson 2001), the impacts of avian ecotourism are largely unexamined (Biggs et al. 2011). A more thorough understanding, both of birders' interests and how these might influence their patronage of various protected areas, can deepen our appreciation of PPA resilience. Integrating the cultural service benefits birders receive from interactions with different bird species, along with the avian species composition contained within PPAs, brings together the social and the ecological factors within these little understood arenas of conservation. In so doing this project adheres to calls for a "systematic scientific approach towards understanding natural resources" (Baron et al. 2009: 1034). Through the inclusion of the social component a more comprehensive understanding of natural resources within SESs may emerge. Creating linkages between cultural services and avian diversity may support the resilience of PPAs.

(c) '*Wow Factors'*

The linkage between a reserve's avian species composition and the interest of birders in visiting a PPA is here assessed through the application of 'wow factors' (WF). As a measure of the cultural service benefits birders receive from viewing different bird species in the wild (see Chapter 3), WFs are a tool aimed at deepening our understanding of human-avian linkages through the experience of cultural services. In differentiating cultural service benefits by species, WFs answer calls to deepen our understanding of the ecosystem services provided by birds (Sekercioglu 2006; Wenny et al. 2011). It is hoped that the application of this tool can augment information provide by traditional avian point counts. In linking avian species composition with the interest of birders, WF scores add a new, social, dimension to ecological information. The varying levels of birder-demonstrated interest in viewing different avian species can help reserve owners and managers better assess the possible contributions of resident birdlife to a PPA's social-ecological resilience. This awakens the possibility of bringing different avian species into the social arena. If this can be accomplished not only does it stand to transform such social arenas, but those impacts will feedback across linked SESs; increasing the associations of the social and the ecological may have widespread impacts (Latour 1988).

In combination with bird count data, WF scores provide a measure for the extent to which cultural service benefits may be experienced during a hypothetical PPA visit. Seen as formative of human regard for the natural world and of conservation action (MA 2005), the formation of cultural services similarly links across the social-ecological. Tracing the cultural service production functions of PPAs, through examinations of birdlife, not only speaks to the benefits tourists receive, but can further support the importance of PPAs as both social and ecological entities. As such WFs are the perfect bridge for linking PPA ecology with the social benefits received through avian tourism.

3. METHODS

(a) *Study sites*

Surveys of avian community composition data were undertaken using stratified, random point counts at eight private protected areas (PPAs) within the Western Cape Province, South Africa, from October 2012 – December 2013 (Appendix 1). [5] Biome types typical of the Western Cape are reflected in the differing protected areas. Fynbos (Gondwana Game Reserve), coastal fynbos (Buffelsfontein Private Game Reserve), renosterveld (south Sanbona Wildlife Reserve), karoo (Badshoek Hunting Experience and Lemoenfontein/Koka Tsara Game Reserve), succulent karoo (African Game Lodge and north Sanbona Wildlife Reserve), converted farmland (Plettenberg Bay Game Reserve) and planation forest (Gondwana Game Reserve and Plettenberg Bay Game Reserve) all predominate as vegetation types at different protected areas sampled. All PPAs contained man-made dams, ranging in size from ubiquitous, small boreholes, to "Bellair Dam" at north Sanbona, measuring

[5] Sanbona Wildlife Reserve, though gazetted as one protected area is divided into two management areas, a north and a south. Each management area has different management practices (e.g. the southern management zone contains no predators) and different biomes (the northern management area is succulent karoo, while the southern is primarily renosterveld). The two management areas are thus treated separately in the bird counts and analysis.

approximately 2.3 x 1 km. All PPAs were composed entirely of terrestrial (as opposed to coastal) biomes, though it is worth noting that Buffelsfontein (8km) closely neighbours the Atlantic Ocean, while Gondwana (19km), and Plettenberg Bay (10km), neighbour the Indian Ocean. Buffelsfontein and Lemoenfontein/Koka Tsara respectively border the West Coast and Karoo National Parks, while African Game Lodge and Sanbona border each other.

PPAs were selected based upon three criteria: 1) the presence of charismatic megafauna, particularly the so-called 'Big Five'; 2) the perceived public profile of the protected area – aiming towards the most high-profile PPAs; and 3) proximity to the city of Cape Town. These criteria were developed in the hopes of capturing a large proportion of the Cape Town ecotourist population. Choosing among larger operations allowed for a less specialised segment of the ecotourist population then would a selection of areas focused upon avian tourism. Furthermore, while these areas may represent greater visitation rates from ecotourists, it does not follow that greater amounts of data pertaining to the birdlife within these PPAs have been collected. It should be noted that initially numerous other PPAs fitting the selection criteria were contacted – though it proved not possible to engage in birding counts on those properties.

While the protected areas surveyed were all privately owned, they differed widely in management approaches. Only two of the eight PPAs contained all of the 'Big Five' (Gondwana and north Sanbona). While all sampled PPAs stock and trade game, the extent to which different PPAs engage in each is varied and is being pursued in parallel research. Two of the eight PPAs (Badshoek and Lemoenfontein/Koka Tsara) allow for hunting on the property, including the hunting of Common Ostrich (*Struthio camelus*) and Helmeted Guineafowl (*Numida meleagris*), though no hunting took place during sampling visits. The ecological management at each is variously handled by full-time ecologists (three PPAs), on-site staff (two), or managers/owners (three); all with varying qualifications and levels of training. Staff size ranges from fewer than ten to greater than one hundred. Though all eight are privately owned, two lease plots of land within their borders for family households. The impacts of these management differences are being pursued in parallel research.

(b) ***Point counts***

At each PPA 40-50 sites along the accessible road network were surveyed. Each site was sampled on four occasions, with a minimum of 21 days separating visits. For each PPA two count sessions were conducted during both the austral summer, and the austral winter. As a primarily winter rainfall region (May-August) (Froneman et al. 2001), the Western Cape displays weather sometimes inclement to birding prospects. During each visit environmental conditions were recorded. Temperature and wind speed measurements were taken using a *Weatherhawk Skymate*; wind speed is for an average speed over ten seconds. Rainfall intensity (delineated in categories of intensity from 0 – 2) and cloud cover percentage were estimated. At each site the dominant vegetation type, mean vegetation cover height (estimate) and level of visibility was recorded. While levels of visibility were infrequently affected by weather, there was some seasonal change in foliage on flora, though this was thought to be relatively unimportant. No significant environmental alterations (human-caused or otherwise), save seasonal change, were noted at any site.

The locations of individual point count sites were selected using a stratified, random sampling approach. Dominant vegetation classifications for each PPA were obtained from area staff (where available), or via the South African National Biodiversity Institute (SANBI). The dominant vegetation type within a ten-meter buffer of the area's accessible road network was broken down into percentages, with a minimum threshold of 0.5% for inclusion. The proportion of sites occurring within a given vegetation type reflects the overall vegetation breakdown within the road buffer for the protected area. Random points were created in the mapping software program ArcGIS 9.0.2 (ESRI 2013) and exported to a Garmin 76CSx handheld GPS. Because sites were assigned by a vegetation buffer percentage, points frequently fell up to ten meters off the road itself. In this case a specific point was approached as closely as possible at the first visit, and the point was reset to the road, with subsequent visits returning to the reset point location. In certain cases the road network no longer agreed with the information provided by mapping software, when this occurred points were approached as near (straight-line distance) along the road network as possible and the site was reset to this achieved location.

All sites were accessed using a 4x4 vehicle and all samples were taken from within an open-air vehicle. At least two birders, and never more than four, were present for every sample. Field point count methods were adapted from Sutherland, Newton, & Green (2004) and through personal communication with Professor Graeme Cumming. Counts spanned daylight hours so as to collect varying environmental conditions across the day. Given that the hours surrounding sunrise and sunset tend to have higher amounts of bird activity, hours of site visitation were classified into four different categories (0600-0900, 0900-1200, 1200-1500, 1500-1800); wherever possible each site was visited once within each category. Surveys commenced no earlier than fifteen minutes before local sunrise, and terminated no later than fifteen minutes before sunset. At each site observers remained in the vehicle for an initial five-minute habituation time. Immediately following this a fifteen-minute count of all birds seen within 150 meters of the point, and all birds heard, took place. Sampled birds – those considered "in the count" – were those which occurred only within 180-degree view from the front of the vehicle, this served to minimize double-counting. Species were not categorised by distance from the point; simply falling within the 150 meters qualified the bird for inclusion. All seen individuals were categorised by three different behaviours: "foraging," "not foraging," and "flying over." Where species identification was uncertain Sinclair and Ryan's *Birds of Southern Africa: Complete Photographic Field Guide* was consulted (Sinclair and Ryan 2009). Naming conventions were taken from *Robert's Birds of Southern Africa* (Hockey, Dean, and Ryan 2005). Given that birds tend to move during a fifteen-minute count double-counting is possible. When there was uncertainty as to whether or not an individual had been recorded it was assumed that it had not been. All bird species seen at counts were identified with binoculars and recorded. Throughout the habituation and count time potential sources of disturbance (e.g. presence of other animals, people, or vehicles) were recorded. No incidental sightings occurring between samples were recorded. The same two birders were present for every count, minimizing differences in observer bias. Though the time strictures of the project did not allow for a full census, the methods provide an easily repeatable baseline from which sampling may continue over time.

(c) ***The Application of 'Wow Factors'***

As reviewed in the previous chapter, WF scores measure the relative level of enjoyment expert birders receive from encountering various bird species in the wild. Responses were collected via paper surveys distributed at the BirdLife South Africa, 2013 Annual General Meeting (1-4 March), and via an electronic version distributed to ornithologists and ornithology-focused graduate students at the Percy FitzPatrick Institute of African Ornithology. Survey respondents were presented with the name of randomly-selected South African bird species. Species names were taken from *Robert's Birds of Southern Africa, 7th edition* (Hockey, Dean, and Ryan

2005), with each paper sheet containing 15 unique species names, and each online survey page containing up to 200 unique species names. The bird species names appearing on each sheet contained both terrestrial and pelagic species – though only terrestrial species appear in the analysis. For each species respondents were asked to assign a numerical value, from 1 (lowest) to 10 (highest), demonstrating a relative level of enjoyment. Of the 134 bird species returning WF rankings, 28 species were present within a minimum of one sample across the eight PPAs. The presence of these species enable the application of WF scores measuring different expected levels of enjoyment derived from the avian species composition of each protected area. It should be noted that, while the bird count surveys recorded species both seen and heard, WF scores were only assigned to those species which were specifically seen. Given the difficulty of differentiating between bird calls, as well as the notion that only viewing a species 'counts' (Oddie 1980; Koeppel 2005), WFs were specifically targeted towards those species seen.

WF scores were applied in three ways: Wow Presence, Wow Abundance, and Wow Service Provision: the first two measures provide an indication of aggregate WF scores for different PPAs, while the third focuses upon each species across the different PPAs. Wow Presence is a measurement which sums all the WFs for those species seen within a PPA – regardless of how often sightings occurred. For example, thirteen Acacia Pied Barbet (*Trichomela leucomelas*, WF = 4.889), one Cardinal Woodpecker (*Dendropicos fuscescens*, WF = 3.722), and four Egyptian Geese (*Alophen aegyptiacus*, WF = 1.895), would yield a Wow Presence score of 10.506

species a *WF + species* b *WF + species* c *WF = Wow Presence*

e.g.: *4.889 + 4.722 + 1.895 = 10.506*

To compare Wow Presence across PPAs and seasons, Wow Presence scores were standardized. This was achieved by dividing aggregate species WF scores by the number of sites sampled within an area, with a constant multiplier then applied. Standardization was calculated for each season (austral summer and winter) and in total; each dividing the Wow Presence by the number of sites sampled. For those three species above, at the PPA Badshoek Hunting Experience, for the total number of counts (across both seasons), such calculation reads:

(sum Wow Presence/# of points sampled) × constant = standardized Wow Presence

e.g.: *(10.506/160) × 100 = 6.563*

This measure communicates wow scores based upon a species' presence within a PPA, and is comparable across PPAs and seasons. Wow Abundance measures the WF for all species seen and multiplies it by the number of individuals seen. Thirteen Acacia Pied Barbet, one Cardinal Woodpecker, and four Egyptian Geese, would yield a Wow Abundance score of 74.859, such a calculation reads:

(species a *WF × # of individuals) + (species* b *WF × # of individuals) + (species* c *WF × # of individuals)*

= Wow Abundance

e.g.: $([4.889 \times 13] + 3.722 + [1.895 \times 4]) = 74.859$

Similarly this measure was standardized across PPAs and seasons. For those three species, at the PPA Badshoek Hunting Experience, for the total number of samples, such a calculation reads:

(Wow Abundance/# of points sampled) × constant = standardized Wow Abundance

e.g.: $(74.859/160) \times 10 = 4.679$

This measure allows for comparison of WF experiences between PPAs based upon the sampled abundance of species and accounting for birders stated interest in viewing each species. Wow Service Provision takes each WF-applicable species and looks at total WF based upon the number of individuals seen across all PPAs. Abundance numbers are standardized and then multiplied by species WF. For example, the species South African Shelduck (*Tadorna cana*) was seen 47 times across all points sampled, and has a WF score of 4.5. The Wow Service Provision equation is thus:

([# of individuals sampled across all points/total number of points sampled] × constant) × WF score

= Wow Service Provision

e.g.: $([47/1405] \times 100) \times 4.5 = 25.054$

For visualization purposes WF Service Provision scores were also log-transformed.

These three measures, Wow Presence, Wow Abundance, and Wow Service Provision, each standardized across counts, seasons, and areas, provide a host of different insights into where cultural services experienced via WFs will be realized. Together these measures provide a more nuanced assessment of area and species' WFs than any of the three measures would individually.

Bird count data were entered into a *Microsoft Access* (2007) database and double-checked for data-entry typographical errors and inconsistencies. Statistical analysis were performed in *R* statistical software (2013) and *Microsoft Excel* (2010). Statistical analysis for each of the eight PPAs, and for all PPAs together, were performed. For each PPA the statistics for the frequency of species presence (calling and visual) across all sites, the number of unique species across all sites within the PPA (calling and visual), and the number of total individuals seen, per species, were compiled. The application of WFs takes these rigorous sampling methods and views the results through a more social-ecological lens.

4. RESULTS

A total of 1,405 separate point counts yielded 227 unique species seen, with another 25 that were heard but not seen. Table 1 provides a summary for the number of species and individuals seen at each PPA, both in total and separated by season. The most abundant species across all PPAs was the Barn Swallow (*Hirundo rustica*) with 708 individuals seen, 703 of which occurred during summer counts – unsurprising for a migrant. 274 individual Southern Double-collared Sunbirds (*Cinnyris chalybeus*) were recorded, making the species the most abundant during winter counts. Counts at the PPA African Game Lodge yielded the greatest number of species seen (n = 112) and the greatest number of individuals seen (n = 2288). Though the recorded number of species seen, both in total and per site (with the exception of the Gondwana Game Reserve (dominant vegetation: fynbos) was uniformly higher during summer counts, there was no statistical difference between the two seasons. Tests for variance (One-way ANOVA) highlight that the number of individuals sampled, both in total (Table 1) and per site (Table 2), significantly differs between summer and winter seasons. This suggests that while most species are residents, they are less likely to be active in the austral winter (conversely less active during the austral summer for sites in the Karoo, potentially due to the extreme heat of Karoo summer temperatures). Counts focusing primarily upon species seen may therefore prove inadequate to sampling during months of low local species' activity. Further statistical breakdown by reserve can be seen in Appendix 2.

Correcting for differences in the total number of samples at each PPA, Badshoek Hunting Experience returned the greatest species richness per sample, across both seasons (total) (n = 1.05), as well as for both the summer (n = 0.938) and winter seasons (n = 0.669) (Table 2). Correcting for difference in the total number of counts, the Plettenberg Bay Game Reserve returned the greatest number of individuals per sample, both in total (n = 11.548) and for the summer season (n = 18.33); Buffelsfontein Private Game Reserve returned the highest number of individuals per sample for winter counts (n = 10.45). The Plettenberg Bay Game Reserve also returned the greatest range of difference between number of species per sample by season (n = 13.564). In contrast, the range of difference between number of species per sample, differentiated by season, was least at Badshoek (n = 1.138), followed by its neighbour, Lemoenfontein/Koka Tsara (n = 2.107). This suggests that avian abundance is most highly seasonal at Plettenberg Bay (coastally located on converted farmland) while being least seasonal in the arid Karoo.

	AGL	BHE	BFT	GDW	LKT	PBB	(n) SWR	(s) SWR
Species Seen								
Summer	92	84	59	65	68	85	82	84
Winter	80	75	59	75	66	78	74	67
Total	112	107	78	87	86	108	99	99
Individuals Seen								
Summer	1651	692	1001	1162	475	1723	1445	917
Winter	637	783	836	839	652	448	466	364
Total	2288	1475	1837	2001	1127	2171	1911	1327
Number of sites	50	40	40	50	42	47	43	41

Table 1. Summary of number of species and number of individual birds seen by PPA and total. (Sample size: 353 total sites, each sampled twice in winter and summer[6]. Column headings: AGL, African Game Lodge; BHE, Badshoek Hunting Experience; BFT, Buffelsfontein Private Game Reserve; GDW, Gondwana Game Reserve; LKT, Lemoenfontein/KoKa Tsara Game Reserve; PBB, Plettenberg Bay Game Reserve; (n) SWR, (north) Sanbona Wildlife Reserve; (s) SWR, (south) Sanbona Wildlife Reserve.) Differences between species seen and number of individuals for summer and winter counts were tested. Differences for species seen between seasons were not statistically significant, (One-way ANOVA, F (1, 14) = 1.35116, p = 0.26451). Differences for number of individuals seen between summer and winter counts were statistically significant (One-way ANOVA, F (1, 14) = 8.67577, $p < 0.05$).

[6] Five individual site visits for summer counts at the (north) Sanbona Wildlife Reserve were not completed due to logistical issues. This has been accounted for in standardizing count values and WFs.

	AGL	BHE	BFT	GDW	LKT	PBB	(n) SWR	(s) SWR
Species seen (per site)								
Summer	0.92	1.05	0.738	0.65	0.81	0.904	0.953	1.024
Winter	0.8	0.938	0.738	0.75	0.786	0.83	0.914	0.817
Total	0.56	0.669	0.488	0.435	0.512	0.574	0.593	0.604
Individual Abundance (per site)								
Summer	16.51	8.65	12.513	11.62	5.655	18.33	16.802	11.183
Winter	6.37	9.788	10.45	8.39	7.762	4.766	5.753	4.439
Total	11.44	9.219	11.481	10.005	6.708	11.548	11.443	8.091

Table 2. Standardized summary of number of species seen and total avian abundance per site, by PPA. (Sample size: a total of 353 site visits, each visited twice in winter and summer. Column headings: AGL, African Game Lodge; BHE, Badshoek Hunting Experience; BFT, Buffelsfontein Private Game Reserve; GDW, Gondwana Game Reserve; LKT, Lemoenfontein/KoKa Tsara Game Reserve; PBB, Plettenberg Bay Game Reserve; (n) SWR, (north) Sanbona Wildlife Reserve[7]; (s) SWR, (south) Sanbona Wildlife Reserve.) Differences between species seen, and individual abundance for summer and winter counts were tested. Differences between seasons for species per site were not statistically significant (One-way ANOVA, F (1, 14) = 1.1662, p = 0.2984). Differences for number of individuals per site between summer and winter counts were statistically significant (One-way ANOVA, F (1, 14) = 9.88261, p < 0.01). This suggests that while many species remain present between seasons the likelihood of their being seen by birders (possibly a function of species' activity levels) significantly fluctuates.

Species abundance breakdowns by each PPA are provided for those 28 species with applicable WF scores (Table 3). None of these focal species was present at all eight PPAs, though at least two Speckled Mousebirds (*Colius striatus*) and at least three Egyptian Geese (*Alophen aegyptiacus*) were present at seven of the eight reserves; numerous species were present at only one of the sampled reserves, e.g. Brown-hooded Kingfisher (*Halcyon albiventris*) or Narina Trogon *(Apaloderma narina*). The Wow Presence measurement (Figure 1) highlights the different levels of seasonal variability in WF species on offer during samples. If birdwatchers are interested in seeing certain species this result suggests that different seasons yield a different likelihood for seeing certain species. Similarly this allows for coarse-scale comparison between PPAs. Given WF scores and the presence of those species seen, typical birdwatchers (those whose interests mirror mean WF scores) could expect to maximize their cultural service benefits during summer visits to (south) Sanbona Wildlife Reserve, and during winter visits to Gondwana Game Reserve; though WF scores account for only 28 species.

Wow Abundance incorporates the number of individuals seen per PPA and provides an aggregate measure of WF cultural service benefit for PPAs relative to one another. This provides a different look at expected WF benefits than Wow Presence on its own. Whereas the Wow Presence value for summer counts at Plettenberg Bay Game Reserve returned the second lowest score (n = 2.8209), the Wow Abundance score for

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[7] Five incomplete counts for (north) Sanbona Wildlife Reserve, summer season. These counts are centered around Bellair Dam," the largest dam (~ 2.3km × 1km) at any of the sample PPAs. Previous summer counts at these sites have yielded high numbers Brown-throated Martin (*Riparia paludicola*) (n = 222) and Red-knobbed Coot (*Fulica Cristata*), though not necessarily unique species.

summer counts at Plettenberg Bay Game Reserve (n = 48.9462) was roughly 66% higher than the next highest summer Wow Abundance score (African Game Lodge, n = 32.1148). Accounting for the abundance of those species seen with applicable WFs, it is most likely that a typical birder will receive the highest WF cultural service benefit from birding at the Plettenberg Bay Game Reserve during the summer. Again, these WF scores account for only those 28 species with applicable WF scores.

SPECIES	WF	AGL	BHE	BFT	GDW	LKT	PBB	(n) SWR	(s) SWR
Acacia Pied Barbet (*Trichomela leucomelas*)	**4.889**		13			6		3	1
African Hoopoe (*Upupa epops*)	**3.474**		1	2	4		2		
Brown-hooded Kingfisher (*Halcyon albiventris*)	**3.118**		1						
Cape Shoveler (*Anas smithii*)	**4**	4					2	6	
Cape Spurfowl (*Francolinus capensis*)	**4.176**	2	8	12			1	4	3
Cape Teal (*Anas capensis*)	**4.176**	2							
Cardinal Woodpecker (*Dendropicos fuscescens*)	**3.722**		1						2
Common Ostrich (*Struthio camelus*)	**2.611**	4		8	1	10	27		
Diderick Cuckoo (*Chrysococcyx caprius*)	**3.895**		1			1	1		
Egyptian Goose (*Alophen aegyptiacus*)	**1.895**	4	4	16	3		66	9	10
European Bee-eater (*Merops apiaster*)	**3.778**		1			1			
Giant Kingfisher (*Megaceryle maxima*)	**4.334**								1
Grey-winged Francolin (*Francolinus africanus*)	**5.333**				2				
Ground Woodpecker (*Geocolaptes olivaceus*)	**6.15**	2							4
Helmeted Guineafowl (*Numida meleagris*)	**3**		12	64			3		
Hottentot Buttonquail (*Turnix hottentottus*)	**7.606**				1				1
Lesser Honeyguide (*Indicator minor*)	**6.647**						1		
Malachite Kingfisher (*Alcedo cristata*)	**4.222**						1		1
Narina Trogon (*Apaloderma narina*)	**6.78**				1				
Red-faced Mousebird (*Urocolius indicus*)	**2.944**	15	45		1	14		15	14
Red-necked Spurfowl (*Francolinus afer*)	**5.125**				1				
South African Shelduck (*Tadorna cana*)	**4.5**	14	3			9		10	11
Speckled Mousebird (*Colius striatus*)	**2.765**	2	7	2	2	8	18	26	
Spur-winged Goose (*Plectropterus gambensis*)	**2.667**	40	1	7	1		12		
Swainsons Spurfowl (*Francolinus swainsonii*)	**3.53**				2				
White-backed Mousebird (*Colius colius*)	**4.118**	15	33	14		29			10
White-faced Whistling Duck (*Dendrocygna viduata*)	**3.222**						2		
Yellow-billed Duck (*Anas undulata*)	**2.706**	48					7	4	3

Table 3. Number of birds sampled, by PPA, for species with applicable 'wow factor' scores. (Sample size: 1405 total site visits. Column headings: WF, mean "wow factor" scores for each species; AGL, African Game Lodge; BHE, Badshoek Hunting Experience; BFT, Buffelsfontein Private Game Reserve; GDW, Gondwana Game Reserve; LKT, Lemoenfontein/KoKa Tsara Game Reserve; PBB, Plettenberg Bay Game Reserve; (n) SWR, north Sanbona Wildlife Reserve; (s) SWR, (south) Sanbona Wildlife Reserve.)

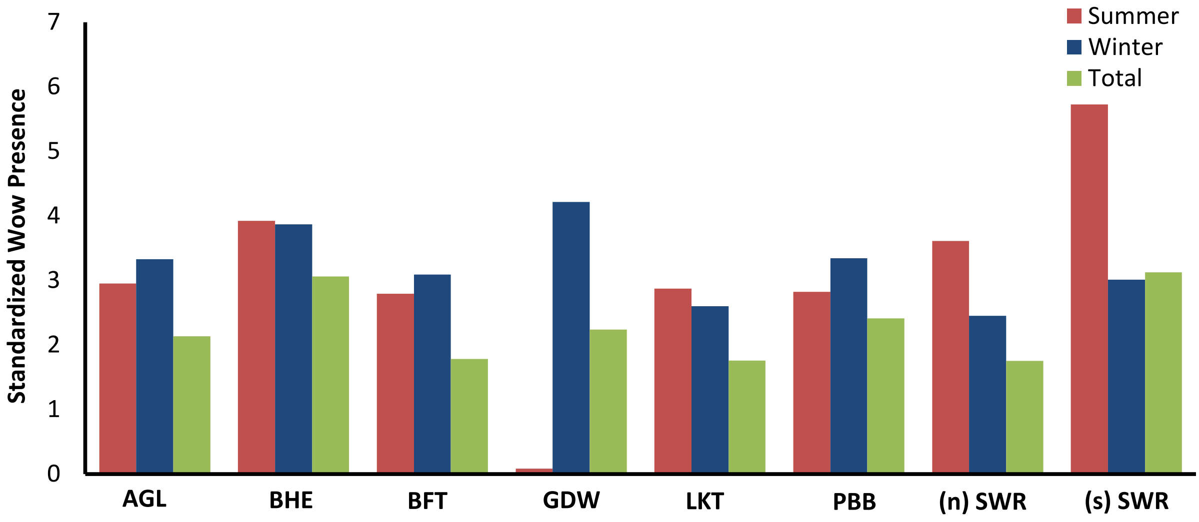

Figure 1. Bar Chart showing standardized Wow Presence for each PPA. WF scores for 28 species were applied based upon species presence within reserves, across seasons and in total. (PPA labels: AGL, African Game Lodge; BHE, Badshoek Hunting Experience; BFT, Buffelsfontein Private Game Reserve; GDW, Gondwana Game Reserve; LKT, Lemoenfontein/KoKa Tsara Game Reserve; PBB, Plettenberg Bay Game Reserve; (n) SWR, (north) Sanbona Wildlife Reserve; (s) SWR, (south) Sanbona Wildlife Reserve.) Total Wow Presence is often less than seasonal Wow Presence given that the divisor (the number of counts sampled) will be twice as high for the total as for each season. Recording species presence contrasts with species abundance (visualized in Figure 2), in that WF scores do not account for WF variation based upon number of individuals seen. Whereas standardized WF abundance scores, and WF service provision for each species (Figure 3) may be weighted towards relatively abundant species, standardized Wow Presence is more representative of those rare species with higher WFs which may be seen very infrequently, e.g. Narina Trogon and Hottentot Buttonquail. Wow Presence scores did not significantly differ between winter and summer counts (One-way ANOVA, F (1, 14) = 0.10584, p = 0.74975).

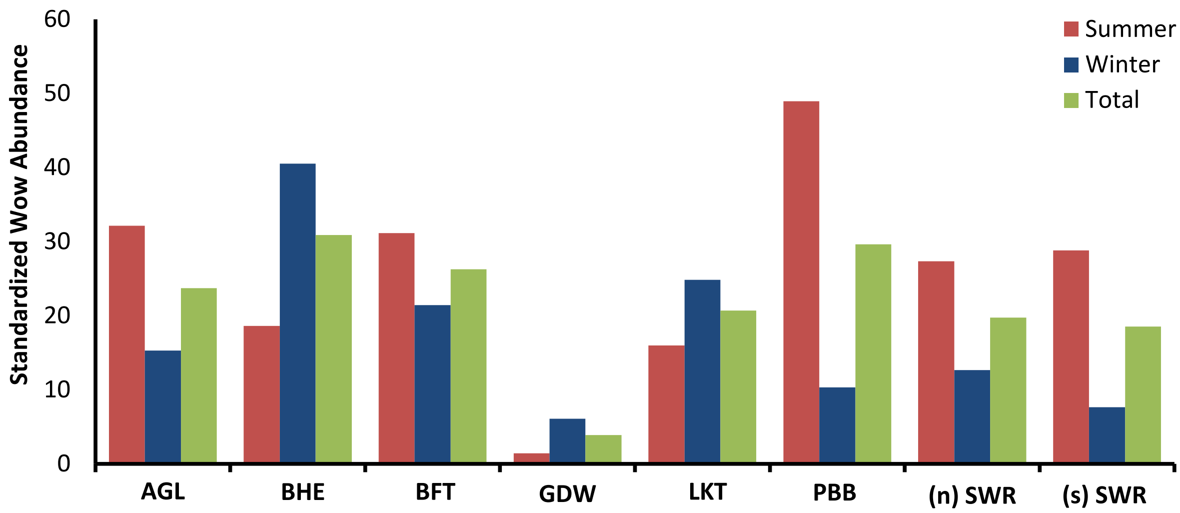

Figure 2. Bar Chart showing standardized Wow Abundance for each PPA. WF scores for 28 species were applied to the number of individuals seen and standardized between reserves (dividing by number of point count sites and applying a constant multiplier). (PPA labels: AGL, African Game Lodge; BHE, Badshoek Hunting Experience; BFT, Buffelsfontein Private Game Reserve; GDW, Gondwana Game Reserve; LKT, Lemoenfontein/KoKa Tsara Game Reserve; PBB, Plettenberg Bay Game Reserve; (n) SWR, (north) Sanbona Wildlife Reserve; (s) SWR, (south) Sanbona Wildlife Reserve.) It is worth noting that, though none of the species with applied WFs are considered classically migratory, standardized WF provisioning across reserves is generally higher during the austral summer. The exceptions to this (Badshoek and Lemoenfontein/Koka Tsara) are neighbouring reserves in the Karoo, where oppressive summer heats may minimize bird movements. Difference between summer and winter Wow Abundance was not statistically significant (One-way ANOVA, F (1, 14) = 1.6621, p = 0.2181). The influence of common species on Wow Abundance scores contrasts with Wow Presence (Figure 1), which may be more heavily influenced by rare, high WF species.

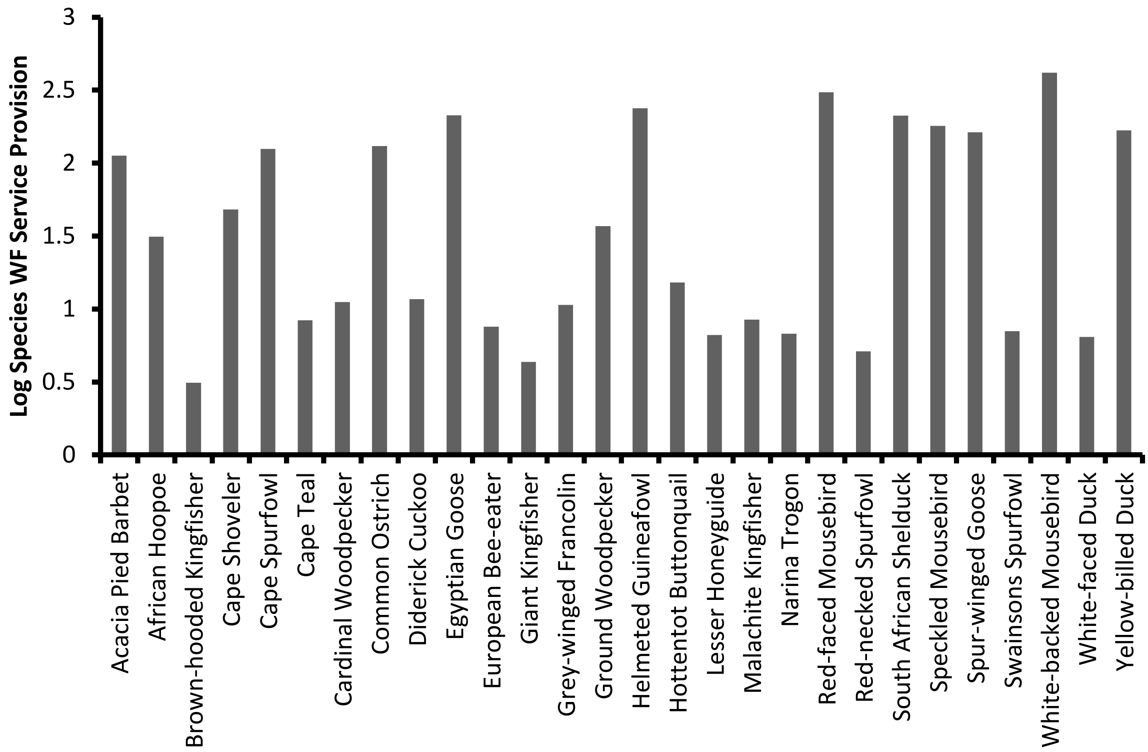

Figure 3. Bar chart showing the log value for WF provisioning of each species across all PPAs. This indicates WF cultural service provided by each species relative to one another, taking into account both abundance and level of birder interest. This suggests that WF scores and relative species abundance will impact the level of cultural service realization provided by differing species within the PPA studied.

The WF Service Provisioning for each species further highlights the dynamics of species rarity and WF scores (see Chapter 3). While the species White-backed Mousebird returned a middling WF score of 4.118, given the species' relative abundance (101 individuals seen) it yields the WF Service Provision score (Figure 3), seen above with log transformation (n = 2.619). This combination of demonstrated birder interest and species abundance suggests that, in effect, a typical birdwatcher visiting this suite of PPAs is most likely to gain the greatest aggregate cultural service WF benefit from the species White-backed Mousebird. Obviously even such a qualified and tentative conclusion is in need of examination. What the log WF Service Provision measure does provide is a relative accounting for birders' levels of interest in different species viewed in light of that species' abundance. Once again we can see the coupling of the social and the ecological within the designs and results of these differing surveys.

5. DISCUSSION

The avian point count surveys provide a robust and easily repeatable baseline from which the birdlife of these PPAs can be monitored. Bird conservation remains low on the agenda of African states, necessitating careful attention to the continent's birdlife (Brooks and Thompson 2001). As conservationists and economists wrestle over the 'worth' of birds, whether socially, economically, or ecologically defined, areas where the protection of bird species can flourish should be cultivated (Ryan and Turpie 1999; Sekercioglu 2002; Craig et al. 2011). If the avian species composition of PPAs can assist in making these areas more resilient, then area managers, owners and birds will find themselves in a win-win situation. The first step towards assessing the impacts of birds on PPA resilience will be the continued monitoring of birdlife within such reserves (Joubert and Ryan 1999; Biggs et al. 2011) . As the temporal component becomes accounted for the interactive dynamics characterizing social and ecological functioning may become more apparent.

The application of the WF tool has sought to operationalize birds not only as an ecological component of these ecosystems, but as social-ecological players who are both nested within (pun intended) and formative of evolving social-ecological spheres (Berkes, Colding, and Folke 2003; Sekercioglu 2006, 2010). As research into PPAs deepens, we may better understand how residence within PPAs impacts bird species – this must be met with an understanding of how avian composition similarly impacts PPAs. Measurements of Wow Presence, Wow Abundance and Wow Service Provision provide initial insights into how the cultural services of birds can be realized in on-the-ground conservation scenarios. This both answers the various calls for a more complete incorporation of cultural service research into conservation scholarship (Chan, Satterfield, and Goldstein 2012; Daniel et al. 2012), and begins the business of incorporating more of the social into the ecosystem service concept (Reyers et al. 2013). The Wow Presence measurement, in providing a guideline for the amount of potential cultural service, can help ecotourists assess the quality of their differing birding choices. The extension of WF scores to a greater number of bird species can both broaden the scope and deepen the power of the WF concept. If an increase in the number of species with WF scores can be achieved, alongside the continued monitoring of avian species composition, the role that different avian species play in supporting conservation stands to be expanded. This would both aid in a much needed diversification away from the narrow showpiece mind-set of much of conservation across southern Africa (Kerley, Geach, and Vial 2003), and explicitly integrate the social and ecological on a broader scale.

While the Wow Presence measurement provides one sort of maximal value for an area’s culture service provision from birds, it does not account for the effort involved to see different species. This aspect is tricky to assess, as those birders most interested in maximizing species lists (and perhaps, someday, wow scores) may invest more effort into viewing particular species. Inasmuch as WF scores seem to increase with species rarity (see Chapter 3), avian point count methods may be more profitably geared towards recording rare or cryptic species. However, the methods included herein are well suited to assess species abundance, which Wow Abundance scores more directly account for. However the manner in which WF and abundance are related together is likely in need of further methodological review. Aggregate wow scores seem to inadequately reflect the level of benefit a birdwatcher derives from viewing different species. For example, viewing three Helmeted Guineafowl (WF = 3) is unlikely to be considered of greater cultural service benefit to South African birders than would be derived from seeing one Madagascan Cuckoo (*Cuculus rochii*; WF = 8.75). It is worth noting that none of the species sampled returned WF scores greater than the Hottentot Buttonquail’s (WF = 7.606), of which only two were positively identified. We as birders would be remiss if we did not extend these lessons to further studies: surely I received greater personal satisfaction, or benefit, as a birder, from these two Hottentot Buttonquails than I did from any number of Egyptian Geese or Yellow-billed Ducks. The Wow Service Provision is an initial attempt to account for species abundance and WF in one measure. However, anecdotal information suggests that WF may increase as species prevalence decreases; this will hopefully not prove an insuperable obstacle to the WF concept. How the WF tool is applied and altered must be carefully thought-through.

Integrating WF scores into avian surveys demonstrates the application of a social-ecological approach to conservation research. While the ecosystem services of birds have received some attention (Sekercioglu 2006; Wenny et al. 2011), these approaches have rendered ecosystem service benefits a one-way street, from the ecological towards the social. Such approaches do little to realize the imperatives of a linked social-ecological world. The aspects of feedback, change, and transformation highlighted in literature focusing upon system resilience (Elmqvist et al. 2003; Walker et al. 2006; Hahn et al. 2008) alerts us to the fact that ecosystem services are a dynamic coupling of the social and the ecological. Designed as a measure of cultural services, WF scores internalize both spheres. Their application is both demonstrative of an SES approach, and, if they can become effective conservation tools, can encourage further social-ecological ways of thinking.

The passage across the social-ecological spectrum, from the specifically social arena of ecotourist surveys, towards the interaction of both the social and ecological in the creation of 'Wow Factors,' and finally in the application of the WF tool, is demonstrative of SES thinking and an SES approach to research. These attempts to operationalize social and ecological components are but one step towards accounting for the dynamics of SESs (Cumming 2011). If the WF tool is to support the cultural services concept as an approach to conservation, further research is needed to highlight how WFs realized through human-avian interactions will support the resilience of PPAs and other linked SESs. While these results suggest the validity behind a further investigation into the WF concept, only with further research can a more comprehensive picture relating WFs, species composition and abundance emerge. Given the novelty of the approaches within this work, conclusions from this research must remain somewhat tentative. In applying the SES lens to the little understood ecosystem services category of cultural services, this approach specifically eschews the problematic aspects of ecosystem service valuation (Chapter 1) while grounding one dimension of the ecosystem services concept in a broader theoretic approach. If the ecosystem services concept is to assert its transformative potential as a conservation tool, novel approaches to conservation science must be explored. Existing scientific methods for quantifying, measuring, abstracting, simplifying, and objectivizing the ecological world number beyond count; *how* the results of such methods influence our willingness to engage in sustainable interactions with the world requires greater attention (Medawar 1982). Social-ecological approaches allow us to recognize that the construction of scientific understandings does not preclude our ability to assess the world – rather our relationships to ecological phenomena inform our scientific pursuits (Cumming and Collier 2005; Latour 2010; Heydinger 2012). The explicit integration of the social and the ecological is crucial to meaningfully transforming not only social-ecological relationships, but the scientific approaches used to assess them. The difficulties of integrating such seemingly oppositional spheres result less from ontological states than from epistemological and disciplinary tendencies (Latour 1993). Further research into SESs may deepen the work of linking both social and ecological functional components. Such efforts will have far greater implications when multidisciplinary approaches are more broadly supported within academic and institutional settings (Snow 1965; Nicolescu 2011).

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APPENDIX 1 – Sub-set of Private Protected Areas

(Image credit: Google, 5/3/2014)

- **African Game Lodge**
  (33°42'11.12"S; 20°21'4.90"E)
- **Badshoek Hunting Experience**
  (32°11'52.03"S; 22°46'28.36"E)
- **Buffelsfontein Private Game Reserve**
  (33°17'18.79"S; 18°13'35.66"E)
- **Gondwana Game Reserve**
  (34° 4'25.59"S; 21°54'50.94"E)
- **Lemoenfontein/Ko-ka Tsara Game Reserve**
  (32°14'50.67"S; 22°34'28.78"E)
- **Plettenberg Bay Game Reserve**
  (33°56'29.02"S; 23°20'51.60"E)
- **(north) Sanbona Wildlife Reserve**
  (33°42'46.96"S; 20°36'46.11"E)
- **(south) Sanbona Wildlife Reserve**
  (33°44'35.89"S; 20°36'23.56"E)

APPEDNIX 2 – Summary Protected Bird Count Results

Protected Area Name	# Unique Species	Most Abundant	2nd Most Abundant	3rd Most Abundant	Total Species Accounts
African Game Lodge (Total)	138	Grey-backed Cisticola (128)	Karoo Prinia (121)	Southern Double-collared Sunbird & Black-headed Canary (115)	2543
AGL (Summer)	119	Black-headed Canary (114)	Lark-like Bunting (108)	Grey-backed Cisticola (99)	1195
AGL (Winter)	92	Southern Double-collared Sunbird (48)	Yellow Canary (47)	Cape Bulbul (41)	1348
Badshoek H.E. (Total)	121	Cape Sparrow (144)	Pale-winged Starling (119)	African Red-eyed Bulbul (115)	1876
BHE (Summer)	106	Cape Sparrow (58)	African Red-eyed Bulbul (43)	Pale-winged Starling (39)	1024
BHE (Winter)	86	Cape Sparrow (86)	Pale-winged Starling (79)	African Red-eyed Bulbul (70)	854
Buffelsfontein P.G.R. (Total)	88	Grey-backed Cisticola (157)	Cape Bulbul (144)	Southern Double-collared Sunbird (115)	1376
BFT (Summer)	64	Cape Bulbul (94)	Barn Swallow (70)	Cape Canary (62)	570
BFT (Winter)	70	Grey-backed Cisticola (109)	Southern Double-collared Sunbird (66)	Pied Crow (56)	806
Gondwana G.R. (total)	117	Orange-breasted Sunbird (190)	Southern Double-collared Sunbird (164)	Barn Swallow (144)	2116
GDW (Summer)	87	Barn Swallow (141)	Orange-breasted Sunbird (84)	Greater Striped Swallow (69)	1155
GDW (Winter)	96	Southern Double-collared Sunbird (107)	Orange-breasted Sunbird (104)	Cape Sugarbird (77)	1061
Lemoenfontein/Koka Tsara G.R. (Total)	105	Pale-winged Starling (107)	Common Waxbill (68)	Cape Sparrow (61)	1386
LKT (Summer)	90	Common Waxbill (48)	Pale-winged Starling (41)	Grey-backed Cisticola (27)	680
LKT (Winter)	75	Pale-winged Starling (66)	Cape Sparrow (55)	Lark-like Bunting (37)	706
Plettenberg Bay G.R. (Total)	133	Barn Swallow (200)	Egyptian Goose (157)	Cape Longclaw (147)	2199
PBB (Summer)	111	Barn Swallow (200)	Egyptian Goose (143)	Cape Longclaw (125)	1225
PBB (Winter)	90	Common Fiscal (39)	Amythest Sunbird (31)	Long-billed Pipit (27)	974
(n) Sanbona W.R. (total)	117	Red-knobbed Coot (293)	Brown-throated Martin (257)	Cape Sparrow (181)	1716
(n) SWR (Summer)	102	Red-knobbed Coot (292)	Brown-throated Martin (251)	Cape Sparrow (129)	890
(n) SWR (Winter)	89	Cape Sparrow (55)	Karoo Chat (44)	Yellow Canary (32)	826
(s) Sanbona W.R. (total)	113	Barn Swallow (134)	Yellow Canary (101)	Common Starling (78)	1598
(s) Sanbona W.R. (Summer)	96	Barn Swallow (133)	Yellow Canary (78)	Common Starling (77)	813
(s) Sanbona W.R. (Winter)	91	Grey-backed Cisticola (33)	Karoo Scrub-Robin (29)	Southern Double-collared Sunbird (24)	785

Protected Area Name	# Unique Species	Most Abundant Species	2nd Most Abundant	3rd Most Abundant	Total Species Accounts
All PPAs (total)	252	Barn Swallow (708)	Cape Sparrow (541)	Grey-backed Cisticola (540)	14810
All PPAs (Summer)	194	Barn Swallow (703)	Red-knobbed Coot (381)	Grey-backed Cisticola & Cape Sparrow (292)	7552
All PPAs (Winter)	184	Southern Double-collared Sunbird (274)	Cape Sparrow (249)	Grey-backed Cisticola (248)	7258

Appendix 2. Table detailing total and most common species seen at each PPA, as well as totals across all PPAs. Counts are separated by season, and provided in total. (Column headers: # Unique species, the number of unique species found across all point counts; Most Abundant Species, species with the greatest number of seen individuals (number of individuals in parenthesis); 2nd Most Abundant, species with the second greatest number of seen individuals (number of individuals in parenthesis); 3rd Most Abundant, species with the third greatest number of seen individuals (number of individuals in parenthesis); Total Species Accounts, number of entries for unique species – both seen and heard – across all point counts for each protected area, by season and total.

CLOSING COMMENTS

The application of the social-ecological approach to "doing" science has been at once this project's most valued, and most it's most trying aspect. Employing the SES approach, this research sought to interrogate a limited set of social-ecological relationships. In so doing I have been reminded that social-ecological research itself is a social process (Cumming 2011). Concerns of study feasibility, respondent attitudes to differing surveys, the evolution of techniques, and moments of learning, have all helped to form the final research product, and serve as a foundation moving forward. Unworkable approaches (sadly glossed over here) have been insightful moments of learning, as well as formative of the finished product. While a comprehensive recounting of the social learning process through which this project has passed would be a volume itself, the existence of linked social-ecological concerns within the conservation realm should be clear.

Moving across the social-ecological spectrum, this research has sought to answer a triple difficulty of addressing primarily social, primarily ecological, and coupled social-ecological avenues of researches. Departing from the home-ground of the ecosystem services concept, I have sought to journey along a pathway pioneering new approaches to understanding ecosystem services – one guided by the Social-ecological Systems approach. Recognition that system components, whether deemed social or ecological, are engaged in an interactive process of transformation, feedback, and evolution (e.g. Whitehead 1929; Engels 1972; Gunderson and Holling 2002) has kept the concept of change at the forefront of this work. In attempting to quantify the experience of cultural services, this study has been explicitly situated at a nexus of change: whereby the person experiencing the cultural service is participating in an explicitly non-physical interaction with the world. These studies have been an initial foray, a foundation, which future work may build upon. How change and the temporal dimension are manifest in social-ecological interactions will greatly impact not only the subjects of research, but the methods to achieve coherence (Shapin and Schaffer 1985; Descola 1996; Cronon 2000; Nicolescu 2012). While setting-off along an unexplored pathway has yielded no shortage of methodological and conceptual difficulties it is recognized that this is typical of science at the so-called "second stage" of enquiry (Shneider 2009): the development of novel tools and approaches is seldom straight-forward. In working towards a more comprehensive toolbox for assessing cultural services as linked social-ecological interactions, setbacks are bound to occur. However, as our awareness of the linkages between people and the natural world deepens, we must recognize the possibility that our sciences will also have to change – if they are to continue to speak meaningfully to the questions raised by a transformed planet. Coupled SESs require novel ways of "doing" science and assessing social-ecological linkages. Much as smart and sustainable management and decision-making practices will not foreclose potential future pathways, our methods should support diverse ways of knowing. In multiplying our ability to speak meaningfully of the world, new methods will also foster novel interactions. Seeing differently does not simply mean examining the unexamined. It also means creating the unforeseen; transforming both subject and surveyor in an unending adventure.

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