AN EVEN LESS CONVENIENT TRUTH:

ADDRESSING THE CHALLENGE OF SUSTAINABLE DEVELOPMENT

THROUGH AN INTEGRATION OF COGNITION AND CULTURE

by

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Abstract

‘Sustainable development,’ or how to achieve durably desirable states in our planet’s nested social-ecological systems, has been heralded by many as the core civilizational challenge of the 21st century. Adding to this challenge is the fact that the scientific study of how to model and manage such complex systems is confounded by a number of archaic intellectual legacies from predecessor disciplines. Chief among these is a relatively crude, low-resolution ‘rational actor’ theory of human behaviour, which lies in tension with a range of more recent, empirical insights regarding how humans absorb information, make decisions, and act, *in situ*. I argue that, while authors widely acknowledge the former theory to be insufficient, terminological inconsistencies and conceptual opacity have prevented the latter insights from being fully integrated into much sustainable development research. This dissertation aims to help bridge that gap on the level of both theory and practice. First, I present an accessible, original synthesis of cumulative recent findings on human cognition. This synthesis suggests a key object of analysis should be the particular ways in which people reduce the deep complexity of their social-ecological context into actionable information. I then apply this theoretical lens to the study of two areas designated by the UN as sites for experimentation with the concept of sustainable development: Mt. Carmel UNESCO Biosphere Reserve in Israel, and Clayoquot Sound UNESCO Biosphere Reserve in British Columbia, Canada. Both Mt. Carmel and Clayoquot Sound are reeling from major ecological shifts, and discordant multistakeholder relations. In my data chapters, I show that by (a) applying my synthesized theoretical lens to an analysis of how

the various stakeholders perceive their local context, and (b) adapting and combining a range of elicitation and analysis methods that heretofore have been applied in isolation, I am able to generate insights that have direct, actionable significance for the management of these sensitive, politically fraught social-ecological systems. I conclude with a discussion of implications, caveats, prospects of scalability, and suggestions for future research.

Preface

The physical collection and collation of the interview data reported in this dissertation was done by me. The analysis of the data in this dissertation was also largely my own work, but I had considerable technical support from a number of people. Namely, Coral Kasirer assisted in analysis of all Hebrew-language print material, and Michael Muthukrishna collaborated with me on the statistical analysis of the Clayoquot Sound data (see Acknowledgements). Supervisors Dr. Kai M.A. Chan, and Dr. Terre Satterfield, played important roles as advisors throughout the process. However, unless otherwise stated, all other work described in this dissertation, from concept to completion, was entirely my own.

The fieldwork I conducted both on the west coast of Vancouver Island and in northern Israel was explicitly approved by UBC's Behavioural Research Ethics Board. The identifying number of the two Ethics Certificates we obtained for the research were H09-02523 and H11-00835. The former pertained to an initial round of exploratory interview research I conducted in various locations on the west coast of Vancouver Island, while the latter pertained to the interviews I conducted in and around the two biosphere reserves, specifically.

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- CSBR: Clayoquot Sound Biosphere Reserve
- ECM Model: 'Efficient Complexity Manager' Model
- MAB: Man and the Biosphere project
- MCBR: Mount Carmel Biosphere Reserve
- MCNP: Mount Carmel National Park
- (I)NPA: Israel Nature and Parks Authority
- JNF: Jewish National Fund (English name for KKL)
- KKL: Keren Kayemet L'Israel (Hebrew name for JNF)
- UN: United Nations
- UNEP: United Nations Environment Programme
- UNESCO: United Nations Educational Scientific and Cultural Organization
- WCVI: West coast of Vancouver Island

Glossary

- Accessibility (cognitive): the relative ease with which an object of mental attention is recalled.
- Aggregate mental model: the combined mental models (see *Mental model*) of two or more individuals who constitute a single analytical unit, but whose set of beliefs about the system in question may or may not be identical
- Analogical representation: a simplified, abstracted representation—often stored implicitly in one's memory—of something one has encountered, or experienced. This representation is then used to make inferences about situations or things that seem analogous to the original object of representation (e.g., the mental map one uses to navigate through one's city). See Figure 2.2 for a simple typology.
- Availability (cognitive): see *Accessibility (cognitive)*.
- Benefit transfer (method): an economic valuation tool in which the already-quantified

monetary benefits of one ecosystem function or feature are used as an approximation to infer the economic value of another one, elsewhere, that appears roughly similar to the first (e.g., approximating the value of a waterfall in Canada by drawing on valuations already conducted of waterfalls in the USA).

- Biosphere reserve: a protected area designated by UNESCO that contains a zone of legally-enforced environmental protection, as well as adjacent zones of human habitation and activity. A biosphere reserve's purpose is to serve as a living 'laboratory' for experimentation with the concept of 'sustainable development.' There are currently 621 biosphere reserves located across 117 countries.

- Contingent valuation: a survey technique for approximating the economic value of something for which there is no clear market price. Respondents are often asked to state how much they 'would be willing to pay' in order to preserve a feature of the environment; e.g., a lake.

- Cultural model: a social group's collective shared concept, either explicit or implicit, of how they imagine a particular system to function.

- The Druze: a small Arabic-speaking religious community that lives scattered across primarily the mountainous regions of the eastern Mediterranean. They practice an esoteric faith that broke from Shi'a Islam in 11^{th} century, and which features a clear bifurcation between religious initiates (the minority) and their majority, non-initiated brethren.

- Ecosystem services: a term used to describe the various benefits that humans derive from their surrounding ecosystem; some definitions refer instead to the specific biophysical processes that render those benefits.

- The embedding effect: a phenomenon in environmental economics wherein, after survey respondents have valued one environmental good, they appear to undervalue subsequent equivalent goods, 'embedding' the value of the new good(s) in the original valuation (e.g., expressing a willingness to pay $*X* to preserve one lake, but <$2*X* to preserve two lakes).

- Heuristic: a method of problem solving whereby one draws on familiar patterns of thinking to significantly reduce the complexity, and hence the cognitive burden, of a given task.

- Hyperbolic discounting: a theory meant to account for the empirical observation that the more imminently a reward is made available, the more likely people are to prefer it over a larger reward that can only be received later.

- Mental model: a person’s working concept, explicit or implicit, of how (s)he imagines a particular system to function.

- Multistakeholder management: a dynamic in which multiple stakeholders, often with different interests or agendas from one another, must collectively manage a single shared social-ecological system, or one or more resources within that system.

- Non-linear: a dynamic in which a system is liable to exhibit rapid or unprecedented changes that are often irreversible.

- Salience (cognitive): the degree to which an object stands out as more noticeable relative to other objects. Not entirely identical, but sometimes functionally equivalent, to *accessibility*, or *availability*.

- Social-ecological system: an analytical unit consisting of an ecosystem, in combination with the human social system(s) that affect(s) and/or interact(s) with it, and vice versa.

- Somatic marker hypothesis: a theory that people often draw on the visceral, emotional associations they have with an object of attention in order to help make decisions about it.

- Spiral of silence: a theory of mass communication proposed by Noelle-Neumann (1993) whereby one opinion becomes dominant over time, mainly because those who disagree assume themselves (often mistakenly) to be in the minority, fearing ostracism if they speak out.

- Strong reciprocity: a phenomenon wherein people tend to cooperate, and/or punish non-cooperators, more than pure 'rational self-interest' would instruct.

- Sustainable development: an organizing principle based vaguely on the idea of meeting people's contemporary needs without compromising the ability of our species to meet its needs in the future.

- Zionism: the Jewish ethno-religious nationalist movement that calls for Jews of the Diaspora to immigrate to the land of the Bible (Israel-Palestine) so as to create and maintain a Jewish state.

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Dedication

To my family, both passed and present,

and to anyone who may find this work useful in the service of others.

Chapter 1: Introduction

1.1 An even less convenient truth

We are living in an era increasingly defined by the question of whether contemporary civilization is sustainable (Pawloswki 2011, Griggs, et al. 2013). As the global south races to catch up to the resource-intensive living standards of the 'developed' north, and as global per-capita consumption reaches new heights, our species is having unprecedented impacts on the biophysical structures of the Earth (Steffen, et al. 2011). The spectre of unpredictable climate change, rapid biodiversity loss, collapsing fisheries, massive soil erosion, fresh water depletion, and pollution crises are each said to already loom with varying degrees of imminence on our collective horizon (Millennium Ecosystem Assessment 2005).

Focusing on climate, American former Vice-President Al Gore infamously christened this reality an "inconvenient truth" (Gore 2005). The Gore narrative is shared, albeit with more nuance, by many environmental scientists, who argue our species' path is unsustainable insofar as the planet lacks the capacity to absorb the impacts that would result from the entire global population—projected to peak at between nine to 11 billion people (UN DESA 2013)—consuming to the same degree, and in the same forms, as do the citizens of the world's richest nations today (Rees and Wackernagel 2013, Sakschewski, et al. 2014, Springer and Duchin 2014).

The consequent sense of insecurity has inspired visions of what a new, more durable global system would entail. 'Sustainable development' is one term that has emerged as a widely used—if vague—signifier for such a vision. 'Sustainable development' implies a system in which levels of human welfare (conceived in various ways) continue to rise, while our species simultaneously avoids or even reverses destructive impacts on the environment that would otherwise deprive future generations of current standards of living (Langhelle 2000, Hopwood, Mellor and O'Brien 2005, Mitcham 1995, Du Pisani 2006). A complementary vision that has emerged in academic circles, closely associated with the work of Nobel-prize winning economist Elinor Ostrom (e.g., Ostrom, 2009, Ostrom and Janssen, 2004, Young, et al. 2006) and the research community at Stockholm University, focuses on the notion of 'resilience' (Folke 2006, Folke, Carpenter, et al. 2002). This approach highlights the importance of improving 'adaptive capacity,' whereby we modify or design the complex social-ecological systems we inhabit in such a way as to be able to quickly recover from inevitable 'surprises,' such as failures in prediction or the crossing of non-linear thresholds (Berkes, Colding and Folke 2003, Folke 2006, Folke, Carpenter, et al. 2002, Liu, Dietz, et al. 2007).

Despite the valiance and apparent necessity of such visions and their ensuing research programs, it is still unknown to what degree this search for 'sustainable' civilizational models is a doomed case of wanting our collective cake while eating it too or, rather, whether such a search constitutes the sole path to would-be salvation for our species and its future on this planet. Of course, it is also possible (if not probable) that reality will prove to be some combination of the two, wherein the search for a new, sustainable modus operandi is both necessary, but insufficient: some much more radical scenario (such as a Malthusian population crash, or other large-scale initial reduction in aggregate human welfare) may well be an inevitable precursor to the future emergence of a more durable global system (Small 2002, Seidl and Tisdell 1999, Nekola, et al. 2013, Johansen and Sornette 2001). We simply do not yet know. Nor, it seems, *can* we know (Reuveny 2012, Johansen and Sornette 2001).

Our best science notwithstanding, the profound complexity and interconnectedness of our linked social and ecological systems precludes a single, clearly prescriptive path with definitive outcomes. Rather, despite our innate preference for certainty, and for the ideological narratives this human need produces (Peterson and Flanders 2002) (be they environmentalist, capitalist, socialist, or otherwise), when studying the interconnections between complex social and ecological systems, we are firmly in the realm of often ambiguous probabilities, subjectivity-tinged metrics of uncertainty, and a near limitless plethora of possible future scenarios (Fischer and Sterner 2012, Hillerbrand and Ghil 2008, Millennium Ecosystem Assessment 2005, Dessai and Hulme 2004, Kriegler, et al. 2009, Pittock, Jones and Mitchell 2001, Lempert, et al. 2004).

Thus, the apparent unsustainability of our current socioeconomic system is, indeed, “inconvenient” (Gore 2005), particularly for those whom it currently benefits the most: the approximately 75% of the world population that is not mired in poverty (OPHDI 2014). The problem this “truth” (Gore 2005) presents, however, is in fact even more confounding than various shades of environmentalist narrative suggest (G. B. Smith 1998, Shantz 2003, Douglas 2009, Pepper 2007). This is because, as a species, our rapidly accumulating data on social and ecological interaction simultaneously present us with an inextricably related challenge: that of collective interpretation. The deeply probabilistic, necessarily cautious nature of the predictions made by many biophysical models, and the relative lack of firmly visceral, and hence indisputable, facts about the exact impact of our behaviours on the environment, open up the field for a wide, disparate range of interpretations, narratives and prescriptions (Zehr 2000, Stocking and Holstein 2008, Carvalho 2007, Corbett and Durfee 2004, Ravetz 2004).

I argue that actively acknowledging and incorporating this ‘even less convenient’ truth of epistemic, ontological and ideological diversity into social-ecological research is crucial, both for understanding how culture and cognition interact with ecological dynamics, but also for translating scientific findings into successful, actionable policy (Eccleston 2004, Raymond, et al. 2013, Smith and Sterling 2010). This holds true at multiple scales. On a global scale, we live in an increasingly multipolar international system that is simultaneously anarchical and interdependent (Zala 2010, Hurrell 2008, Bull 2002). This means that any planetary-level action requires the coordination of multiple states and non-state actors with highly divergent interests, outlooks and agendas, whose leaders are often compelled to prioritize their own domestic political survival, or corporate bottom-lines, over long-term communitarian or even national interests (Kleinberg and Fordham 2013, Caselli and Morelli 2004, Callander 2008). This suggests that the most powerful actors may often be operating within entirely different motivational, and hence cognitive (Peterson and Flanders 2002), frames, both from one another, and from the wider policy-making and research communities.

At a higher resolution, our planet is home to a vast diversity of sub-state-level communities and human actors, each with their own particular priorities, histories, epistemologies and ontologies, which sometimes do and sometimes do not neatly map on to those of academic knowledge-producers (Raymond, et al. 2013, Rodríguez-Labajos and

Martínez-Alier 2013, Oguamanam 2007, Saab 2009, Curry 2003, Howitt and Suchet-Pearson 2006, Icaza and Vázquez 2013). In this light, successfully addressing our species' collective sustainability problem is as much an exercise in open deliberation, multistakeholder negotiation, and the crafting of a shared—or, at the minimum, a mutually recognizable—narrative, as it is a question of finding the right suite of technocratic solutions (Hurrell 2008, Ratner 2004, Fischer, et al. 2012, Zorn, et al. 2012, Clark and Dickson 2003, J. Robinson 2004, Bulkeley and Mol 2003).

Taking this fact seriously, however, means more than making scientific sense of complex social-ecological systems. Just as importantly, it also means studying how relevant actors themselves make sense of the social-ecological systems in which they are embedded, how those actors make sense of knowledge produced by 'experts,' and how, ultimately, those actors make sense of each other. Insofar as this particular subset of social-ecological systems research shifts the object of analysis from facts about the natural world, to how people make sense of their world, the agenda I am advancing here, suggested obliquely by others (Folke 2006), must draw upon methods more familiar to cognitive anthropologists (Atran and Medin 2010, Medin and Atran 1999, D'Andrade 1995), sociologists (Borgatti 1996, Smith and Borgatti 1997), social and cultural psychologists (Heine 2012, Peterson and Flanders 2002) or religious studies scholars (Blum 2012, Slingerland 2008, Slingerland 2004) than those employed by ecologists or economists in the traditional sense.

Just as age-old religious and metaphysical systems comprise frameworks for action drawn from a combination of naïve environmental observation, diverse social influences, and deep cognitive structure (Peterson 1999), so too do peoples' contemporary beliefs about our shared social-ecological systems hinge on these same contextual, cultural and cognitive factors (Atran and Medin 2010, Medin and Atran 1999). For those of us who seek to understand the role of humans in the sustainability of these complex social-ecological systems, this presents us with a peculiar challenge: having to synthesize a coherent new theoretical and methodological foundation for such an agenda. The need for this synthesis is as follows.

Recent decades have seen a wealth of empirical data emerge on how deeply the nuances of cognition and culture shape human behavior (Henrich, Heine and Norenzayan 2010, Kahneman, Slovic and Tversky 1982, Heine 2012, Gentner and Stevens 1983, Atran and Medin 2010). However, because these insights have arisen from such diverse disciplinary corners, and have been articulated in such varied language, they have yet to coalesce into a cohesive, empirically-responsible theoretical foundation upon which to firmly establish a study of the human actor in social-ecological systems (see Chapter 2). Because this foundation is lacking, the question of which methods are best suited for which aspects of such a research program—let alone what the actual *objects* of analysis would then be (e.g., stated or revealed preferences, values, narratives, mental models, beliefs, or something else entirely)—is in no way clear.

I argue this dearth of theoretical and methodological clarity tempts many of us to fall back unreflectively on conventional techniques (Adamowicz 2004, Shove 2010) rooted in an accessible yet infamously naïve view that has been debunked many times over: the assumption that humans are predictably rational, autonomous, self-interested, utility maximizers (Ariely, Loewenstein and Prelec 2003, Henrich, et al. 2001, Gintis 2000). But basing otherwise cutting-edge research on flawed theoretical assumptions is simply not satisfactory. I argue we can do better, with respect both to theory and to methods. As such, I focus the entirety of my dissertation on meeting this challenge directly.

I begin this dissertation by synthesizing a range of contemporary findings in the cognitive, behavioural and social sciences to create an accessible theoretical foundation for thinking about how humans actually navigate the complexity of their social-ecological systems. I then demonstrate the usefulness of this theoretical lens at the regional scale by applying it to the study of two different field sites: Mt. Carmel UNESCO Biosphere Reserve in northern Israel, and Clayoquot Sound UNESCO Biosphere Reserve on the west coast of Vancouver Island, in British Columbia, Canada. In so doing, I adapt and recombine a number of methods from other social sciences in novel ways, enabling me to deliver original insights that are directly relevant to the multistakeholder management of the two reserves. Ultimately, this effort serves as a prototype for how coherent theory rooted in the study of cognition and culture can be explicitly and usefully incorporated into the study and management of social-ecological systems.

1.2 Why UNESCO biosphere reserves?

In 1971, UNESCO launched a long-term project to develop a global network of protected areas, dubbed ‘biosphere reserves,’ originally aimed at balancing ecological conservation with the human use of natural spaces. By 1976, this project had developed into the so-called ‘Man and the Biosphere’ (MAB) initiative, which designated 208 new protected areas around the world, constituting the first generation of the nascent World Network of

Biosphere Reserves (WNBR) (Jaeger 2005). By 2013, that number had nearly tripled, with 621 reserves spread across 117 countries (UNESCO 2013).

Over the past several decades, the mandate of these reserves has evolved from an original tripartite aim of ecosystem conservation, research and education (Jaeger 2005), to the explicit aim of functioning as living ‘laboratories’ for experimentation with the concept of sustainable development (Jaeger 2005). According to MAB’s 2008 Madrid Action Plan (MAP), the aim of the MAB initiative is now to “raise biosphere reserves to be the principal internationally-designated areas dedicated to sustainable development in the 21st century” (3).

Unlike many other protected area schemes, WNBR claims to focus specifically on bringing together multiple stakeholders to link biodiversity conservation directly with socio-economic development (UNESCO-MAB 2008). Included in UNESCO’s official list of the ‘main characteristics of biosphere reserves’ are: “focusing on a multi-stakeholder approach with particular emphasis on the involvement of local communities in management” and “fostering dialogue for conflict resolution of natural resource use” (UNESCO 2014). In this sense, biosphere reserves are, at least in theory, ideal case-study sites for investigating the role of cognition and culture in the multistakeholder management of social-ecological systems.

In terms of their spatial structure, biosphere reserves are intended to each share a number of common characteristics. One, they are areas, within sovereign states, where humans already reside but which have also been specifically recognized for their biological diversity. As a condition for granting a given area ‘biosphere reserve’ status, UNESCO now also requires the implementation of a loosely standardized zoning scheme, comprised of (a) a core protected area officially recognized by domestic legislation, (b) a buffer zone of limited human activity, and (c) a transition zone of—ostensibly sustainable—human habitation (UNESCO-MAB 2008).

By 2008, UNESCO had adopted language being used by the UNEP and began explicitly promoting an 'ecosystem services' framework for managing reserves in the WNBR. The 'ecosystem services' approach was first articulated in its current form by ecologist Gretchen Daily (1997), and later more formally codified by the UNEP's Millennium Ecosystem Assessment (Millennium Ecosystem Assessment 2005). Rather than promote biological conservation for its own sake, this approach adopts the economic metaphor of 'service provider,' and focuses explicitly on the processes whereby 'nature' renders 'benefits' to humans. The theory is that by actively considering and managing for the specific 'services' nature 'provides' to people, relevant stakeholders will be able to strike a more sustainable balance between long-term improvements in human well-being, and the preservation of local ecological integrity (Millennium Ecosystem Assessment 2005, Daily 1997). UNESCO's attempt to promote this particular conceptual framework across the WNBR complements their requirements for a common zoning scheme. Theoretically, this helps reserves generate roughly comparable data that can be shared and studied methodically across the wider network—a core, original goal of the MAB initiative (Jaeger 2005).

The biosphere reserve model has met with mixed success (Rosas and Clusener-Godt 2010, Jaeger 2005, UNESCO-Jakarta 2010). From my own experiences attending WNBR conferences, interviewing UNESCO officials, and observing first-hand the struggles of reserve managers, the model suffers from at least two key challenges. One, while UNESCO does provide the recognition and designation of 'biosphere reserve' status, it does not and cannot, as a rule, offer any guaranteed funding to help implement sustainable development projects in the reserves (Frankenberg 2009, Cook 2009, Karez 2010). Thus, once earning reserve status, domestic actors are then left to search out funding solutions themselves. Sometimes, as in the case of Clayoquot Sound UNESCO Biosphere Reserve, this funding comes in the form of a government grant or trust. In other cases, however, such as with the Mt. Carmel UNESCO Biosphere Reserve, specially earmarked government funding is essentially non-existent.

In the case of Latin America, specifically, this model has met with a measured degree of success, as the Spanish government has adopted widespread funding of biosphere reserve projects in its former spheres of influence (Karez 2010, Rosas and Clusener-Godt 2010, Jaeger 2005). In Asia, the South Korean and Japanese governments have similarly helped finance a number of international WNBR initiatives (UNESCO-Jakarta 2010). Many other reserves, however, have not been well-funded, and thus exist more in name than in substance, often to the bemusement of local residents (Frankenberg 2009, Rosenberg 2011) (see Chapter 3).

Apart from the hurdles presented by this typical funding gap, there is also a second, arguably more profound, challenge faced by actors in biosphere reserves. This constitutes a direct incarnation of the issue of epistemological and ontological diversity I described in Section 1.1. In the course of my research, I have encountered the issue in at least two observable forms.

One, when diverse actors in a given biosphere reserve must attempt to manage their shared environment sustainably, it is often challenging, both for the actors themselves and for us researchers alike, to appreciate how differently from one another we may each be perceiving and thinking about the same space. Social-ecological systems are so complex, and so multifaceted, that our individual and collective experiences within them, and hence our fundamental, underlying conceptions of what they consist of, how they work, and what the problems may be, are by no means given, not even to ourselves (Peterson 1999). Rather, the situation is liable to resemble the inverse: our individual and collective wealth of knowledge about our social-ecological surroundings are generated through a massive number of repeated visceral, embodied actions and habits of mind, and thus are stored for the most part implicitly in our embodied memories, rather than sitting ready and waiting for our immediate, transparent, conscious access (Atran and Medin 2010, Medin and Atran 1999, Mischel 2009, Lewicki, Hoffman and Czyzewska 1987) (see Chapter 6). As a result, while we as individuals are often deeply knowledgeable about our own particular observable ambit, we are not necessarily fully conscious of what it is we know or believe about our environment, or why, let alone how to usefully articulate it to others (Boiral 2002, Broadbent, Fitzgerald and Broadbent 1986) (see Chapter 6). This is where adapting well-selected methods to generate and share research on the human dimension of social-ecological systems can be critically useful for multistakeholder management processes. Such methods can externalize implicit, or tacit, knowledge and beliefs with communal legitimacy. This in turn can boost the degree to which such information is integrated into the deliberative process itself, fostering better negotiated outcomes (Van den Bossche, et al. 2011, L. A. Liu 2004, Dowd and Miller 2011).

A second crucial way in which cognition and culture appear to influence the (lack) of success in biosphere reserve management is the degree to which our innate drive for cognitive efficiency (see Chapter 2) means that we exhibit a range of very real partialities in our perception (Kahneman, Slovic and Tversky 1982, Shah and Oppenheimer 2008). People readily perceive some things very clearly (e.g., *who* can be most convincingly blamed for environmental mismanagement), while we find it incredibly difficult to attend to other things (e.g., *which* long-term underlying ecological processes drive continuity and change in our environment) (see Chapter 4). This creates a real problem for both the management, and study, of social-ecological systems alike, in that while relevant theory is currently aimed at understanding how people use the resources in their ecosystem, the 'inconvenient truth' of cognitive partiality suggests we are all just as often reacting primarily to each other, while the effects on our natural environment are indirect, unintentional and confounded by cultural and cognitive specificities. Appropriately addressing this issue hinges on bringing our cognitive-cultural biases and their effects into explicit awareness (see Chapters 3, 4 and 5), an often humbling and jarring task.

Finally, a distinct, but related, problem I have repeatedly encountered in both the relevant literature, and in my field work, is the issue of how we as researchers tend to imagine the process of resource management itself. Often, academic papers and grey literature alike propose conceptual frameworks, management options and technical solutions having already made a key *a priori*, tacit assumption: that a rational, objective decision-making context really does exist, wherein the ultimate aim truly is integrating the best information possible, and weighing the relevant risks most wisely (Jay, et al. 2007). From my observations in the field, and in my interaction with managers who have described to me their own experiences, this notion often appears quite starkly divorced from reality (Rosenberg 2011, Frankenberg 2009, Wright, et al. 2013, Jay, et al. 2007). Not only are management decisions routinely if not exclusively made on profoundly emotional, social, political, and ideological levels—not via an idealized algorithmic cost-benefit analysis—but often a decision-making context does not even truly exist. Expert and local stakeholders' values are frequently elicited, if at all, mainly for procedural and bureaucratic reasons, while the actual course of events is already set in motion by personally- or structurally-driven political-economic momentum (Rosenberg 2011, Wright, et al. 2013). This both challenges the relatively generic nature of popular frameworks for the study of social-ecological systems (Ostrom 2009, Folke 2006), and puts additional pressure on the researcher to provide insights that are truly contextually relevant.

Such an assessment may sound excessively pessimistic. However, there is a figurative silver lining. As alluded to at the close of Section 1.1, there is a vast quantity of work that has already been done in a range of other disciplines (e.g., Atran and Medin 2010, Borgatti 1996, D'Andrade 1995, Gentner and Stevens 1983, Haidt 2001, Heine 2012, Henrich, et al. 2001, Kahneman and Frederick 2002, Kahneman, Slovic and Tversky 1982, L. A. Liu 2004, Medin and Atran 1999, Peterson 1999, Peterson and Flanders 2002, Shah and Oppenheimer 2008, Smith and Borgatti 1997, Tversky and Kahneman 1973) that, if carefully synthesized and appropriately adapted, can be of direct use in theorizing and solving the challenges I have highlighted in this section. Below, I outline how the driving impetus for each of the subsequent chapters in my dissertation is this aim of enriching social-ecological systems research through a transparent and novel integration of insights from the multidisciplinary study of cognition and culture.

1.3 Structure of the dissertation

This is a papers-based dissertation, meaning that apart from the Introduction (Chapter 1) and Conclusion (Chapter 7), each chapter functions as a stand-alone paper intended for publication in a refereed journal. As such, there is some redundancy in my description of the case study sites in Chapter 3 and Chapter 4, which both present findings from Mt. Carmel Biosphere Reserve, and then again in Chapter 5 and Chapter 6, which both present findings from Clayoquot Sound Biosphere Reserve. That said, apart from this slight redundancy, each of these chapters presents an entirely different data set, and uses or recombines different methods to provide unique actionable insights into the dynamics of the given biosphere reserves in question.

1.3.1 Synthesizing a theoretical foundation

Before presenting the results of my research in each case study site, I begin with a paper (Chapter 2) aimed specifically at solving the problem of theoretical foundations. In Chapter 2, I present this problem as one of how the human actor has been characterized, both implicitly and explicitly, in sustainable development- and social-ecological systems research to date. I go on to describe how (as mentioned in Sections 1.1 and 1.2 above) the vast quantity of recent empirical research on the role of cognition and culture in human decision-making has emerged from a wide array of disciplines, in often very different language. This diversity of nomenclature and disciplinary framing, I argue, has thus far made it difficult for social-ecological systems researchers to integrate this new generation of insights into a single coherent model of human behaviour. Because of this, it remains lamentably easy for researchers to employ techniques and make simplifying assumptions that in fact are rooted in the pre-empirical, but comfortably accessible, 'rational actor model', known somewhat less affectionately as *Homo economicus*. After demonstrating the ways in which the 'ghost' of *Homo economicus* continues to figuratively haunt the study of sustainable development today, I proceed to collate and render comparable a number of more contemporary insights on human thought and behaviour that have begun to emerge from a range of empirically-oriented disciplines in recent decades. Together, these insights, which I express in a common language, comprise a list of principles that guide a more empirically informed, conceptually coherent theoretical foundation for the study of the human role in social-ecological systems. As I detail in the paper itself, a central, common theme to emerge from this synthesis is a shift from conceiving of humans as perfectly informed, rule-based thinkers who make their decisions on a single fungible metric, to a model of human cognition in which people have evolved over time to excel at the *efficient management of massive environmental complexity*. This specialization in 'complexity management' (Peterson and Flanders 2002) in turn helps us act in rapid, frugal, satisfactory ways (Kahneman 2003), rather than require us to expend the excess time and energy needed to arrive at theoretically optimal decisions. Ultimately, I summarize this model in the form of a simplified, abstracted chronological decision-making process (see Figure 2.4). I then use this as a theoretical foundation in the subsequent four papers (Chapters 3 to 6) to guide my selection and interpretation of objects of analysis.

1.3.2 Mt. Carmel UNESCO biosphere reserve

In Chapter 3, I first introduce the context of Mt. Carmel Biosphere Reserve. Mt. Carmel is inhabited by two communities of an ethno-religious minority of Arabic-speakers known as the Druze, whose presence in the area predates the existence of the Jewish-majority, Hebrew-speaking Israeli state by centuries. The Mt. Carmel Druze community is growing rapidly, and their town limits are expanding. Controversially, the Druze are now constructing homes directly adjacent to and sometimes within a surrounding contested area. This area contains a sizable amount of legally-recognized Druze property, but was *de facto* nationalized by the Israeli government in the 1970s for conversion into a mix of nature reserve and national park. Notwithstanding their shared reverence for the Carmel forest, the demographic situation has led to an increasingly acrimonious dynamic between the Druze and local state authorities. While the Druze feel compelled to build new single-family homes for their children, even without proper government permits, local authorities remain torn between protecting the environment by enforcing state law, but also not wanting to unduly provoke the fiercely independent Druze community, who in addition to having *de jure* title to much of the land in question, are the only Arabic-speaking population to serve as conscripts in the national army, thus serving a key strategic role in the state's defense apparatus.

In 2011, I began conducting semi-structured interviews amongst both local Druze, and government managers, with the aim of investigating how participants from each group tended to reduce the complexity of their shared social-ecological system, and how the details of that may be affecting the lack of productive dialogue. The insights I gained from these interviews informed my construction of a follow-up survey instrument, which aimed at bringing to light what I hypothesized was a greater flexibility in popular Druze opinion on the issue of housing than the government authorities seemed to believe existed. Ultimately, the results of the survey revealed a number of crucial unspoken assumptions that appear to underpin the Druze community's stance on housing practices. These tacit beliefs, which I detail within the paper (Chapter 3), explain how popular opinion on the issue appears to stand in direct contradiction to the perceptions both of government managers, and of many Druze themselves. The results have direct applications for the negotiation of sustainable development solutions in the reserve. As such, with the help of local partners, I disseminated these findings throughout the community prior to my departure, and will soon be delivering them to government officials, at the request of local managers.

In Chapter 4, I present a largely orthogonal set of data on the Mt. Carmel Biosphere Reserve, rooted in a cataclysmic event that occurred in the region just prior to my arrival. In December 2010, Mt. Carmel was engulfed in the largest forest fire in the history of the modern Middle East, claiming over 40 lives, as well a considerable amount of property and a massive amount of national park. Because of a history of politicized arson in the region, this disaster immediately led to a spike in ethnic tension between Jews and Arabs. This was followed almost instantaneously by a political and media frenzy in which individual government ministers scrambled to distance themselves from the event, and from the shockingly inadequate domestic firefighting response that contributed to its scale.

By the time I had arrived in the region several months subsequent to the disaster, there was still a considerable amount of confusion, ethnic discord and finger-pointing surrounding the issue in the Israeli public sphere. Unfortunately, there was little to no substantive coverage in the media of more systemic factors behind the fire, nor of how addressing them could help prevent disasters of this scale from recurring. Essentially, my local colleagues and I saw this as an opportunity for building societal resilience and enriching public understanding of the regional social-ecological system, which was nonetheless being squandered by excessively reductionist public discourse. This amounted, in our minds, to a compounding of the recent tragedy.

As a new media cycle soon led the fire and its aftermath to fade from the spotlight, my colleagues and I felt it was crucial to investigate, and ultimately share, specifically how under-reported systemic factors, inextricably intertwined with the nuances of human cognition and culture, contributed both to the fire, and to its damagingly simplistic construal in the public sphere. As such, we conducted and compared the findings of three different analyses using three different sources of data and three different sets of methods. These analyses included: (a) a textual analysis of issue-conflation in the mainstream Israeli print media coverage of the disaster, (b) a mental-models analysis of how key local interviewees understood the dynamics of the regional social-ecological system, and (c) a textual analysis of the historical record on how successive groups of actors related to and ultimately shaped the ecological makeup of the Carmel slopes as per their own partial, often ideological, vision of the landscape.

While the forms of data in each case were different, the objects of analysis were comparable, in that each approach took as its theoretical foundation the same efficient complexity-reduction model of human behaviour outlined in Chapter 2. The result is a coherent account of how the Mt. Carmel disaster, along with its sociopolitical and ecological fallout, were facilitated by multiple groups' successive, particular forms of complexity reduction having gone unchecked, and unproblematized, for over a century. Rather than pinning the blame on a single individual, or reducing a deeply multifactorial event to a single cause, this account allows us to think explicitly about how dominant narratives are constructed, how landscapes are themselves shaped by cognition and culture, and, ultimately, how the inevitable blind spots that these processes produce can be avoided or mitigated to create more resilient social-ecological systems in the future.

1.3.3 Clayoquot Sound UNESCO biosphere reserve

In Chapter 5, I shift attention to my second case-study site: Clayoquot Sound UNESCO Biosphere Reserve on the west coast of Vancouver Island (WCVI), in British Columbia Canada. As I describe in Chapters 5 and 6, the WCVI is a region characterized by lush temperate rainforest, rich in both terrestrial and aquatic biodiversity. Prior to sustained European activity in the area beginning in the mid-18thcentury CE, human presence on WCVI was limited mainly to First Nations Nuu-Chah-Nulth tribes, who for millennia subsisted off a marine-based proteinrich diet, ranging from salmon, to shellfish, to whale meat. Due to the rich diversity and high volume of aquatic biomass in the area, the WCVI has also historically supported a large and varied population of marine mammals. In addition to orcas, dolphins, porpoises, seals, and two species of sea lion, the WCVI was—crucially—once home to a large population of sea otters (*Enhydra lutris*). As I later describe in Chapters 5 and 6, the sea otter has come to play a uniquely pivotal, and remarkably divisive, role in the changing dynamics of the WCVI social-ecological system. Here I provide some historical background that will help contextualize the material I present in Chapters 5 and 6.

The sea otter's pelt is unrivaled in its softness, with one of the highest densities of fur follicles per cm^2 of any animal alive (Kuhn, et al. 2010). When Europeans arrived on the WCVI, they soon capitalized on this by hunting otters and selling their pelts into rapidly growing markets in Asia and Europe. Within decades, the Pacific otter hunt—which involved both Europeans and First Nations—began to take on large-scale commercial proportions throughout the northeast Pacific. On the WCVI, this ultimately culminated in the complete extirpation of the sea otter population by 1929 (Fisheries and Oceans Canada 2013).

The social and ecological effects of the sea otter's disappearance from the WCVI can scarcely be overstated. When the otter was present, the nearshore marine environment was dominated by thick kelp beds, which would have harboured a rich diversity of marine life, including a variety of demersal fish species (kelp greenling, lingcod and numerous varieties of rockfish), as well as a diverse foodweb of both herbivorous and carnivorous invertebrates (Fisheries and Oceans Canada 2013).

With sea otters gone, predation on one of the otter's favourite foods—the sea urchin—virtually disappeared. Urchins, in turn, subsist largely off of kelp. Otter extirpation led to a ballooning of the sea urchin population, which thus went on unchecked to decimate many nearshore kelp beds (Fisheries and Oceans Canada 2013). The end result was a ubiquity of what came to be called 'urchin barrens': large patches of sea floor dominated almost exclusively by urchins, with a relative lack of habitat-forming flora.

As this major ecological regime shift occurred underwater, above water, First Nations populations on the WCVI were undergoing a figurative perfect storm of catastrophic proportions. With up to 90% of their population killed off by European diseases and conflict, and intensive efforts by British colonizers to erase many of their key cultural practices, the indigenous Nuu-Chah-Nulth peoples were hemorrhaging much of their orally-transmitted knowledge and historical memory (Turner and Turner 2008, McMilan 1999). Adding to these existential pressures was the colonial practice of spatially constraining Nuu-Chah-Nulth communities, along with many other First Nations groups, to ever-smaller "Indian reserves" with ever-more limited access to fisheries (Harris 2008). This regime was entrenched by the *Indian Act* of 1876, which was later copied directly by post-war South Africa to help create the infamous 'Apartheid' system in that country (Kuper 2003).

In the face of this attempted cultural genocide (MacDonald and Hudson 2012), Nuu-Chah-Nulth memory of pre-European history, and of an earlier, pre-fur trade ecology, had begun to fade. Instead, local First Nations adapted to the relatively new urchin-rich, kelp-scarce regime as their new baseline. While they no longer had access to otters for their pelts (once used by tribal chiefs for ceremonial purposes) (Robinson 1996), Nuu-Chah-Nulth did now have relatively easy access to an abundance of shellfish that was previously the mainstay of the sea otters' diet.

Archeological records show that clams, chitons, and mussels, along with sea urchins themselves, were a key component of the Nuu-Chah-Nulth diet for millennia (Deur, et al. 2013). However, with the disappearance of otters, the erasure of much historical memory, and the British settlers' systematic exclusion of First Nations from their traditional territories and fisheries, ready access to such edible invertebrates grew to have an unprecedented importance, both caloric and cultural, for the surviving Nuu-Chah-Nulth.

This delicate new status quo in the social-ecological system was soon upset by an idiosyncrasy of the Cold War. In 1965, the United States began conducting nuclear tests in Alaskan waters. Aware that there was a small remnant population of endangered sea otters in the region, the US government requested that Canada relocate the animals to safer waters for the protection of the species. The Canadian government obliged, and over the course of 1969-1972, 89 otters were removed from Alaska and introduced to the far northwestern end of Vancouver Island (Fisheries and Oceans Canada 2013).

This area of Vancouver Island, while remote, was not uninhabited. It constituted the traditional territory of the once numerous Kyuquot and Checkleseht Nuu-Chah-Nulth tribes, now consolidated into one small band of survivors of the deadly centuries-long colonial encounter. Yet, no one from this surviving Nuu-Chah-Nulth community was consulted about the otters’ introduction. This is perhaps unsurprising, as First Nations had only recently even won the right to vote in Canada, in 1960 (Knight 2001).

At first, the introduced otter population was small, geographically isolated, and thus did not pose a significant problem to the human community. However, as time went on, and the otter population grew, it expanded ever farther southwards. Eventually, otters began competing directly with the small, isolated Kyuquot-Checkleseht band for calories, primarily in the form of clams, urchins and other shellfish, which the Kyuquot-Checkleseht had become accustomed to collecting at specific sites within close distance to their government-delimited reservation. Indeed, as the only marine mammal without blubber, sea otters must consume upwards of 25% of their body weight in food each day simply to remain healthy (Jessup, et al. 2004). Thus, this perceived interspecies competition soon became intense—and heated.

Whereas historically the Nuu-Chah-Nulth had highly skilled techniques for cultivating shellfish in accessible areas (Deur, et al. 2013), and for physically excluding otters from these areas (whether by frightening them away or by performing a limited cull), by the turn of the 21st century, none of these options was any longer available to the Kyuquot-Chechleseht. Historical memory of how Nuu-Chah-Nulth ancestors managed otters had been damaged. Moreover, regardless of this loss, otters were now a ‘threatened species,’ protected by federal law (Fisheries and Oceans Canada 2013). Harming or ‘harassing’ an otter in any way was, and remains, a serious punishable crime (Canada 2014). Federal and provincial law notwithstanding, however, frustrations have sometimes boiled over, and the occasional sea otter has indeed been found riddled with bullets in various locations on the WCVI.

The problem is neither resolved, nor isolated. Rather, it is spreading southwards. Apart from the Kyuquot-Checkleseht, there are numerous larger communities of Nuu-Chah-Nulth scattered amongst inlets and coves along the entire west coast of Vancouver Island. These communities intermarry, and share deep cultural and familial ties. Thus, as otters continue to expand their territory southwards, down the WCVI, they are preceded by visceral personal stories of just how much damage the species is said to have wrought farther north. This has prompted strong defensive reactions from more southern Nuu-Chah-Nulth bands, some of whom have flouted the law by physically attacking otters on sight. In recent years, as the conflict intensified amongst otters, the Nuu-Chah-Nulth, and government officials, some local tribal leaders have declared their intention to re-initiate a traditional otter hunt as part of what they argue is permitted under their federally-recognized food, social and ceremonial (FSC) hunting rights (CBC 2009).

At the same time, government managers, scientists and conservationists have been investigating and promoting the numerous positive knock-on effects they believe will be generated by the sea otter's return to the WCVI. With more otters, and thus fewer urchins, kelp beds are observed to be thriving to a degree not seen for over a century (Espinosa-Romero, et al. 2011, Wilmers, et al. 2012). This process is described by ecologists as a 'trophic cascade,' whereby increased high-level predation by one species cascades down the foodweb to ultimately create more habitat for a wide range of other species (Wilmers, et al. 2012, Espinosa-Romero, et al. 2011). In the case of the WCVI, and of Clayoquot Sound in particular, this includes small invertebrates such as the kelp crab, but also large demersal vertebrates such as lingcod, numerous species of rockfish, and a fish known as 'kelp greenling.' Some observers also hypothesize that more kelp cover will provide added shelter from predation for the juveniles of commercially important salmon and herring runs, and that more kelp detritus may help grow larger populations of halibut and other benthic or demersal fish farther out to sea. However, these latter hypotheses are currently only speculations, as yet unconfirmed to any degree of certainty by ecological science (Gregr 2014).

What does seem certain, though, is that tourists enjoy viewing sea otters (Loomis 2006). This is particularly true since 2007, when an amateur YouTube video of two captive sea otters 'holding hands' at the Vancouver Aquarium 'went viral.' This display was more likely an instinctual defense mechanism against strong currents, rather than a tender moment between two enamoured otters (in reality, otter mating is in fact disturbingly violent) (Fisher 1939). Nonetheless, the video had proceeded to garner no less than 19 million views by 2014 (Otters holding hands 2007), a figure equivalent to approximately three times that of the entire rural population of Canada (Statistics Canada 2011).

It is perhaps not surprising, then, that the 'return' of sea otters to Vancouver Island, and to Clayoquot Sound in particular, is thus being heralded by a range of interests as a literal golden opportunity for locals to capitalize on a potential increase in ecotourism dollars (Fisheries and Oceans Canada 2004). However, not everyone on the WCVI, nor in Clayoquot Sound itself, perceives this potential windfall as benefiting them or their community. During my time in the field, it became clear to me that relatively few First Nations residents are directly involved in the ecotourism business on the WCVI, and some seem either unaware or outright skeptical that a fair share of such revenue could ever find its way onto the local Nuu-Chah-Nulth reserves. Even many non-First Nations locals seem more upset about the otter's perceived decimation of crab stocks than they are excited about their ecotour-operator neighbours making a premium by adding 'otter watching' onto already-popular whale watching tours.

In other words, while some see the reappearance of otters as an overwhelmingly positive return to a more 'natural' (or at least more biodiverse) state, with many possible economic and ecological benefits, not all agree. Many others are skeptical as to the disaggregated way in which such benefits are likely to be distributed. Rather, they are more concerned with the more palpable immediate decrease in access to edible invertebrates that they associate with the otters' return.

It was in this context that, in the spring of 2012, I began semi-structured interview research in the Clayoquot Sound region, a relatively densely and diversely populated segment of WCVI, located approximately 140km south of Kyuquot. My aims were multifold. One, I wished to simply estimate empirically how much of the local resident population was in favour of the otters' immanent reestablishment in the local ecosystem. More specifically, however, I hoped to elicit the particular sets of perceptions, beliefs and values that underpinned locals' statements about otters, and to compare and contrast them to those of government managers charged with the otters' protection. In this way, by focusing on how both 'laypeople' and government 'experts' tended to cognitively reduce and normatively load the deep complexity of their shared social-ecological environment, I could demonstrate where the gaps and overlaps were in conflicting groups' respective understanding of the immanent trophic cascade and its likely effects.

To elicit this information, I devised a somewhat unorthodox interview protocol (see Chapters 5 and 6) that required participants to engage in drawing, map work, freelisting (i.e., listing terms in the order they come to mind in response to a single question), ranking and sorting, in addition to answering a range of standard demographic questions. Due to the sheer volume of the data compiled, only some of the most immediately pertinent findings are featured in this dissertation, divided thematically across two chapters.

Chapter 5 features the analyzed results of the combined freelisting and ranking tasks I included in the interview protocol. I used these tasks to elicit multiple representations of how participants ranked both local species, and local 'ecosystem services,' in terms of relative importance. I then analyzed the results using a technique known as 'salience analysis' (Borgatti 1996), which combines the relative frequency and relative position of terms on a list to arrive at a score indicative of how collectively 'salient' or, as I adapted the technique, important, a given list item is to a sample of respondents. In light of my ecologist colleagues' projections about the ecological effects of the coming trophic cascade (Espinosa-Romero, et al. 2011, Gregr 2014), these data ultimately enabled me to infer which demographic groups are most likely to perceive direct benefits, and which will not, as otters repopulate Clayoquot Sound. While I found evidence of expected differences amongst laypeople and government managers, there were several other demographically-mediated dimensions of difference that caught me by surprise in their starkness. Collectively, these serve as the core results reported in Chapter 5.

In Chapter 6, I present results from another two subsets of the freelisting data, demonstrating how simple techniques can be used to reveal rich, useful information on how people perceive and tacitly model their social-ecological system. To arrive at these results, I first used salience analysis, as in Chapter 5. However, I then innovated a technique with my colleague Michael Muthukrishna, whereby we used the results of the salience analysis as raw data for a series of subsequent network analyses using the free 'Gephi' software package (Gephi 2014). This allowed us to construct meaningful, multifaceted visual representations of participants' mental models of the local foodweb. From these representations, it becomes quite clear where important similarities and differences in perception lie amongst multiple stakeholders in the biosphere reserve. Due to the immediate relevance of these results for management, my colleague and I intend for them to be ultimately shared directly with decision-making boards and relevant local communities on the WCVI.

1.3.4 Conclusion

Finally, I conclude this dissertation with a section (Chapter 7) aimed at placing each of the key findings from the previous chapters in a larger context. I discuss some potential implications of the findings at both local and remote scales, as well as note some key caveats. I close with some suggestions for a research program aimed at further integrating insights from the study of cognition and culture into sustainable development and social-ecological systems research.

Chapter 2: From Rational Actor to Efficient Complexity Manager—*exorcising the ghost of* Homo economicus *with a unified synthesis of cognition research*

2.1 Introduction

Any effort that aims to account for some aspect of collective or individual human behaviour, from estimating societies' capacity to sustain themselves, to explaining why individuals so often hold unsubstantiated or debunked beliefs (e.g., the economy's independence from biophysical limits, or humans' non-effect on climate), must ultimately rely on a theory of human action. The response of twentieth century economic thought to this challenge has been a working model of humans as 'rational utility maximizers' (Monroe and Maher 1995, Sen 1997, Siebenhuner 2000, Simon 1982). This 'canonical' model—known popularly as *Homo economicus* or 'economic man' [*sic*]—assumes, by implication, that people have pre-determined, consistent desires, and that human behaviour is therefore the product of a calculated, utilitarian fulfillment of as many of those desires as possible, ostensibly as measured in additive, fungible bits of utility, or 'utiles.' Furthermore, in the most radically economistic, but still widely accepted, interpretation of this model, *Homo economicus*' self-interest is assumed to be primarily, if not entirely, *material*, concerned chiefly with increasing one's ability to consume, by amassing wealth (Frank 1987, Sen 1988)

It is now commonplace to note that this canonical model has been resoundingly debunked by a wide array of contemporary findings (Gintis 2000, Fehr and Gachter 2000, Henrich, et al. 2001, Jager, et al. 2000, Kahneman, Slovic and Tversky 1982, Roth, et al. 1991, Siebenhuner 2000, Thaler 2000, Van den Burgh, Ferrer-i-Carbonell and Munda 2000). Yet, as we will outline in more detail below, the figurative 'ghost' of *Homo economicus* appears to stubbornly persist even today, mainly in the form of lingering inaccurate assumptions that still structure academic and policy discourse in often subtle, undetected ways. We argue this elusive but enduring 'ghost' skews researchers' and policymakers' thinking about humans' role in complex social-ecological systems. As such, it is liable to hinder both (a) academic progress on questions of sustainable development, and (b) the pursuit of sustainable development as a normative goal (i.e., as an aim driven by ethical or political concerns).

Given the sheer volume of credible evidence debunking *Homo economicus*, it may seem perplexing that its legacy, or 'ghost,' endures. We argue that the unwelcome staying power of outdated canonical assumptions is at least partially due to the sheer diversity of partial replacements to *Homo ecomonicus* proposed by various disciplines, in very different language, with a confusing (and sometimes confused) mix of normative and descriptive flavour (Becker 2006, Bina and Vaz 2011, Faber, Petersen and Schiller 2002, Ingebrigsten and Jakobsen 2009, Jager, et al. 2000, Siebenhuner 2000, Van den Burgh, Ferrer-i-Carbonell and Munda 2000). The result is that, without an easily understood, easily remembered and—importantly—unified replacement for *Homo economicus* as a primary foundational model, researchers and policymakers alike are liable to unwittingly default to earlier debunked theories of purely rational, optimizing action. This is likely simply because canonical ideas are more familiar, less complex or merely assumed to be 'good enough' for a given job.[1]

Our aim in this paper is to move toward fully exorcising the 'ghost' of *Homo economicus* from sustainable development research by presenting a synthesis of insights from recent cognitive and behavioural science in consistent, intelligible language. As we argue in more depth below, the conclusion that emerges from such a synthesis is that, rather than assume we are a species of primarily rational, utilitarian optimizers (albeit subject to a number of problematic cognitive 'blind-spots'; e.g., Kahneman, Slovic and Tversky 1982), it is more empirically accurate to model *Homo sapiens* primarily as *cognitively efficient reducers of massive complexity*. Furthermore, as a mechanism for achieving cognitive efficiency, evidence suggests that people are primarily driven not by a clear-headed, time-and-energy intensive optimization of abstract utiles, but rather by rapid, less cerebrally-taxing, emotionally- and viscerally-felt responses to a narrow band of environmental complexity (Buck 1985, Camerer, Loewenstein and Prelec 2005, Murphy and Zajonc 1993). In fact, emotions appear so inescapably relevant to decision-making that they cannot be neatly separated from higher-level cognition (Haidt 2001, Pessoa 2008). The basic drive to achieve desirable emotional states (or 'affect') may sometimes be well served or even best served by a clear-headed optimization of an imagined metric of value, such as utiles (i.e., idealized rational utilitarianism). Crucially,

[1] Ironically, this constitutes a prime example of 'satisficing'—an immediate time-and-energy saving, but decidedly sub-optimal, problem solving strategy (Simon 1982)

however, the former is in no way synonymous with the latter, and it is a mistake to confuse one for the other.

In light of this distinction, the remainder of our paper is structured as follows. First, we present some examples of how the 'ghost' of *Homo economicus* persists in contemporary research and practice (Section 2.2). Next, in Section 2.3, we contrast the assumptions of the canonical model with a series of descriptive (rather than idealized or normative) principles we have identified over the course of reviewing a range of recent empirical findings on human behaviour and cognition. Together, these synthesized principles constitute what we call the Efficient Complexity Manager (ECM) Model of the human actor. In Section 2.4, we present the ECM model in a more formalized fashion, outlining in representational terms the implications of this work for understanding how people proceed from perception, to cognition, to action. The ECM model is, of course, a necessarily drastic simplification of human cognitive processing. As such, we do not present it as a conclusive replacement for other models. Rather, our goal is an accessible synthesis that usefully reflects the points of convergence amongst the most recent, relevant findings on human cognition from multiple disciplines. We argue that this, in turn, can lead to a more empirically-responsible foundation for work on the behavioural aspects of sustainable development challenges. We conclude with some suggestions for future research.

2.2 Spotting the ghost

Examples of the legacy or 'ghost' of *Homo economicus* are evident in the continued pervasiveness of several trends, both in social science generally and, to some degree, in sustainable development work in particular. At least three trends in this field strike us as particularly telling. These include:

- *A steady increase in contingent valuation and revealed preference studies, many of which assume preferences to be stable (Adamowicz 2004, Ariely, Loewenstein and Prelec 2003, Kahneman and Knetch 1992).* Because these studies produce monetary values as outputs, which are therefore commensurate with the language of the global economic system, they hold particular instrumental appeal for conservation and sustainability scientists. However, the underlying premise of many such valuation studies is an often-mistaken assumption that the preferences being 'measured' are stable (Kahneman and Knetch 1992). Empirical findings have firmly established that many preferences are not stable, but rather constructed (i.e., largely the product of contextual factors including framing, scale, scope, reference points, the cognitive complexity of the valuation task, and time pressure (Lichtenstein and Slovic 2006)). Nonetheless, framing and scoping problems remain under-scrutinized in many published papers (Desvousges, Mathews and Train 2012, Gomez-Baggathun, et al. 2010). Some argue the resulting focus is on generating data that provide monetary valuations, however unstable, rather than understanding realistically presented and empirically defensible choice behaviour and tradeoffs (Adamowicz 2004). 'Choice experiments' can help resolve this quandary to an extent, but these methods are still subject to the critique that they do not in fact capture actual, stable, behaviour patterns observed across a range of *in situ* contexts.

Rather, they extrapolate preferences from answers obtained in highly controlled situations that do not necessarily reflect or even approximate the diverse range of cognitive and social environments in which most behaviour actually occurs (Hudson, Gallardo and Hanson 2012). This exposes an ongoing assumption in the field that people's decision-making patterns are far more independent from *in situ* context than contemporary science (Hart, et al. 2010) suggests.

- *A dramatic rise in payment for ecosystem service (PES) schemes, and other market-based mechanisms, based on the implicit assumption that monetary incentives are primary motivators and relatively unproblematic (Engel, Pagiola and Wunder 2008, Kissinger, Patterson and Neufeldt 2013)*.[2] The exuberance with which such schemes have been embraced and promulgated, despite a relative dearth of supporting longitudinal evidence, suggests an underlying assumption that specifically *monetary* rewards are the best way to incentivize people. This assumption is consistent with a relatively myopic, but popular, interpretation of self-interest, whereby even when supposedly broadly conceived it is conflated with the single-minded pursuit of specifically monetary personal gain (Fong 2001, Ingebrigsten and Jakobsen 2009, Sen

[2] While such schemes can, theoretically, create win-win scenarios for biological conservation and poverty reduction, they can also have a slew of less savory effects, both predictable and unpredictable (Engel, Pagiola and Wunder 2008, Kissinger, Patterson and Neufeldt 2013). PES schemes can reinforce a commodification of ecosystems, which some argue is a key driver of ecological degradation in and of itself (Gomez-Baggathun, et al. 2010) putting long-term sustainability at risk (Siebenhuner 2000). Others note that primarily financial interventions like PES schemes can lead to both social and macroeconomic dislocations (e.g. the inflation of food prices, or major disruptions in social relations), which can ironically leave poor people worse off in the long run (Bute, et al. 2008, Fisher, et al. 2010, Frey 1994).

1988). Lamentably this is notwithstanding early advancements to the contrary in rational actor theory itself (Arrow 1963). This sort of confusion is perpetuated by the continued conflation of normative (i.e., prescriptive or hopeful) ideals, with more empirical-minded, descriptive accounts of actual human behaviour (e.g., Becker 2006; Faber et al. 2002; Ingebrigtsen and Jakobsen 2009; Siebenhuner 2000). Mixing normative and descriptive theories of human action has little empirical value, but is rather a phenomenon rooted firmly in early modern political philosophy, which tended to combine the two seamlessly and uncritically (Bowles and Gintis 1993, Thaler 2000). Unbridled enthusiasm for PES schemes perpetuates this problematic, self-reinforcing conflation, preventing more empirically-informed descriptive models of human motivation from taking hold.

- *A persistent gap between research output and policy outcomes based in part on prevalent assumptions that people will change their behaviour when provided with new information (Ruth 2006, Shi 2004, Turner, Adger and Brouwer 1998, Shove 2010)*. Although it is certainly not the only culprit, a major driver of the continued gap between research findings and sustainable development policy seems to be an inherited belief that, to help people act in their own or society's best interests, all one must do is provide them with the relevant facts (Bulkeley and Mol 2003, Macnaghten and Jacobs 1997). This belief follows logically from the canonical model, which implies people attend equally to all kinds of information and, unaffected by context or emotion, make perfectly consistent, calculated decisions on the basis of said information (Shah and Oppenheimer 2008). This 'information-deficit model' of human behaviour, however, has been soundly refuted by empirical data (e.g., Goldstein et al.'s (2008) demonstration that hotel guests were more likely to conserve water when told that other guests normally do so, not when given facts about environmental impact). Rather, people tend to grasp and attend to some kinds of information (visceral and emotional, or 'affect laden') more readily than others (abstract and cerebral) (Borgida and Nisbett 1977, Miloslavljevic, et al. 2012). In addition to content, the source of information, its form, and the way it is framed, are hugely important factors in how or even whether such information is absorbed (Gilovitch, Griffin and Kahneman 2002, Tversky and Kahneman 1992). Social norms, along with ingrained habits, can further affect the impact of new information on decision-making and behaviour (Goldstein, Cialdini and Criskevicius 2008, Klockner, Matthies and Hunecke 2003). In light of these empirical insights, it seems closing the gap between sustainable development research and policy will require forms of science communication that are more thoroughly disabused of inaccurate assumptions about how people attend to, accept, or reject, new information.

2.3 A set of empirically-derived principles for a descriptive model of the human actor

Here we focus on a number of convergent trends in contemporary empirical accounts of human cognition and motivation. We present these trends as a set of descriptive principles constituting a synthesis that contrasts with the core assumptions of *Homo economicus*. Taken as a whole, these principles comprise what we call an 'Efficient Complexity Manager Model' (ECM) of the human actor or, alternatively, *Homo efficens*. (See Figure 2.3 for a combined visual representation of these principles. See Section 2.4 for an abstracted formalization.)

2.3.1 Cognition is triage: we are efficient within our computational, energetic and temporal limits

While *Homo economicus* revolves around the notion of humans' rational maximization of self-interest, contemporary studies of cognition and decision-making[3] are converging instead on the importance of humans' *cognitive efficiency*. From psychology (Gilovitch, Griffin and Kahneman 2002, Shah and Oppenheimer 2008, Gigerenzer and Goldstein 1996, Peterson and Flanders 2002) to the study of artificial intelligence (Wray, et al. 2007), contemporary research suggests a primary task of our mental faculties is to usefully parse the vast barrage of potentially relevant information—i.e., the profound complexity—that continuously confronts us. Importantly, studies of human cognition indicate that people have limited information-gathering and computational power (due the size and nature of our brains and bodies) (Peterson and Flanders 2002), limited energy (Corcoran and Mussweiler 2010, Macrae, Milne and Bodenhausen 1994) and, most often, limited time (Weenig and Maarleveld 2002). To

[3] By 'cognition' we mean how the human body and mind integrates and makes sense of information. It is both a precondition for, and subsumes, the narrower concept of 'decision making,' which has connotations of conscious reasoning aimed at a particular actionable outcome. *Homo economicus* is largely a model of the latter, which takes the former for granted, essentially ignoring the important constraints imposed by the task of selecting and processing relevant information (Dougouliagos 1994). Here, we argue that an empirically sound understanding of decision-making cannot be usefully separated from broader theories of cognition. Hence, for the purposes of this paper, we tend to conflate the two when presenting our revised set of descriptive principles.

survive and flourish, we thus appear to have evolved intuitive and largely pre-rational (Greene and Haidt 2002) mechanisms and strategies for making good-enough decisions (particularly in hunter gatherer-type contexts) *given these limited resources.*

In this sense, our minds are not unlike doctors and nurses who engage in 'triage': a technique used in emergency situations with multiple casualties, whereby medical workers have to rapidly decide who gets treated, how, and in what priority, given limited amounts of time, supplies and personnel. The analogy is apt, in that we are continually inundated with an immense volume of potentially relevant information, and have to use our combined but limited powers of accumulated experience, instinct, and various degrees of conscious deliberation to decide how thoroughly (if at all) new data will be attended to, and in what order. Throughout this process, we must all the while economize for our limited reserves of time, energy and computational power. In other words, our minds are predisposed to sacrifice detail for efficiency.

The above vision lies in stark contrast to *Homo economicus*, who is assumed to make the best possible, fully-conscious, utility-maximizing decisions *irrespective of the actual computational, energetic and temporal limits* imposed by our physical makeup and surrounding context (Doucouliagos 1994). In the language of analogy, this model resembles more of an 'omnipotent, omniscient supercomputer' than it does the humble but effective 'triage nurse' implied by cognitive research. Shifting from an unwitting belief in the former, to an explicit integration of the latter, seems a pre-requisite for establishing a more empirically-responsible model of the human actor.[4]

2.3.2 Different goals, different glasses: what we perceive is a function of our goals

An explicit acknowledgment of our species' computational, energetic and temporal limits begs the question: how, exactly, is it that we humans parse complexity *efficiently* when making decisions? The canonical model assumes that we hold all relevant information in our minds simultaneously and apply a set of consistent decision rules until we arrive at an objectively optimal outcome (Shah and Oppenheimer 2008). Yet, from an empirically-informed perspective, how one parses complexity, which includes first distinguishing what is 'relevant' from what is not, is largely dictated by one's *in situ* goals (Peterson and Flanders 2002), which are themselves shaped by a combination of one's biological needs, one's beliefs and one's immediate context (Eclles and Wigfield 2002, Hickey and McCaslin 2001). Furthermore, psychology affirms that the motivations underlying our goals are experienced emotionally, mediated by affect (Buck 1985, Camerer, Loewenstein and Prelec 2005, Forgas 2000, Lowenstein, et al. 2001, Murphy and Zajonc 1993), and that emotions cannot be neatly separated from higher-level cognition (Haidt 2001, Pessoa 2008).

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[4] The central notion of the 'triage nurse' metaphor is efficiency under constraints. Since efficiency (defined broadly as a ratio of work output to energy inputs) is also "the bedrock of policy, planning and business approaches to sustainable development" (Jollands 2006), applying such a lens to human decision making has the additional benefit of aiding disciplinary and scalar consilience within and across ecological economics and other behavioural sciences.

In this sense, it can be said that even prior to any decision is made, our chosen methods for merely perceiving a situation itself (our metaphorical cognitive 'glasses,' of which we have many varieties) depend heavily on our moment-to-moment goals, which are, in turn, less conscious than they are visceral, liable to change readily in reference to context. In other words, our particular momentary goals largely dictate what narrow band of ambient information we attend to, while the rest gets filtered out (see Section 2.3.4).

2.3.3 The emotional elephant and rational rider: emotions bound reason, not the inverse

Emotions appear to motivate, contextualize, enable, and arguably precede, more conscious reasoning processes (Damasio 1994, Lavine 1998, Zajonc 2000)—not the other way around (Haidt 2001). It can thus take significant effort to override emotional inclinations (or 'affective appraisals,' more broadly), with sheer will or rational reflection.

Rather, a working assumption of efficiency implies the following: all else being equal, individuals will save time and energy by refraining from emotional introspection, and instead unwittingly allow their pre-conscious impulse towards emotional gratification, and away from emotional discomfort, to dictate the scope and direction of their reasoning. In other words, positive emotional experiences such as receiving peer validation, enjoying short-term gains, or avoiding the experience of shame, ostracism, paralyzing complexity, or loss, are all stronger fundamental drivers of behaviour than the more cerebral drive to, e.g., develop a flawless casual understanding of the world around us, or always remain perfectly consistent in speech and action (except insofar as one is able to associate said goals with an expectation of powerful emotional reward). Peterson and Flanders (2002) argue that this is particularly relevant to why people hold tenaciously to rigid theories and belief systems in the face of contradictory or threatening evidence, an issue directly relevant for sustainability science (e.g., the denial of climate change or refusal to accept the reality of non-linear thresholds with respect to the effects of resource depletion).

Social psychologist Haidt (2006) introduced a useful metaphor for this tightly linked dynamic between the behemoth of emotional motivation, and the incisive but relatively underpowered faculty of conscious abstract thought: the emotional 'elephant' and its rational 'rider.' An important point to note in this otherwise apt metaphor, is that the rider has evolved to help steer the elephant, not the other way around. As Haidt (2006) himself explains:

> [The] rider [is] placed on the elephant's back to help the elephant make better choices. The rider can see farther into the future, and the rider can learn valuable information by talking to other riders or by reading maps, but the rider cannot order the elephant around against its will (17).

The contrast between the model of cognitive efficiency that begins to emerge from these cumulative analogies, and the notion of a coolly rational *Homo economicus*, is stark. Whereas the latter implies a near Spock[5]-like absence of emotion, paired with the unlimited freedom of an omniscient, unconstrained supercomputer, the former—to begin melding our metaphors—suggests a resource-constrained metaphorical 'triage nurse,' with an array of

[5] I.e., Mr. Spock, the famously logical, emotionally unengaged character on the original science-fiction show 'Star Trek.'

discrete, goal-specific 'glasses,' serving as humble navigator atop a powerful elephant-boss of emotion. We discuss some implications of this more nuanced model for future sustainable development research in the conclusion.

2.3.4 Filter then fill-in-the-blanks: we mostly filter complexity and complete patterns

Homo economicus implies humans make decisions by applying something akin to the so-called weighted additive rule ('Franklin's Rule'). This is the idea that one tallies the pros and cons of any given action, assumes the perfect commensurability of said pros and cons, cancels out those of equal weight and arrives at a clear decision outcome (Shah and Oppenheimer 2008). While some specific contexts may allow for such deliberate and systematic evaluation, empirical findings suggest human cognition, culminating in decision-making, is more akin to (1) the *application of a sequence of filters*, (see Figure 2.1) followed by (2) *pattern completion*. One can think of this heuristically as a "filter and fill-in-the-blanks" process.

The act of filtering complexity begins physically, with our body's sensory inputs. Evolutionary theory suggests these have adapted to be able to capture only the small amount of information around us most relevant to our survival (particularly in a hunter-gatherer context), and to our moment-to-moment goals (see Section 2.3.2, above) (Peterson and Flanders 2002).[6] Once information has been filtered through our senses, and the metaphorical 'glasses' determined by our *in situ* goals (see Section 2.3.2), it then progresses to our brain's

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[6] For example, we detect sound waves but not radio waves, and middle-spectrum light but not ultraviolet light, let alone the near-infinite quantity of other potential data of which we are still unaware.

neural circuitry, the content of which can be thought of, here, as a memory bank of previous experiences (Bar 2009).

In metaphorical terms, it can be useful to imagine this memory bank as an ever-expanding collection of ‘maps,’ compiled and revised continually over the course of our lives, each map representing our understanding of a prototypical object or situation. Importantly, the function of these ‘maps’ (known in the broader literature as ‘mental representations,’ of which there are many varieties—see Figure 2.2) is to suggest, based on previous experience, how we should behave *in situ* to achieve our desired goals (Peterson and Flanders 2002, D'Andrade 1995).

Importantly, cognitive studies suggest that for this process we rely largely on *associative thinking*, whereby we compare and contrast current stimuli with what appear to be relevant ‘maps’, i.e., stored memories of previous experience (see Section 2.3.5)[7] (Bar 2009, Fauconnier and Turner 2002, Slingerland 2008). We are then able to reason by analogy to ‘*complete the pattern*’, as it were. That is to say, if one’s brain remembers A+B=C, and, via an intuitive, associative process of comparison and contrast, new stimulus ‘D’ is deemed similar in character to ‘A,’ then one’s brain ‘completes the pattern’ by inferring that D+B probably also equals C. One then proceeds to *act as if* that were so (Bar 2009, Lakoff and Johnson 1999).[8]

[7] On a physiological level, one can think of this process as follows: rather than make sense of each incoming sensory input entirely anew, our mind recruits already existing neural networks to compare and contrast new sensory experiences with memories of previous ones it deems similar or relevant (Bar 2009, Fauconnier and Turner 2002).

[8]In a sustainable development context, the benefit transfer method of ecosystem service valuation, for instance, is a transparent example of this.

Phrased differently, once information has been filtered through our senses, as per our *in situ* goals, we appear pre-disposed to intuitively and pre-consciously *scan for similarities and differences with respect to previous experience*, and act accordingly (Bar 2009). This is less effortful (Gilovitch, Griffin and Kahneman 2002), and hence more efficient, than applying such processes as the idealized weighted additive rule described above (Shah and Oppenheimer 2008).

2.3.5 Efficient cognition is distributed: the 'elephant and rider' belong to a herd

A *Homo economicus* model assumes people process inputs, and proceed to weigh pros and cons, as autonomous, independent beings. An empirical perspective, however, reminds us that this view is more early modern European idealism than fact (Persky 1995, Winch 1992). Rather, our cognitive processes are deeply dependent on our environment. We develop and operate in a context most often replete with socio-cultural and technological means for further reducing one's cognitive load. For instance, we defer to skilled or knowledgeable community members when dealing with a complex issue requiring action, we use modern information technology such as the internet to clarify what to do about virtually any conceivable problem, or we defer to our peer groups to determine contextually appropriate behavior (e.g., Goldstein, Cialdini and Griskevicius 2008). This penchant for offloading one's cognitive burden onto a more effective or reliable entity is known as 'distributed cognition' (Giere and Moffatt 2003).

By helping to reduce individual mental effort, distributed cognition functions as another key mechanism of efficiency (Zhang and Patel 2006), continually shaping our cognitive strategies and development to help us better adjust to our social and ecological milieu. In metaphorical terms, one can think of the ubiquity of distributed modes of cognition by imagining Haidt's (2006) elephant and rider as merely one human-pachyderm pair in a vast herd of other elephants and riders, each of whom is regularly copying, taking cues from, and communicating with, others in the herd.

2.3.6 Heuristics are the rule, not the exception: brains are not lazy computers

Empirical research in sustainable development, and social science broadly, is now replete with examples of flagrant violations of *Homo economicus* (Gintis 2000, Gilovitch, Griffin and Kahneman 2002, Henrich, et al. 2001, McDaniels, et al. 2003). However, the slew of biases that have been identified to account for these apparent idiosyncrasies of human judgment are often popularly interpreted as just that: idiosyncrasies, flaws, or cracks in an otherwise firmly rationalist foundation.

Such an interpretation only makes sense against an empirically-uninformed backdrop, wherein people are assumed to be fully self-conscious, rational maximizers of abstract utility who occasionally and unwisely cut corners by deferring to fast-and-frugal 'heuristics' (cognitive shortcuts) for dealing with complexity. That characterization is a radical misunderstanding (Kahneman 2003), symptomatic of the lingering paradigmatic privilege enjoyed by the canonical model. In contrast, from the unified perspective we are presenting here, heuristics are not 'shortcuts' for a system that otherwise reasons everything in a fully self-aware, linear, utilitarian fashion. Rather, it is exactly the inverse: humans possess a cognitive and behavioural system optimized for *in situ* efficiency, not precise utility maximization.

From this view, 'heuristics' are especially obvious examples of the fundamental and indispensable process of emotionally-driven, goal-oriented, time- and energy-efficient complexity reduction that is continually at work in people's minds. Fully conscious reasoning (which may or may not be explicitly structured on, or well approximated by, a model of abstract utility maximization) can sometimes arise, under certain conditions. However, much of cognition occurs in a semi-automatic, associative manner, shaped profoundly by one's surrounding context in confluence with one's set of underlying motivations, which in turn are experienced emotionally and viscerally (Buck 1985, Damasio 1994, Lavine 1998, Slovic, et al. 2007).

In other words, cognitive research suggests that Haidt's (2006) allegorical elephant rider is not a hyper-rational supercomputer with unlimited time and energy, who nonetheless gets lazy. Rather, the rider is, as described in Section 2.3.1, more like a full-time triage nurse whose *default* state is to make quick-and-dirty decisions in the face of voluminous complexity, and limited time and energy. Only when conditions are just right does the metaphorical triage nurse experience a lull in pressure, enabling him or her to deliberate at greater length, and with greater precision and foresight, than would normally be affordable. Otherwise, the triage nurse goes with his or her experience-informed, emotionally-mediated 'gut.'

In the context of sustainable development, looking at things from this perspective can help us de-mystify, and perhaps re-theorize, some of the apparently less 'rational,' more bemusing examples of observed behaviour alluded to above. With specific respect to sustainable development research, these include the embedding effect (McDaniels, et al. 2003), hyperbolic discounting (Gintis 2000), strong reciprocity (Gintis 2000), hyper-fair offers in economic games (Henrich, et al. 2001), seemingly unrealistic optimism or risk appraisals (Gilovitch, Griffin and Kahneman 2002), and so on. While an underlying theory of unconstrained rationality would perceive these as anomalies, a vision of the human mind as deeply embedded in shifting social-ecological contexts, engaging in constant information 'triage' and motivated to achieve desirable emotional states rather than abstract maximum utility, would in fact predict such kinds of behaviour.

2.3.7 Analogy as the unit of thought: the elephant rider navigates with maps

Kahneman and Knetsch (1992) compellingly argue that respondents to willingness-to-pay (WTP) questions (e.g., for the protection of lakes) often treat the hypothetical transaction not as if they were 'purchasing an outcome' (a contrived, unfamiliar task in reference to non-marketed environmental goods like distant lakes) but rather as if they were 'donating to a cause' (an only roughly analogous, but much more familiar, and hence less cognitively taxing, exercise). For WTP researchers, who are generally more interested in approximating the total economic value of environmental goods (e.g., lakes) than they are in respondents' donation preferences, this sort of response behaviour can be a significant challenge, resulting in the potential under-valuing of public goods (i.e., the embedding effect) **(**Kahneman and Knetch 1992, McDaniels, et al. 2003). What accounts for this sort of behaviour, and why is it surprising?

Evidence suggests the answer lies, again, in our propensity toward cognitive efficiency (or 'information triage', see Section 2.3.1), which requires us to use all neurological resources available to make actionable sense out of vast quantities of incoming data as quickly and effortlessly as possible. Above, we described how people do this by drawing on memories of previous experience that appear relevant, and by then 'completing the pattern' (see Section 2.3.4). This can also be helpfully conceptualized as reasoning 'by analogy' (Bar 2009, Lakoff and Johnson 1999, Slingerland 2008).

Different disciplines focus on different aspects of this process, using different vocabulary.[9] Despite said diversity of nomenclature, each field's conception of this mechanism has in common the notion of *analogy*: using one, relatively familiar, tangible, or otherwise easily recalled domain of knowledge ('source domain') to make sense of, and reason about, another, relatively less familiar, domain ('target domain').[10]

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[9] Artificial intelligence researchers call this 'case-based reasoning' (De Mantaras, et al. 2005). Cognitive linguists call this the 'mapping' of 'source domains' (familiar, tangible ideas or memories) onto 'target domains' (more opaque, less familiar realms of knowledge or complexity) (Fauconnier and Turner 2002, Lakoff and Johnson1999, Slingerland 2008). Philosophers of science call this 'model-based reasoning' and have documented the crucial role that mental experimentation using this aspect of cognition plays in the creation and refinement of new scientific concepts (Magnani and Nersessian 2002).

[10] A classic, and especially clear, example of analogical reasoning is described by Gentner and Gentner (in Gentner and Stevens 1983). They examined how different 'mental models' (internal, mental representations of external reality) can affect students' reasoning about electrical circuits. The authors found that the students who participated in their study tended to think about electricity in one of two ways: one, *like a flowing liquid* or, two, *like a density of particles*. Those participants who imagined electrical current to flow like a liquid were more accurate in their predictions about various arrangements of batteries in a circuit than they were about the effects of resistors on a circuit. The exact inverse held true for participants whose mental models characterized electricity as a density of particles. Those who reasoned using the flow analogy were best able to distinguish between current and voltage, which are analogous to the flow-rate and pressure of a moving fluid, respectively. Those who preferred a particle analogy were best able to account for the role of resistors, because the latter operate like barriers containing gates, which restrict the number of electrons passing through per unit of time.

Key to any notion of analogical reasoning is the idea that one takes a salient attribute of one thing (e.g., the fact that water 'flows') and 'projects' or 'maps' it onto another thing (e.g., electricity), in order to make new and useful inferences (e.g., that electricity can be thought to flow, giving rise to the idea of 'current') (Gentner and Gentner 1983). By engaging in this kind of reasoning, we can make use of lessons already learned from previous experience when navigating new scenarios that we deem roughly analogous (Bar 2009).

This mechanism, which cognitive linguists call the 'invariance principle' (Lakoff 1993), appears to be a core feature of our cognition (Peterson 1999, Peterson and Flanders 2002). We are also able to selectively combine aspects of different source domains together to create entirely new, increasingly detailed analogical representations of the world around us (a process called 'conceptual blending'). This capacity to usefully blend analogies appears to be a fundamental mechanism of human creativity (Fauconnier and Turner 2002, Slingerland 2008).

Nonetheless, despite the efficiency and creativity that analogical reasoning affords, it does have drawbacks. In the psychological study of heuristics, analogical reasoning gone awry is known as 'attribute substitution' (Kahneman 2003). This occurs when a person erroneously (often unconsciously) assumes similarity between cases that are in fact different in consequential ways, and then goes on to make an error in judgment stemming from that difference (in essence, using the wrong 'map'). The embedding effect, described above, is merely one such example.

Given these findings, we argue it can be helpful to think of people as always relying on some kind of simplified 'map' or 'analogical representation,' in a broad sense (be it an internal representation such as a ‘mental model,’ a specific, analogous memory, or an external representation, such as a literal, physical image, text, etc.) to frame and guide their interactions with the complex world around them (Peterson and Flanders 2002, Shore 1996). (See Figure 2.2 for a typology of the various categories of analogical representation described in the cognitive science literature.)

As psychologists Peterson and Flanders (2002) argue: “We are doomed to formulate conceptual structures that are much simpler than the complex phenomena they are attempting to account for.” (429)

The question is not why we rely on such simplifications; cognitive science suggests this is inevitable given our species’ biologically-mediated perceptual, energetic and temporal limitations (Peterson 1999, Shah and Oppenheimer 2008). Rather, the more relevant question to answer is what factors influence people to draw on one analogical representation versus another, when, and why. In other words, how does Haidt’s (2006) proverbial elephant-rider duo determine which map to use? We consider this question in Section 2.3.5.1, below.

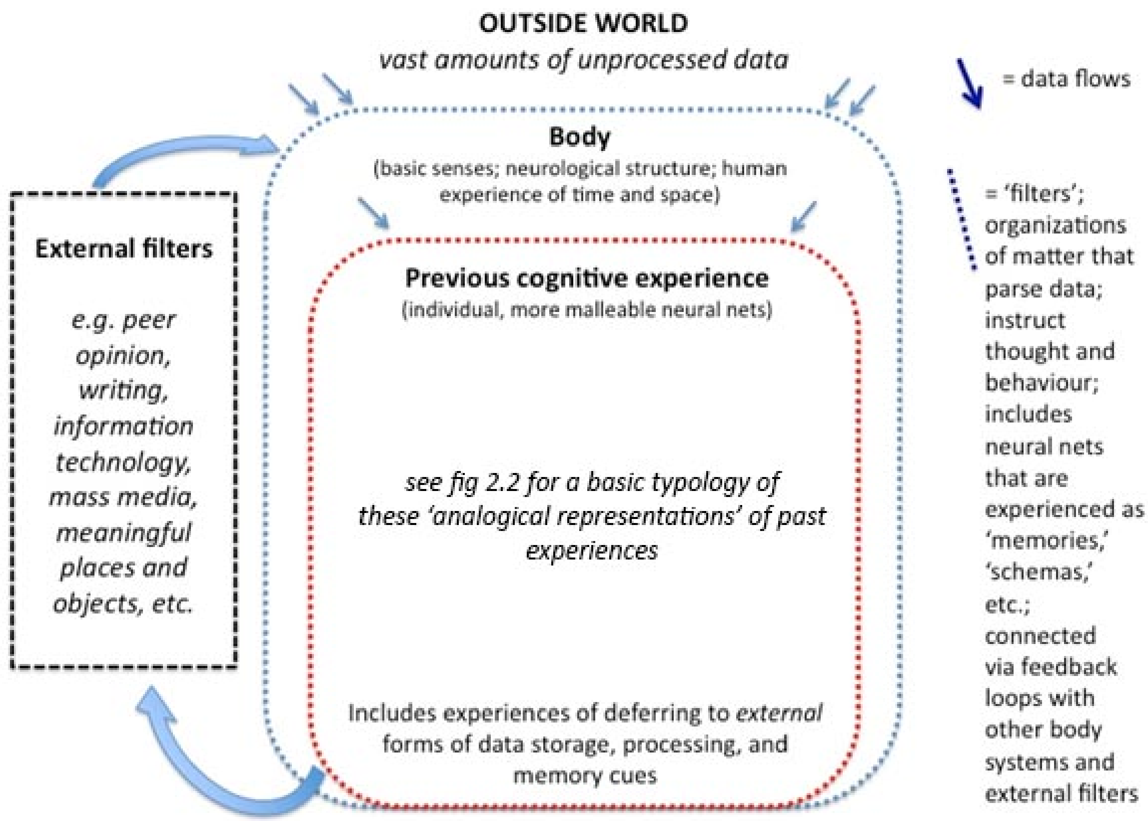

Figure 2.1 Abstracted schematic of the complexity-reduction process

This figure is a synthesized representation, in abstract terms, of the process whereby we use our bodies and minds to filter the vast barrage of new data with which we are perpetually confronted. This iterative helps us make reasonable inferences that facilitate useful action (Bar 2009, Giere and Moffatt 2003, Lakoff and Johnson 1999, Fauconnier and Turner 2002, Slingerland 2008, Peterson and Flanders 2002).

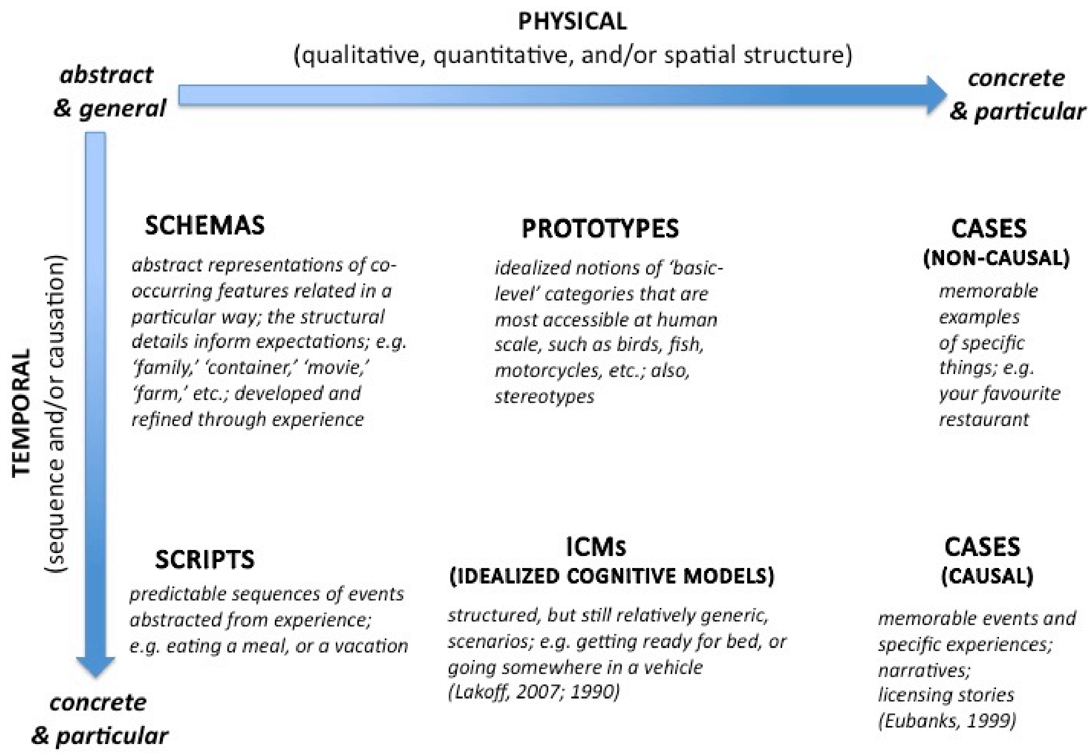

Figure 2.2 Typology of analogical representations

This figure shows a range of various types of analogical representations (metaphorical 'maps') of previous experience that we draw upon when attempting to make sense of how to act in the face of new data. Different disciplines tend to focus on different varieties of representation, and often use different nomenclature. For clarity's sake, here we have ordered some key varieties on two axes: physical structure, and temporal structure. (Slade 1991, Kolodner 1992, D'Andrade 1995, Eubanks 1999, Lakoff and Johnson 1999, Lakoff 2007, Atran and Medin 2010).

2.3.7.1 Analogies are chosen by availability, associations, and contextual cues

For those of us studying real human behaviour in the context of sustainable development, it is helpful to know which kinds of analogies people will tend to draw on, when, and why. For instance, why would respondents draw on experiences of donation, rather than commerce—or even simple addition—when answering WTP questions about protecting all the lakes in a country, versus just one lake? What factors would help in better designing surveys to accommodate these kinds of tendencies? In cognitive terms, this question could be phrased as: Why do people's brains select one source domain, rather than another, to reason about a given target domain?[12] A diversity of research findings (see Sections 2.3.7.1.1 and 2.3.7.1.2, below) suggest at least two answers to this question, one involving a proximate cause, and the other a more distal cause.

2.3.7.1.1 Availability

The first, proximate influence on which analogical representation one draws upon is availability (or 'accessibility'): this is simply the relative ease with which something comes to mind relative to something else (Tversky and Kahneman 1973). The more readily available a given domain of thought is, the more likely it is that we will draw on it to reason about any given situation, as doing so requires less effort than drawing on a less available domain. All else

[12] For clarity, consider Gentner and Gentner's (1983) electrical current experiment once more. In terms of the experiment, the question we are asking here is why some students chose to think of electrical current *as a flowing liquid*, while others chose to think of it *as a series of small round objects*. Moreover, why were the source domains they chose limited to the two mentioned here? Why didn't the participants in the experiment choose to think of electrical current as something else entirely, such as a donkey, or frying pan?

held equal, what makes a given domain 'available,' or 'accessible,' for our minds to reason with involves at least two factors: (1) how frequently the domain is recalled; i.e., one's 'habits of mind' (Bang, Medin and Atran 2007), which, in physical terms, equates to how practiced we are at exercising the particular neuronal pathways associated with that given domain (Fuster 1999, Read 1995); and (2) how emotionally charged (or 'affect' laden) a given domain is (Keller, Siegrist and Gutscher 2006). The more often one 'rehearses' (i.e., accesses or 'activates') a particular source domain, and the more intense emotions it evokes, the more available it is. Hence, we are more likely to draw on that domain, or 'map,' rather than another, when attempting to interpret a new instance of complexity.[13]

2.3.7.1.2 Context and associative networks

The second, more distal cause determining which source domain an individual will be disposed to draw on has to do with what creates relative differences in availability to begin with (i.e., when all else is *not* held equal as above). At least two other factors in addition to the basic effects of rehearsal and emotional content further determine availability. These are (1) context, broadly conceived; and, (2) the particular network of associations amongst various emotions, ideas, memories and concepts that each of us has (what Bower (1981) coined 'associative networks'). There are a plethora of findings in psychology detailing the effects of context (often called 'priming' effects) on how we make sense of complexity and, ultimately, how we take

[13] See, e.g., Leiserowitz (2006) and Roeser (2012) on the role of affect, associative imagery, and availability in risk perception, particularly as concerns climate change.

decisions (Kusev, van Schaik and Aldrovandi 2012, Tversky and Kahneman 1981, Smith and Semin 2004, Storbeck and Clore 2008).

Context, here, should be thought of in its broadest possible sense. Through a largely unconscious process of association (Claxton 1999, Dijksterhuis and Nordgren 2006), virtually anything a person perceives or experiences at a given time can have an influence on his or her thinking, on the analogical representation (or 'map') of the situation the person's brain (re)constructs and, ultimately, on his or her choice of action. This includes *external* context, such as how presenting bicultural people with images associated with one or the other of their two learned cultures can produce different responses to the same question (Benet-Martinez, et al. 2002). It also includes '*internal'* context: one's real-time emotional state, object of mental attention, prior train of thought, or preexisting underlying goals (e.g., Cohen et al.'s (2006) demonstration of how the emotions evoked by a perceived insult can directly alter how an individual behaves in an experiment minutes later[14]). All of these contextual factors interact continuously with our networks of mental and emotional associations to help us draw on apparently useful 'maps'—i.e., appropriate memories from which to reason analogically—when dealing with a new instance of complexity.[15]

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[14] The notion that different emotional states can activate different associative memory networks, and thus affect decision-making, is known in the cognitive science literature as the 'somatic marker hypothesis' (Damasio 1996)

[15] Interestingly, with reference to public understanding of ecological science, it is worth noting that the greater the number of cues to which an individual feels he or she must consciously attend, the more likely it appears that individual will default to a very simplistic analogical representation (Ableson and Levi 1985), imaginably as a response to the emotional discomfort of cognitive overload (Peterson and Flanders 2002).

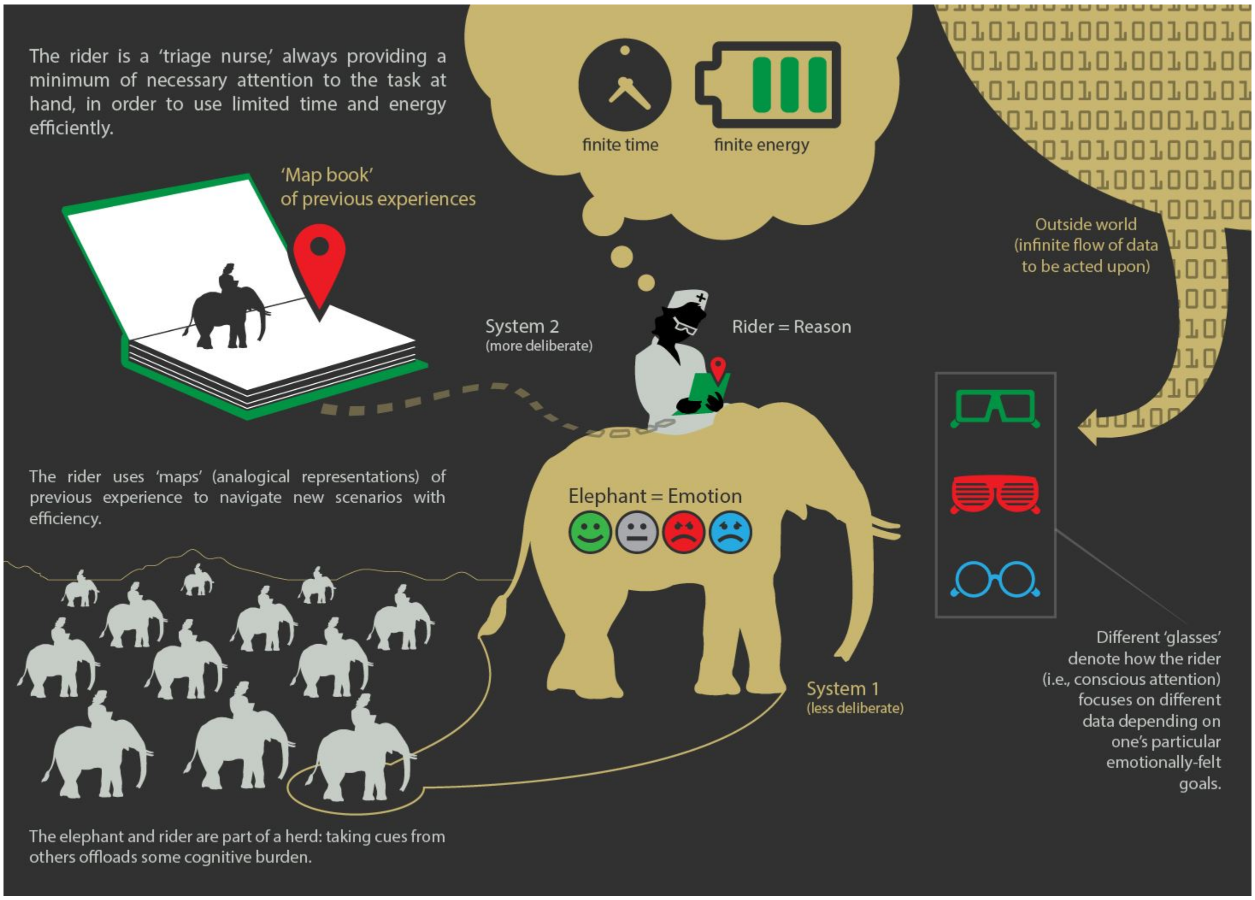

Figure 2.3 Metaphorical representation of '*Homo efficens*', the efficient complexity manager model of the human actor

This representation combines (a) Haidt's (2006) 'elephant and rider' metaphor (see Section 2.3.3) with (b) the other principles described in Section 2.3. The powerful 'elephant' is analogous to our emotions, which lie at the root of our motivational system. The less powerful, but more consciously deliberate 'rider' is analogous to the cognitive process that is required in order for us to make useful sense of the vast quantities of data to which we are constantly exposed. In this, the Efficient Complexity Manager Model, the 'rider' is likened to a 'triage nurse' (see Section

2.3.1) in that (s)he is always working under a set of constraints (limited time, energy, and processing power) and must therefore make continual 'fast-and-frugal' (i.e., efficient) decisions about what to attend to, and how, so as to guide action. One's particular in situ goals, which are dictated largely by the emotion-based motivation system, determine which 'glasses' the rider must wear (see Section 2.3.2): different goals require attention to different kinds of information, as our limited minds are unable to attend to everything at once (Peterson and Flanders 2002). To further increase efficiency, the rider always refers to a 'map' of some sort to help guide action (see Section 2.3.5). Figurative 'maps' are in fact analogical representations of prior experience (see Figure 2.2). Referring to 'maps' saves time and energy by precluding the need to reason entirely from scratch. Finally, the elephant-rider pairs in the distance represent the notion that each of us is in fact part of a much wider network, or 'herd', of cognitive processing (see Section 2.3.4.1): by interacting, taking cues, and copying from those around us (both past and present), we are able to dramatically reduce each of our own individual cognitive burdens, and hence maximize the efficiency with which we determine appropriate actions. This last phenomenon is known as 'distributed cognition.' (Haidt 2006, Peterson and Flanders 2002, Peterson 1999, Giere and Moffatt 2003, Lakoff and Johnson 1999, Kahneman 2003, Shah and Oppenheimer 2008).

2.4 A formalized synthesis: the efficient complexity manager (ECM) model

We have thus far outlined some of the common principles underlying what cognitive and behavioural scientists from various disciplines regard as the means whereby people tend to perceive their environment and, ultimately, make decisions. What a synthesis of these findings suggests is a model that emphasizes humans' evolved ability to reduce massive complexity in a time- and energy-efficient way, a process bounded by our finite brains' capacities and limitations[16] (Peterson and Flanders 2002, Doucouliagos 1994, Shah and Oppenheimer 2008). As such, rather than judiciously applying abstract utility-maximization rules irrespective of context, it appears that people deal with complexity instead by being *highly cognitively resourceful*. We attend to the myriad contextual cues present at any given time (including both external, environmental cues, and internal, associative, physiological and emotional cues) to search efficiently for usefully analogous experiences already stored in our memories (or, by extension, available in our larger social, cultural, technological contexts). We then use said analogues to reason about the situation at hand—sometimes consciously, when conditions allow, but often not (Kahneman 2003). Finally, we act on the basis of said reasoning, a process roughly analogous to map-based (as opposed to abstract rule-based) navigation.

Due to economy of time and energy, this process does not often involve a willful engagement in mental abstraction (such as consciously applying the weighted additive rule to all possible courses of action) or any substantial emotional introspection or self-reflection. Rather, underlying goals (Peterson and Flanders 2002), tied to pre-rational emotional impulses

[16] These capacities and limitations are, presumably, a product of the particular social and ecological contexts in which our species evolved over deep time (Cosmides and Tooby 1994, Jackson 2002).

(Buck 1985, Greene and Haidt 2002), largely drive and contextualize both one's perception of a given situation (Ohman 2001, Peterson and Flanders 2002) and one's subsequent reasoning about it (Haidt 2001). Often, due to emotional factors and time and energy constraints, conscious reasoning does not even have the opportunity to surface at all (Kahneman 2003). In other words, in the interest of time and energy, Haidt's (2006) metaphorical elephant often acts on its own, without significant deferral to the more deliberate rider (a phenomenon Kahneman (2003) popularly refers to as 'System 1' thinking, or 'hot' cognition, which he contrasts with the more time-intensive, reasoned 'System 2' approach of the conscious mind, also sometimes called 'cold' cognition).

Given these attributes, here we refer to our synthesized characterization of the human actor as the 'Efficient Complexity Manager' (ECM) model or, simply, *Homo efficens*. This model is not intended to be a conclusive or comprehensive account of human cognition and motivation. Rather, it is meant as a simplified expression of how recent findings can be unified in a consistent fashion to help better integrate empirical insights from various disciplines into a coherent, contemporary theory. To clarify, immediately below we demonstrate in eight condensed, chronological steps how the ECM model suggests people proceed from perception, to cognition, and ultimately to action. While in reality the process is not likely to be entirely linear, here we present it linearly, purely for clarity's sake:

1) *Perceive Stimulus.* We encounter a new instance of complexity—the 'target domain' (Lakoff and Johnson 1999, Fauconnier and Turner 2002, Slingerland 2008)—interpreted via our body's sensory inputs.

2) *Draw on Context*. We intuitively draw on contextual information to further reduce the time and effort required to usefully interpret the stimulus. Context, here, includes framing, and all other 'external' social and environmental conditions (what we see, hear or sense at the time), as well as 'internal' mental, physiological and emotional conditions (what is 'on our mind,' how we feel at the time, pre-existing goals and motivations that we experience largely emotionally) (Damasio 1994, Damasio 2000, Lavine 1998, Slovic, et al. 2007). This contextual information helps our mind narrow in on which source domain(s) ('maps') of previous experience are most relevant in making further sense of the stimulus (physiologically speaking, which clusters of previously instantiated neural connections to use to determine appropriate action) (Kokinov and Petrov 2001, Peterson 1999).

3) *Draw on Associative Networks.* Given the perceived attributes of the stimulus, and all contextual cues, we then use *association* to search our figurative 'databank' of memories for analogous cases (in metaphorical terms, useful 'maps'; in physiological terms, relevant clusters of neural connections). This process is not unlike using detailed search terms (analogous, here, to contextual cues in Step 2, directly above) to query a tagged database such as an internet search engine (analogous to the mind's associative networks of memory) for relevant domains

of knowledge from which to draw in making sense of the stimulus (Bar 2009). Domains ('maps') that we use more commonly (i.e., more frequently recalled or 'rehearsed') will be easier for our mind to access, and we will thus be more likely to draw on those domains relative to others (Fuster 1999).

4) *(Re)construct an Analogical Representation*. Our mind then draws from the source domains of knowledge we deem relevant in light of Steps 3 and 4 to (re)construct an analogical representation (a contextually refined 'map') of the stimulus that our mind is attempting to interpret (Fauconnier and Turner 2002). Depending on context, this process can range from being highly conscious, to being entirely unconscious and nearly instantaneous (Kahneman 2003). At this point, we may also deem it appropriate to defer to other sources (e.g., more knowledgeable individuals, social norms, technology) when constructing a simplified representation of the situation (i.e., reliance on distributed cognition) (Giere and Moffatt 2003).

4a) *Identify Goals.* Parallel to Steps 1-4 above, we are continually reshaping our goals dependent on our surrounding context and emotional state. New stimuli, new contexts, new associations and new analogical representations, feed back into this process to create goals specific to time and place. These goals may include, but are not limited to, maximizing our personal material gain. They may also include whatever else produces a sense of emotional reward given the particular context (e.g., be that averting a negative feeling such as shame or fear, or increasing a positive feeling such as a sense of security, inclusion or social worth) (Buck 1985, Eclles and Wigfield 2002, Markus and Kitayama 1991, Peterson and Flanders 2002). Because this process is so intimately linked with emotion and affect (Haidt's (2006) figurative 'elephant'), it is largely pre-rational (Greene and Haidt 2002).

5) *Reason.* In light of the goals determined in Step 4a, we then use the model constructed in Step 4 to reason about how we should act towards the stimulus. As with Step 4, this can range from an intuitive, time- and energy-efficient, largely unconscious process (i.e., what Kahneman (2003), Stanovich and West (2000) call 'System 1') to a more deliberate, energy-intensive, fully conscious process, when specific conditions allow (what Kahneman (2003), Stanovich and West (2000) call 'System 2').

6) *Act.* We act accordingly.

7) *Observe and Remember the Outcome*. We then observe the outcome of our chosen action, and said outcome is stored in our databank of memories (i.e., our 'collection of maps') to be drawn upon in future iterations of Step 3 (Bar 2009).

8) *Iterate.* The process is iterative: each outcome serves as a new stimulus, and the cycle repeats *ad infinitum*. Our mind thus continually accumulates lived experience, perpetually deepening its databank of associative memory.

Linearly, steps 1 to 4 of this process can be represented as follows:

$$\textbf{S}\text{timulus} + \textbf{C}\text{ontext (external \& internal)} + \textbf{A}\text{ssociative } \textbf{N}\text{etworks} \xrightarrow{\textit{produces}} \textbf{A}\text{nalogical } \textbf{R}\text{epresentation}$$

or

$$\mathbf{S + C + AN \rightarrow AR}$$

Steps 5, 6 and 7 can be represented as:

$$\textbf{R}\text{eason} \rightarrow \textbf{A}\text{ct} \rightarrow \textbf{O}\text{bserve} + \textbf{R}\text{emember}$$

or

$$\mathbf{R \rightarrow A \rightarrow O{+}R}$$

In total, the iterative process can be represented visually as in Figure 2.4, below. The numbers (1, 2, etc.) highlight the approximate (if simplified) sequential ordering of steps (e.g., Step 1, Step 2, etc.).

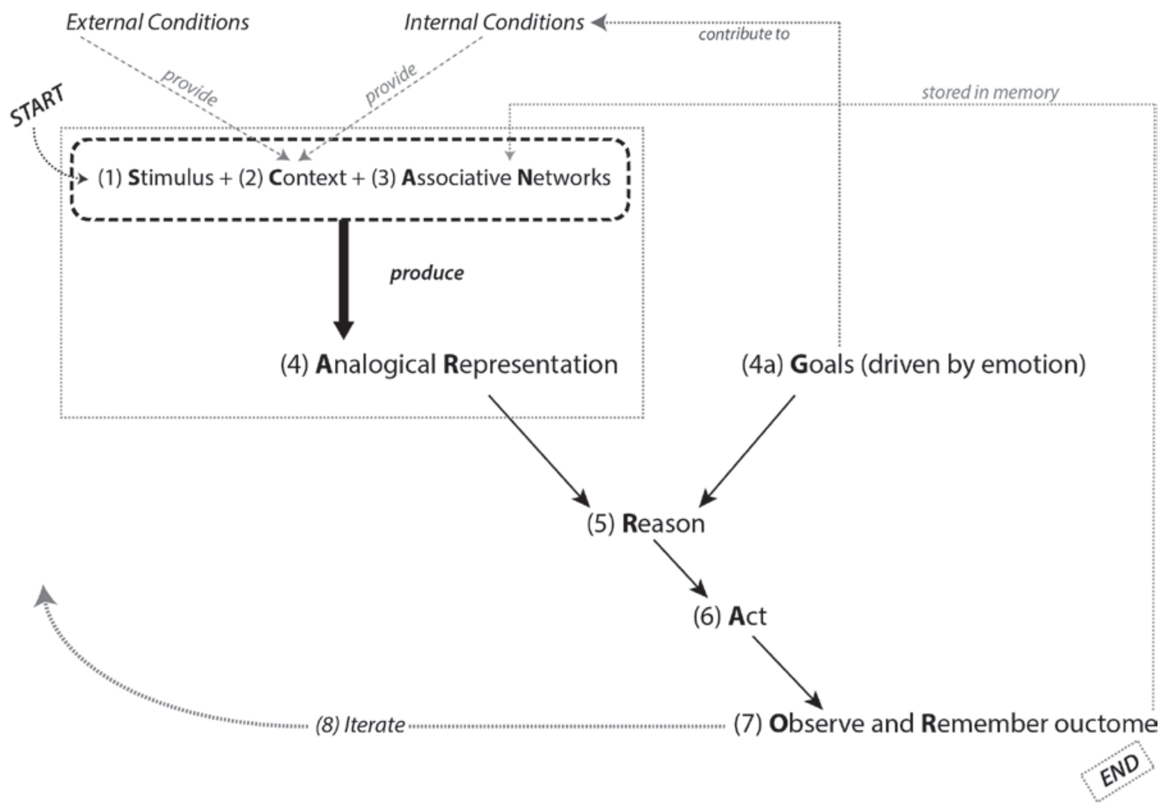

Figure 2.4 Sequential flow diagram of the efficient complexity manager (ECM) model

This diagram represents how the Efficient Complexity Manager (ECM) model, or Homo efficens, accounts for how people reduce complexity into actionable behaviour while economizing for time and energy. The numbers in brackets (1-8) indicate the sequence of steps in an approximate linear order. See Section 2.4 for a full description. (Bar 2009, Damasio 1994, Damasio 2000, Fauconnier and Turner 2002, Haidt 2001, Kahneman 2003, Lakoff and Johnson 1999, Lavine 1998, Peterson and Flanders 2002, Slovic, et al. 2007)

2.5 Conclusion

A core challenge to the field of sustainable development is crafting a clear and unique identity that distinguishes it from the neoclassical economics paradigm, while avoiding the pitfall of becoming a catch-all for any and all transdisciplinary or heterodox work (Ropke 2005, Spash 2012). We believe that a strongly evidence-based, explicitly descriptive (as opposed to normative or wishful) model of the human actor can add to the growing theoretical foundation that is key to consolidating such an identity for the field.

Thus, here we have presented a descriptive model of the human actor (the Efficient Complexity Manager model, or '*Homo efficens'*) that synthesizes diverse empirical findings and theory on cognition, motivation and decision-making into what we hope is a manageable and useful summation. While the canonical model is premised on the notion of rational self-interest, often narrowly construed—the product of a blurred mix of both normative thought and questionable evidence—the ECM model revolves instead around the notion of humans' *cognitive efficiency*, achieved through mechanisms that are perpetually guided and contextualized by emotion.

Importantly, this model is intended as a purely descriptive synthesis of recent findings from relevant disciplines, as distinct from any normative vision of an idealized human actor. While there is certainly a role to be played both by normative visions, and by descriptive accounts, respectively, we believe clearly making such a distinction clear is crucial for future progress on this topic.

With further respect to the issue of progress, we reiterate that the ECM model is by no means comprehensive or final and should not be interpreted as such. Rather, it is intended only as a first-cut synthesis of *descriptive* human actor research, which, ideally, will help ecological economics to 'exorcise the ghost' of *Homo economicu*s from the field. Finally, the synthesis we have provided here also implies some fruitful avenues for future research. These include, in particular: studies and methods that further examine the nuances of (1) *in situ* choice behaviour (e.g., Schlapfer and Fischhoff 2012, Welsh and Kuhling 2009); (2) the role of mental models, analogy and metaphor in both participants' and researchers' thinking, (e.g., Anderies, et al. 2011, Norton and Noonan 2007, Raymond, et al. 2013, Schulter 2009) and, (3) the role of affect and emotion in economic and environmental decision-making (e.g., Arana and Leon 2009, Arana and Leon 2008, Boyer 2008, Finucane, et al. 2000). Many researchers are already employing methods aimed at analyzing precisely these factors. We hope that the simple, but unified, model we have presented here will help provide an even clearer, more solid theoretical foundation for the continuation and refinement of such work.

Chapter 3: The Salient Moustache and the Silent Majority—*cognition, culture and (un)sustainable development in the Mt. Carmel UNESCO Biosphere Reserve*

3.1 Introduction

Development goals, no matter how straightforward or achievable they may seem, are often fatally sabotaged by actors' implicit beliefs. These beliefs, or "unknown knowns" (Zizek 2006, Clark and Ranney 2010), consist of largely unspoken, sometimes pre-conscious assumptions about how the world works (Peterson and Flanders 2002), including inferences about other actors' motivations and beliefs (Noelle-Neumann 1993, Prentice and Miller 1996). They are an ubiquitous feature of human behaviour (Peterson and Flanders 2002), affecting decisions across all parties, from politicians, to civil servants, to local citizens.

When left unexamined, implicit beliefs can and do surface in a multitude of vexing ways, from negative effects on well-being due to implicit mismatches between expectations and reality (Victor, et al. 2013), to skewed outcomes due to unarticulated but deeply held beliefs about gender roles (Maertens 2013). In this paper, we draw on fieldwork in and around the Mt. Carmel UNESCO Biosphere Reserve, in northern Israel, to demonstrate how such 'unknown knowns' can be identified, understood and made transparent to relevant actors. In so doing, we draw on theory rooted in the emerging field of cognition-and-culture, which synthesizes insights from disciplines such as psychology, anthropology, economics and cognitive science to make actionable sense of people's real-world, *in situ* behaviour.

3.2 Mt. Carmel UNESCO biosphere reserve

Mount Carmel UNESCO Biosphere Reserve (MCBR) is a contested space of multiple land-uses in what is today northern Israel. The 26,600-hectare Reserve is situated on a raised plateau overlooking the Mediterranean Sea to the north and west, with a view of the verdant agricultural Galilee region to the east. The MCBR consists of a patchwork of forested national park and nature reserve, as well as several human settlements. Mount Carmel National Park (MCNP), which comprises the largest portion of the Reserve, was created in 1971 by the Israeli state. In 1996, successful petitioning on the part of a coalition of Israeli civil servants and state officials[17] led UNESCO (the United Nations Educational, Scientific, and Cultural Organization) to designate the southern Mt. Carmel region a Biosphere Reserve (Frankenberg 2009). UNESCO Biosphere Reserves are unique protected areas nominally aimed at balancing conservation concerns with human development needs through a tripartite zoning system (UNESCO-MAB 2008).

In the case of the MCBR, that 'balancing' of conservation and human concerns expresses itself in the form of tensions between the prerogatives of the state (which *de facto* represents the interests of the Hebrew-speaking Jewish majority of the country), and the

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[17] This coalition was led primarily by individuals in the Israel Nature and Parks Authority, and in collaboration with the Israeli Ministry of the Environment, faculty from the University of Haifa and the national Israeli UNESCO 'Man and the Biosphere' (MAB) committee. The notion was first raised in the context of a visit from Germany's Environment Ministry in the aftermath of the first Gulf War. The German minister wanted to donate a Geographic Information System tool to an appropriate institutional recipient in Israel as a show of solidarity. There was heated contention amongst the various stakeholders as to who constituted the most appropriate recipient of the gift, and the notion of collaboratively petitioning for Mt. Carmel to receive Biosphere Reserve status was seen as a way to both improve future management of the area, while simultaneously healing inter-institutional strife (Frankenberg 2009).

residents of two Arab villages, ‘Isfiyya and Daliat al-Karmel. ‘Isfiyya and Daliat al-Karmel are located directly adjacent to each other in the heart of the MCBR and are home to approximately 11,300 and 16,000 residents respectively (ICBS 2012), most of whom belong to the insular, endogamous Druze community.

The Druze of Mt. Carmel are descended from ancestors who migrated south from what is modern-day Lebanon to settle the region sometime in the 17th century CE, 200 years prior to modern Jewish immigration (Firro 1999, S. Falah 2002). Today, in the settled wake of the ethnic war that followed Israel’s founding as a Jewish state in 1948, the Carmel Druze constitute a small subset of the country’s remnant Arabic-speaking minority. In stark contrast to Muslim and Christian Arabs, Druze trace their confessional roots to an 11th century Egyptian syncretism of Shi’a Islam and neo-platonic philosophy, which later developed into a distinct esoteric tradition (Parsons 2000).[18] The Druze religion as it exists today is now so secretive that the majority of Druze themselves are kept purposefully uninformed of the details of their faith by religious scholars. Only a minority within the community who take explicit religious vows and embark on a prescribed spiritual path are given gradual access to the Druze faith’s deeper teachings. This religiously initiated segment of Druze society identifies itself explicitly through a unique style of dress (including loose fitting black pants, white headgear and, in the case of males, outsized moustaches) as well as circumscribed patterns of behaviour, distinct from that of their less spiritual relatives (Dana 2003).

[18] Most Druze today live in isolated towns scattered across mountainous highlands in Lebanon, Syria, Jordan and Israel (Parsons 2000).

The Druze are also a unique subpopulation in Israel insofar as they are the only sizeable Arabic-speaking, non-Jewish community to serve as conscripts in the Israeli army. This 'special relationship' was cemented during the 1948 Jewish-Arab war, and has resulted in the Druze being regarded as a key strategic asset to the Israeli state and military since that time (Parsons 2000). Nonetheless, tensions between the Druze of Mt. Carmel and the Jewish state authorities have been rising gradually for decades, due to conflict over land-use in and around the MCNP. Under Ottoman property law, many Druze claim hereditary ownership over tracts of land in what is now protected parkland. While the Israeli state recognizes these claims in principle, and has detailed records of ownership, Israel's national park law bans owners from altering these parcels of territory in any way that departs from how said land was being used at the time of the national park's declaration in 1971 (Rosenberg 2011). Given most of this land had either fallen into relative disuse, or was under small-scale agricultural production at that time, Druze today are thus legally banned from accessing their hereditary land for development, despite a rising shortage of living space within town limits.

This paper first characterizes the contention over Mt. Carmel given these issues of limited land-access, describing how the Druze-state tension was further fuelled, literally, by a massive forest fire that ignited in the reserve in December 2010. Thereafter, we turn to insights provided by emerging theory in the behavioural sciences to reveal how and why some of the more entrenched assumptions on both sides of the tension have less to do with actual, robust differences over land-use preferences, and more to do with actors' intuitive means for reducing the complexity and uncertainty of their difficult political landscape. The outcome of said attempts to reduce complexity include an apparent essentialization of the Druze community both by non-Druze, as well as by the Druze themselves, as well as a widespread pattern of misassumptions about others' preferences for housing and community development.

Empirically, our findings are based on two iterations of interviews. The first iteration consisted of nine open narrative interviews both with relevant Israeli civil servants, and with local Druze, and both in individual and group settings. These were conducted by the paper's first author over the period of 2009 to 2011, in 'Isfiyya, in the wider MCBR, and in authorities' offices in both Jerusalem and Kiryat Bialik. These initial, exploratory interviews revealed a strong set of claims about both the necessity, and the supposed 'cultural impossibility,' of higher density housing in the MCBR.

To examine said claims more closely, we conducted 45 additional, more structured interviews with a wider convenience sample of the Druze population, using a modified mental-models protocol with questions employing response scales and targeted efforts to discriminate between more, versus less, absolute positions on the issue of land and housing. This second round of interviews was conducted by the paper's first author, and a local interpreter, in February 2012. We describe the wording of the relevant parts of each protocol *in situ*, below, as we introduce the particular findings they generated.

3.3 Ignited tensions and fatalistic essentialisms

Political ecologists have long recognized that all landscapes are neither ecologically nor socially neutral (Forsyth 2008). Rather, all current debates and claims of biological necessity are saturated with regional, national and transnational histories (Natter and Zierhofer 2002), and the competing priorities of political agents whose relative degrees of power are invariably asymmetrical (Escobar 1999). Biosphere reserves are often set up to mitigate the tensions borne by such conditions. MCBR is an example of precisely such an attempt.

As many Mt. Carmel Druze explained to us: it is exceptionally difficult for local Druze to procure legal permits to do what they want with their land, which often involves plans to build stand-alone, single-family homes for their sons and their sons' future families, as per centuries-old local practice. Not being able to provide such a stand-alone home for one's male offspring is deeply stigmatizing, and decreases the eligibility of one's children for marriage.

In practice, Israeli authorities continue to cite park law, as well as the state's conservation and forestry prerogatives, as reasons for withholding permits for what they refer to as 'unplanned' construction. The withholding of permits, however, is not a sufficient deterrent for many Druze, who have nonetheless openly risked subsequent fines by clearing land and building homes without permits, in active defiance of the state's legal assertions (Rosenberg 2011). The result is ongoing 'illegal' and contested construction, the gradual encroachment of Druze villages towards park boundaries and increasingly tense and bitter relations between Druze residents and the relevant state authorities. The latter include representatives of the Ministry of the Interior, the Israel Nature and Parks Authority and, to some extent, the Jewish National Fund, which serves as the country's *de facto* forestry body (see Chapter 4, Section 4.6).

These tensions were resonant in the first round of interviews we conducted in the MCBR, which were minimally structured and used to elicit primary concerns with the present and future management of the area. Both local Druze interviewees and Israeli government employees invoked the problem of indefinite expansion of 'Isfiyya and Daliat al-Karmel city limits into the surrounding forest. Interviewees described the practice as 'traditional,' 'unplanned,' and generally non-sustainable.

At the time of our fieldwork, the most obvious solution to this communal problem of land scarcity and growing demography was to begin building multistory multi-family apartment blocks, despite the fact that 'Isfiyya and Daliat al-Karmel have, since the 17th century CE until present, been dominated entirely by low-rise, stand-alone, single-family homes (see Figure 3.2). Several key interviewees, including both Druze locals, and Jewish state officials, each independently noted and expressed their support for this 'untraditional' option. Paradoxically, however, each of these interviewees also argued that virtually no one in the Druze community would be interested in entertaining such an idea. Instead, said interviewees appeared fatalistically accepting of the inevitable forest degradation and community-state conflict that they felt was sure to worsen over time.

Worsen it did: in December 2010, a forest fire of unprecedented severity erupted on the southern slopes of Mt. Carmel. Government authorities were ill prepared for a fire of this magnitude, and over 40 civil servants died in the process of evacuation and fire containment efforts. This made it the most deadly forest fire in Israel's history (Oster 2010). The blaze, its resulting deaths, and speculation over its cause, ignited ethnic tensions almost immediately. This is at least partly due to the analogous memories it evoked: previous, smaller-scale fires in the area had been attributed to nationalistic Arab arsonists (Frankenberg 2009). The history of Zionism also contains numerous instances of Palestinian Arabs protesting Jewish immigration by lighting fires in forests that had been planted by Jews for the purposes of territorial demarcation, reinforcing Arab estrangement from the land (Liphschitz and Biger 2004). The 2010 fire served as a reminder of the tense nature of co-existence amongst Arabs (including Druze) and Jews in Israel's north, leading some to speculate that the latest blaze was either an 'act of terror' (Ronen 2010) or the result of the Druze's abuse of their surrounding forest. The latter 'abuse' was said to be rooted in a lack of aesthetic or ecological sensitivity, that is, a symptom of their 'Arabness,' and difference from Jews (e.g., Ynet 2010).

3.4 Theorizing the growing impasse

Particularly in the wake of the 2010 fire, MCBR has become a highly politicized landscape. Theoretically, then, one approach to understanding the local dynamic is to focus upon the centrality of politics, power relations, and the role of the state in regulating Druze behaviour. However, this does run the risk of mapping Jewish-Arab relations too neatly onto the unique status of the Druze minority. Moreover, such an approach does not directly address why the housing question remains unresolved when both Druze and Jewish interviewees already indicate openness to higher density housing as a viable option, even if this openness remains largely unbeknownst one to the other.

To the first point, on status, the Druze have both a wider regional reputation, and a professed self-perception, of fierce political independence, twinned with a policy of military loyalty to whichever regime happens to govern their community at any given time. This has been explained, both by academics (Dana 2003) and by laypeople, as a collective defense mechanism for surviving in a historically hostile sectarian environment. This caricature is an essentialism, perhaps, but one that appears at least partially borne out by the documented record in Israel (Dana 2003), as well as by field observations in 'Isfiyya[19]. Insofar as this characterization is accurate, the tense situation on Mt. Carmel is a result of a sectarian-political self-preservation strategy running headlong into the Israeli state's interest in maximizing the amount of land under Jewish control, thus circumscribing independent Druze power to whatever degree politically—and geographically—feasible.[20]

Doubly unique to the Druze context, however, is that the otherwise conflictual nature of this community-state dynamic is offset by a delicate power balance whereby the Jewish state,

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[19] While conducting our research we were informed of several recent instances of direct clashes between Jewish state police and Druze locals, including an assault on Jewish police officers at the hands of elderly men, women and youth for perceived acts of disrespect while conducting drug-related arrests in the village. This particular incident occurred in the house directly adjacent to that of our interpreter. The local police station had also been firebombed and partially abandoned prior to our arrival. Simultaneously, in interviews and offhand conversation, young Druze men would express pride over their service in elite Israeli army units, and actively distinguish themselves from 'Arabs' (i.e., Muslim and Christian Arabic-speakers), as per their 'Jewish-like' loyalty to and identification with the Israeli state.

[20] Hence, since 1971, the state has thus far refused to allow Druze owners unfettered access to their more remote parcels of legally owned land, now considered protected area (both on Mt. Carmel and elsewhere), while simultaneously turning a blind eye to permit infractions closer to town limits so as to avoid upsetting this delicate modus operandi.

while dominant, refrains from enforcing its own laws too literally, too close to Druze town limits. This approach is apparently used to avoid risking insurrection and the loss of a key domestic security ally (Rosenberg 2011). (Such a policy contrasts starkly with heavy-handed techniques used elsewhere in contested land under Israeli state control[21]). Viewed solely in this light, it seems sensible that many Druze would continue to construct ever-closer to park boundaries, even without permits, at least in part because they feel a sense of strategically-mediated insulation from state authority.

Nonetheless, Druze interviewees we spoke to did both openly lament a rapidly dwindling amount of available land, and express a deep concern for the aesthetics of the surrounding forest that many Druze appear to associate directly with their communal identity. Why, then, has the Druze community not yet openly explored higher-density housing options? Even a gradual, partial shift to apartment dwelling would conceivably mitigate at least two specific, key problems facing the community: one, the risk of increasingly burdensome fines and rising tensions with the Jewish authorities (despite the community's relative insulation from heavy-handed state tactics, in recent years these tensions have verged on outright riots (Raved 2009)); and two, a relative undersupply of affordable housing for a growing number of young people, all of whom are expected, as per local custom, to settle permanently in 'Isfiyya-Daliat al-Karmel (for males, this takes place upon return from obligatory army service). To make sense of these and related paradoxes, we choose here to supplement an analysis of power

[21] Such techniques have included house demolitions and mass displacements of urban Palestinian and nomadic Bedouin communities, to which Druze and other Arabs with Israeli citizenship are frequently exposed through the national and international media (Al Jazeera 2013).

relations, which do prevail in MCBR as elsewhere, with an application of current theories on cognition—namely, how people interpret and integrate information to inform action. This approach seems useful insofar as it can help explain the otherwise perplexing persistence of some tightly held beliefs and positions, both cultural and political. Specifically, we will account for how and why actors in MCBR appear to be so fundamentally misconstruing each others' preferences and beliefs, both about housing, and about the Biosphere Reserve itself, two phenomena we describe in greater detail below.

Cognitive theory has several important insights to offer such lines of inquiry, particularly as applied to highly politicized contexts (Lau and Redlawsk 2001, Peterson and Flanders 2002). We refer here to work that explains how and why people cope with politically-charged, or otherwise difficult, situations. In brief, the theory is that in such contexts people are primarily complexity-reducing in the way they manage information and detail. Complexity-reduction habits can be efficient (thus, stress reducing), but also sub-optimal from the point of view of achieving desired outcomes (Fu and Gray 2006). In other words, the world, we know, is deeply complex, and people must navigate it while simultaneously economizing for both time and energy (Shah and Oppenheimer 2008) (see Chapter 2). Doing so involves the continual employment of techniques for making fast, reasonable inferences, and satisfactory (as opposed to optimal) decisions (G. Gigerenzer 2008). Moreover, people rely fundamentally on emotion and affect, felt viscerally and pre-consciously, as a fast, efficient cognitive currency to determine the sensibility of most of their decisions and beliefs in real-time (Peters, et al. 2006). One pervasive outcome of these complexity-reduction strategies is that people's social cognition (i.e., beliefs about others' beliefs) are not always accurate, even when applied to issues fundamental to individual or collective well-being (Prentice and Miller 1996, Evans 2008). Below we reveal and discuss specific, non-trivial ways this affects housing and (un)sustainable development patterns in the MCBR.

3.5 Imagining the other: perceiving stagnation in Druze society

During our phase-one (i.e., in-depth, exploratory) interviews, several Israeli park managers in the region asserted that the only sustainable solution to the land crisis in the MCBR would be for local Druze to ultimately abandon their tradition of building single-family housing in an 'unplanned' manner, and instead begin to construct multistory apartment buildings. However, when we asked managers whether any of them had suggested this to the Druze community, we found that no one had done so, nor did they recall knowing anyone else who had. One key Israel Nature and Parks Authority (NPA) figure in the area responded to the question as follows (italics denote spoken emphasis):

> I don't think there's *anybody* [amongst the Druze] that would listen now to that so-called advice. They'd say, you know, we're villagers, this is what we're used to, and this is what we know.

Druze residents we interviewed during the first phase of research echoed similarly essentialist-sounding assessments of their fellow 'villagers.' Yet these same interviewees also expressed support for the idea of multistory apartment buildings in their community, citing both demographic and ecological concerns. This directly contradicted the predictions of the government park managers. One senior Druze clan member expressed it thus:

> [We eventually need to build] big buildings, tall buildings with, like, 12 floors. Lots of people will be able to live in them, and we'll [also be] protecting the environment.

His reasoning was as follows:

> [This is because] the biosphere reserve is a place that we have to protect… [for] our oxygen, we must [protect] our trees. It's a place both to live, and to protect! We need to protect the trees…[maybe] not pines… but the others, [such as] oak, olive, and the fruits that were here before [in earlier times]… like the biblical fruits…[and] they [in turn] protect the environment... Looking forward, this is what people should do.

When asked what prevents local people from constructing apartments now, this interviewee provided the same logic as government interviewees: "Culture, beliefs: we're used to believing that each person [*i.e., male head of household*] has one home only to himself [*i.e., for him and his family*]...Maybe in the future [this will change]." The speaker went on to argue that, despite the potentially catalyzing effect the recent fire could have on locals' environmental values, such change would still take at least 30 years.

Certainly, there were some important differences in the broader narratives expressed by park managers and Druze interviewees, respectively. Generally, the park managers expressed more pessimism, particularly about the cumulative, ecological damages that would occur to the Biosphere Reserve in the process of continued Druze construction. The Druze interviewees were more accepting of the fact that necessary 'cultural' change would have to be, in their estimate, very gradual. Nonetheless, there was a paradoxical commonality, in that interviewees from both groups saw a need for higher-density housing, but doubted or even denied the possibility that any significant proportion of *other* local Druze would currently be open to such an option. For some reason, both groups seemed to be essentializing the local Druze community as stagnant and resistant to change, even though all interviewees indicated considerable awareness and acceptance of the ultimate necessity for change.

To explore these observations in greater depth, we later conducted a second set of more structured interviews with a wider sample of the local Druze population (n=45). We sought a broad sample of interviewees by stationing interviewers at two prominent central grocery stores in 'Isfiyya. All adult shoppers were approached with no other selection criteria beyond exiting or entering the store. This produced a 'convenient' but comparatively random sample of 45 local adults of both genders, both religious and secular, of a wide variety of ages. Interviews were conducted in the local dialect of Arabic, mixed with some Hebrew (a fluent second language for all Israeli Druze), when appropriate.

3.6 Housing: a surprising diversity of opinions and rationales

What first struck us during our second phase of interviews was the wide range of opinions interviewees expressed on future housing possibilities in their villages. The existence of diversity in-and-of itself directly contradicted earlier, phase-one interviewees' predictions that virtually the entire Druze community would be equally uninterested in untraditional options. For this second phase of interviews, each person was initially asked: "How good an idea do you think it would be to have multistory multi-family apartment blocks in 'Isfiyya-Daliat al-Karmel?" They were then requested to express their opinion on a 10 point scale, in which a "10" constituted a very positive response to the idea, whereas a 1 was highly negative, and a 5 was neutral.[22] This constituted 'Question 1.' Interviewees were subsequently asked to explain their answers in 'Question 2.'

Defying the predictions of phase-one interviewees, less than half of all respondents in this second phase of research (n=19, or 42%) responded negatively to Question 1. The same number (n=19, or 42%) answered expressly positively, while seven (16%) chose to remain neutral, marking '5' on the response scale.

Respondents who answered positively gave a range of reasons for their choice. These included: a sense of diminishing available land; a need or desire to follow denser patterns of life now prevalent in more developed urban centres; a desire to be close to other people; a solution to the problem of crowding in houses; parking problems; and the freedom and privacy apartment blocks would grant young people who are unable to afford or procure land for a house of their own. Several interviewees also cited more general environmental and quality-of-life rationales, as with a 21-year old secular male, who answered '10' to Question 1:

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[22] We recognize that while '5' is an arbitrary mid-point, when we asked participants to further explain their rationales for their answers to Question 1, those who said '5' were consistently neutral-to-positive on the question of higher-density housing, and thus were largely using this number as a stand-in for an expression of neutrality. Those who answered '4' or below, however, articulated distinctly negative views towards high-density housing in their villages, while the inverse was true for those who answered '6' and above. In future iterations of research into this question, a more robust neutrality measure should ideally be developed and included in the interview protocol, and/or interpolated during later analysis.

> [Apartment blocks would lead to] a concentration of the population. [This means there would be] more space to make parks, to do something other than just build houses, to do something for the community, so kids don't have to play in the streets. [Now,] they don't have parks, they don't have football fields… they just go [run around] in the street.[23]

Those who provided scores of less than 5, that is a negative response to the prospect of densification, also provided a mix of rationales for their choices. These included: an expressed preference for cultural conservatism, tradition, or avoiding change; concerns about privacy; concerns about the cost of living alone (i.e., at least one interviewee intuitively conflated the idea of living in an apartment to living alone without a family); concerns about the difficulty of getting along with unrelated neighbours; a belief that quality of life in apartments is generally lower than in houses; the difficulty of rapid change; noise; a fear such buildings would destroy people's visual enjoyment of nature; and, 'religious reasons,' which respondents abstained from defining.[24]

Those who provided a neutral answer of '5' on the response scale generally concluded that villagers were 'not yet ready' for apartment buildings, or that local culture could not accommodate such living arrangements. Amongst this group, however, four of seven (57%)

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[23] When we asked this respondent whether he thought other locals would agree with him, he said: "I'm not sure. If it's [shown to be] about the safety of their children, they'll agree. [Otherwise, though,] maybe they'd disagree."

[24] This might be partially tied to discomfort among religious males with having one's female relatives share common space with non-familial males (e.g., in elevators and stairways).

went on to explain that they themselves did, in fact, view the prospect of higher density housing positively, calling it 'helpful,' or ‘necessary in the future.’

Further unstructured discussion with locals during periods of fieldwork indicated that any change in Druze housing patterns would indeed require overcoming a largely unspoken, but significant, social hurdle. Namely, if a Druze’s engaged or newly-married adult child was to move into an apartment block, rather than a stand-alone home on privately owned land, this would suggest the groom’s family was poor or otherwise unable to provide properly for their offspring. Such signaling could result in social stigma, due to the fact that ‘Isfiyya and Daliat al-Karmel are still small enough to preclude any significant degree of social anonymity. Such fears of being stigmatized help explain the comments of some respondents who answered negatively to Question 1. For example, a secular mother of two in her 40s explained her negative rating of ‘3’ as follows, in which she also conflated apartment living with the stigma of single living:

> It [*apartments in ‘Isfiyya*] has never happened before. Nobody wants to live alone. [I] wouldn’t want it for my kids.

A small number of respondents also initially resisted answering the question, as framed, out of protest. The overriding concern in such cases was that the Israeli state authorities were constraining the Druze’s options by disallowing them building permits and access to their own land in general, hence rendering any discussion of apartment construction ‘beside the point’. Associated with this concern was what appeared to be an *a priori* assumption that any high-density housing developments in ‘Isfiyya-Daliat al-Karmel could only be a product of state policy, or of enterprising Jewish developers, not Druze themselves (such as in neighbouring urban Haifa, local Druze's closest point of reference). As one respondent, a secular father in his 40s, explained:

> [Apartments would be fine] if the government builds on its own land. But give us back our land first! If we had access, there would be no problem [in the first place].

Other respondents were somewhat more open to the idea of apartment blocks in 'Isfiyya-Daliat al-Karmel, but were quick to point out that such buildings should be owned locally, not by outsiders or the government. As a secular female in her 20s explained:

> In the beginning, [locals] will find [apartment buildings] strange, but then they'll get used it. But—they shouldn't be owned by outsiders.

A crucial point is that a significant majority (70%) of the specifically religious respondents we interviewed rated the prospect of denser housing options in 'Isfiyya-Daliat al-Karmel negatively. Twenty percent of religious respondents were neutral on the issue and only 10% were in favour. The fact that neutral-to-positive ratings were comparatively rare amongst religious respondents suggests there is a robust religious-secular divide within the community regarding housing preferences. While there are no official figures, no more than one third of the Druze community on Mt. Carmel is popularly estimated to be religious. However, the deep symbolic significance of religion and religious affiliation to Druze identity, including secular Druze, may constitute another unspoken hurdle to adopting denser housing options. Namely, the sizable pro-apartment segment of the population may fear they would be subjecting themselves to a risk of alienation or demonization if they were to flout the sensibilities of their more pious fellow community members. We elaborate on this in greater detail below.[25]

Taken as a whole, these initial findings indicate that, as of 2012, there was, in fact, a wide range of opinion amongst the local community regarding the prospect of high-density housing in ‘Isfiyya-Daliat al-Karmel. Nonetheless, at the time of writing, there appeared to be virtually no public context in which the full range of opinion on this issue was being expressed.

3.7 A case of mistaken preferences

Strikingly, in addition to the diversity of opinion noted above, our results suggest that, at the time of our field work in 2011-2012, most ‘Isfiyya and Daliat al-Karmel residents were indeed fundamentally underestimating the wider community’s openness to high-density housing options. While 19 out of 45 respondents (42%) gave a positive answer to Question 1, and a further 7 (16%) gave a neutral answer (58% in total), 31 out of 45 respondents (69%) speculated that ‘most’ or ‘all’ other Druze residents would view the prospect of apartment buildings in their towns entirely negatively.

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[25] Lastly, a number of respondents speculated that young people would favour denser housing options, but that older generations would largely disapprove. This hypothesis was not borne out by our data. Rather, of the 19 respondents who expressed a positive preference for denser housing options, approximately half were in their 40s or older, including one respondent in his 70s. Conversely, of those who expressed a negative view of denser housing options, 8 of 19 (42%) were in their early 40s or younger. While age may be a factor, it did not emerge as a particularly telling one within our sample.

In other words, while a significant majority (58%) of respondents viewed the prospect of denser housing options either favourably or indifferently, a significant majority (69%) of respondents in fact predicted that either the inverse would be true (i.e., the vast majority would be against it) or, even more dramatically, that no Druze at all would respond favourably to the idea. We later discuss some explanations for how this apparent misperception could be so prevalent.

3.8 Biosphere skepticism

Our interviews also addressed Druze awareness of the Mt. Carmel Biosphere Reserve itself. Specifically, the survey closed with the following question: "Did you know that 'Isfiyya and Daliat al-Karmel are located inside a Biosphere Reserve, which is an area specifically designated by the United Nations for balancing human well-being with the conservation of nature?". Of 45 respondents, only five (11%) had ever heard that their towns were located within a United Nations-designated protected area. No one had a clear idea of what the designation meant, as a spatial area with three distinct zones for varying degrees of emphasis on biological conservation and human development (UNESCO-MAB 2008).

When the concept was explained to survey participants, reactions were mixed. Some were interested in the idea, and expressed approval that their local region had been recognized as unique by the United Nations. Upon learning of the designation, at least one respondent expressed a desire to see more evidence of the United Nations' involvement and presence, which he viewed as positive. However, others were less amenable to the idea, apparently due to a deep distrust of Israeli state motives, rather than any strong opinions or set of associations about the United Nations, specifically. For example, one respondent suggested a theory that the reason no one seems to have heard of the Biosphere Reserve in the area is that the Israeli government is trying to hide it for some, likely sinister, reason. Inversely, others posited that the designation could be a mechanism for the Israeli government to further disenfranchise the Druze from their lawful property. As one such respondent, a religious man in his late 60s, exclaimed:

> We [protect and have] protected this land [for centuries], not the United Nations! Maybe Israel brought this [Biosphere Reserve designation] to prevent us from building homes.

This particular interpretation of the Biosphere Reserve designation on the part of some Druze locals follows directly from a core proposition apparently shared by many in the community, given that we regularly encountered it during our extended period of ethnographic observation in the area. Namely, this proposition is that the Israeli government by the very nature of its self-declared Zionist ideology inherently prioritizes Jewish welfare over that of all other, non-Jewish citizens, including the Druze.

However, there is a deep irony here. This is the precise opposite of how the government officials whom we interviewed claimed to understand the purpose of the Biosphere Reserve. The officials we interviewed described the 1996 designation of Mt. Carmel as a Biosphere Reserve as a compromise aimed specifically at opening up the possibility of more diverse land-use options for local stakeholders, and particularly the Druze, in what is otherwise a legally protected conservation zone.

If both groups' accounts are taken at face value, such starkly divergent interpretations of the meaning and purpose of the Biosphere Reserve designation on Mt. Carmel suggest a second fundamental social cognition problem at play: an apparent misreading of other stakeholders' motivations, fueled not only by Israeli state employees' essentializing of the Druze as culturally stagnant and monolithically 'traditional,' but, also by the Druze's essentializing of the state authorities as monolithically nefarious in intent. The reasons this latter essentialism has taken hold, be they historical, political or otherwise, will likely need to be addressed directly. Ideally this would occur with public outreach, symbolic apology and trust-building measures (Atran and Axelrod 2008), in order for multistakeholder dialogue on the future of the MCBR to succeed.

3.9 Discussion: essentialisms, social cognition, and silence

3.9.1 Essentialisms are easy

A particularly salient result from our interviews is the apparent gap in social cognition, defined here as one's state of knowledge about others' beliefs. This gap exists both between (a) relevant government officials and Druze locals; and (b) within the Druze community itself. The former gap is the less mysterious of the two. The most straightforward explanation is an apparent lack of trust between many Druze and relevant state authorities. This lack of trust, and hence relatively limited positive mutual interaction, precludes members of both groups from creating anything beyond essentializing, homogenizing narratives about the others' characteristics and intentions (e.g., 'The Druze are [all (too)] traditional,' 'The Druze don't respect nature,' or 'The Israeli government only wants to take our [Druze] land and give it to Jews').

From a cognitive perspective, it is not surprising that crafting and drawing on such essentialisms is common. Social scientists who study cognition suggest, rather, that such 'essentialist'[26] thinking should be expected as the default. Consequently, only prolonged positive social interaction that facilitates an understanding of others' core values, or the ability to render cross-group agreement or homogeneity visible will counter the power of broad-brush characterizations. It takes time and energy to revise these (Medin, Ross, et al. 2007, Schaller, Conway and Tanchuk 2002, Haslam, Rothschild and Erns 2000). This is because essentialisms, which, at their core, consist of homogenizing propositions and simplifying narratives, are exactly that: homogenizing and simple, and therefore relatively effortless. Creating more complex, nuanced or heterogeneous mental models of others' characteristics and intentions is, conversely, energy-intensive and, in the absence of sufficient observed evidence that demands such a model, requires awkwardly involved, time- and energy-costly introspection.[27]

[26] 'Essentialist,' here, means using stereotyped, monolithic simplifications as analogical representations to stand in, cognitively, for an entire group that is in fact heterogenous in consequential ways. In cognitive science, this is considered a form of 'attribute substitution' error (e.g., Kahneman 2003).

[27] E.g., "I may feel negatively about what seems like the Druze's disregard for nature writ-large, but could it be the case that my simplifying intuition is wrong, that my mind is merely trying to save itself time and energy, and that not all Druze, maybe not even a majority, share identical values or engage in the same behaviour? Might my impulse to characterize all Druze as 'religious' or 'traditional' be rooted in the fact that my limited interaction with them has only made me cognizant of the most egregious, visible examples of what looks to me like Druze cultural intransigence?"

3.9.2 The salient moustache trumps the silent majority

A lack of familiarity with the out-group does not explain, however, why many Druze themselves also seem to be poor forecasters of fellow Druze's positions on the prospect of high-density housing in their towns. How could it be that a reasonably diverse, representative sample of individuals from such a relatively small, tight-knit, endogamous community could so readily mispredict the responses of their fellow community members?

Figure 3.1 Appearance of religious Druze versus secular Druze

A religious Druze man (left) is dressed in traditional attire with an intentionally large moustache, both symbols of having taken religious vows and having been initiated as a student of the esoteric Druze faith. Non-initiates (right), who comprise the majority of the population of 'Isfiyya-Daliat al-Karmel, do not dress this way, but rather according to current popular fashion. Because religious Druze are more visually salient in their unique appearance, they are more cognitively accessible as symbolic representatives of the Druze community, both for non-Druze and, our findings suggest, the Druze themselves. We argue that, all else held equal, this *heightened cognitive accessibility leads people to overgeneralize the assumed preferences of the religious minority to the community as a whole. (Photo, left,, courtesy of Charles Roffey.)*

We argue that, in the case of Mt. Carmel specifically, this quirk is at least partially accounted for by a number of straightforward qualities of cognition. First, as described above, religious and secular populations in the Druze community are very distinct. Data from our second phase of interviews suggests that religious Druze residents are, on the whole, more negative in their views regarding high-density housing than are their secular neighbours. While religious Druze comprise, by the most generous local estimates, only approximately 30% of the local population (there are no official statistics), they are more visually noticeable than the secular majority. Here, we are referring to the religiously observant Druze's distinct, spiritually symbolic dress, including loose black clothing, white headgear, and in the case of men, uniquely prominent moustaches that are groomed in a specific way as identity markers. Second, because of their visual and confessional distinctiveness from mainstream Israeli and more globalized cultural expressions, as well as their preservation of the culturally emblematic Druze tradition, we argue that religious Druze, as a mental category widely operationalized within the Druze community, are more tightly associated with local Druze identity than are their secular neighbours. This appears to be so in both Druze and non-Druze's minds alike.

These two factors alone (visual uniqueness and close association with the prototype of the mental category 'Druze') are enough to make the minority, religious segment of the local Druze population more cognitively salient, and hence more readily cognitively accessible, for *all* people, than the less emblematic, but significantly more populous, secular majority. From the point of view of cognitive research this ‘salience’ (Biggs and Gibson 2014, Bodoff 2013) causes individual interviewees and survey respondents to overestimate the representativeness (Kahneman and Frederick 2002) of the overtly religious subpopulation. Community members thus falsely extrapolate that, since religious Druze would imaginably be averse to sharing a building with other families for religious and traditional reasons (a relatively—i.e., 70%—accurate prediction, according to our data), it is faster, simpler, and even safer, to assume that the same is true of the Druze community as a whole.

Phrased differently, given that religious Druze appear to be intuitively perceived by locals and non-locals alike as especially emblematic of the Druze community, religious Druze are liable to serve as a sort of heuristic, cognitive placeholder in respondents’ minds for the entire community. Respondents are therefore liable to overgeneralize the characteristics, beliefs, and preferences of the religious minority to the entire local Druze population, even if the wider population in fact has quite different beliefs (Kahneman and Frederick 2002). Similarly, these differences in salience and accessibility of the hyper-distinctive religious Druze, relative to their more populous secular counterparts, provide further explanation for why Israeli government authorities would, like the Druze, be liable to overgeneralize the (fairly accurately) imagined views of religious Druze to the entire Druze population on Mt. Carmel.

3.9.3 The spiral of silence

In addition to the innate inclination to overgeneralize from the hyper-salient, and hence more cognitively accessible religious minority, there is the simple fact that people, generally, have been found to make inferences based primarily on what is most immediately apparent to them. This is referred to as the 'availability heuristic' (Tversky and Kahneman 1973). In this particular case, the fact that the urban landscape of 'Isfiyya-Daliat al-Karmel is entirely dominated by single-family homes—in contrast to the apartment blocks of surrounding towns and cities—likely encourages an 'availability cascade' (Kuran and Sunstein 1999) of self-reinforcing assumptions: "if all I can see are single family homes, everyone here must only ever want single-family homes." The fact that this assumed reality has not yet been publicly challenged in the Druze community likely stems from a form of "pluralistic ignorance" (Prentice and Miller 1996), caused by what political scientist Noelle-Neumann (1993) dubbed the "spiral of silence."

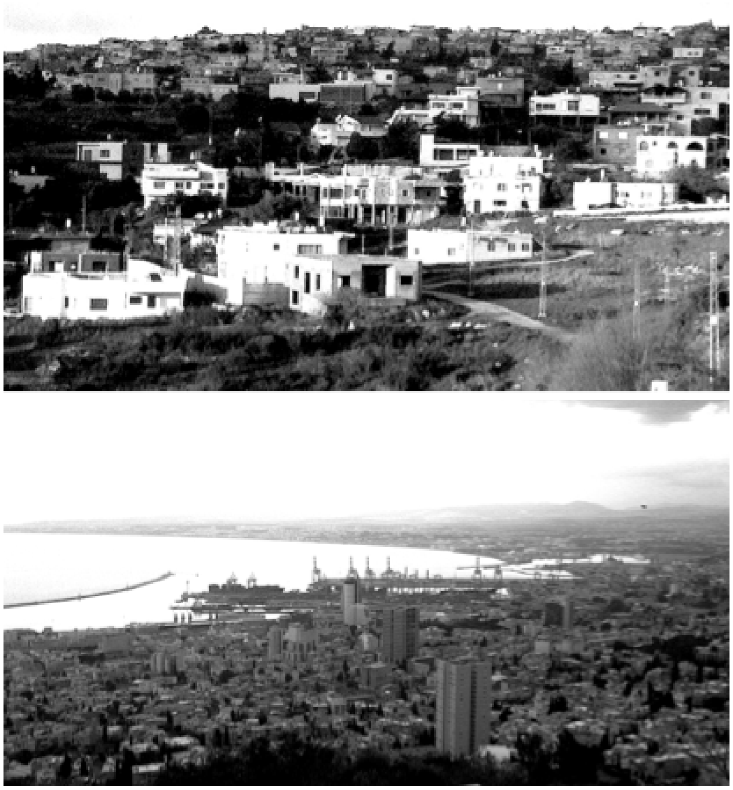

Figure 3.2 Appearance of Druze villages versus urban Haifa

The semi-rural ‘Isfiyya-Daliat al-Karmel skyline (top) features an expanse consisting entirely of single-family villas arranged in an ‘unplanned’ manner on the hillside. This is contrasted with the nearby urban Haifa skyline (bottom), consisting of a high density patchwork of multi-family condominiums, government-planned apartment towers, and industrial zones. Cognitive studies (Kuran and Sunstein 1999) suggest that, because locals and state employees see only the former, and not the latter, forms of housing in ‘Isfiyya and Daliat al-Karmel, they may well over-infer post-facto that no Druze residents are interested in the prospect of higher-density, planned apartments, in their towns.

The ‘spiral of silence’ is a phenomenon also relevant here and occurs as follows. First, individuals arrive at an opinion, which they have not heard popularly voiced in their community (e.g., support for high-density multi-family dwellings). Because they have not heard the opinion voiced publicly, they assume themselves to be in the minority, and thus remain silent out of fear of ostracism. This silence in turn further limits the likelihood that a like-minded thinker will hear their shared opinion reflected in public discourse, and so on. Ultimately, a more vocal, but often fringe, opinion fills that void and becomes the dominant voice, even if it represents a minority position (Dalisay, et al. 2012). In the case of Mt. Carmel, what many locals imagine as their own minority view (which our research suggests is in fact the majority view) is an openness to high-density housing, while the equivalent of the more vocal, but actually much less popular, opinion appears to be the disapproving traditionalist perspective on high-density housing espoused most often by religious Druze, specifically.

3.9.4 Stacked odds further bias social cognition

Based on observations collected over the course of fieldwork in the Mt. Carmel area, several other factors combine to further amplify the gap between perception and apparent reality described above. First, at the time of our fieldwork, a relative lack of non-hierarchical public space existed in ‘Isfiyya-Daliat al-Karmel. No readily accessible public context existed within which vociferous debate about community development could take place with relatively low social risk. Local press exists, but it does not often feature editorials that question (what people assume to be) deeply held community values.

Second, many interviewees lamented a high degree of 'clan-consciousness' in their community. By this, interviewees meant that many residents, the prominent decision-makers amongst them in particular,[29] see local development less as a mutually advantageous activity for the whole community, and more as a zero-sum competition amongst extended families for resources and status. To the degree that this public perception of the community's political logic is accurate, such a dynamic would, indeed, provide a disincentive for risky or long-term policy making that prioritizes public good over individual family benefit. (I.e., this means there would be relatively little personal incentive for decision-makers to attempt conserving land and reducing housing costs by embarking on a risky, divisive, apartment-construction venture, while they could just as well use their relative power to purchase more land for their familial support-base, and build conspicuous private villas to assert status.)

Third, as mentioned earlier and as linked to the 'spiral of silence' effect described above, several interviewees asserted that there is an unspoken social stigma associated with being unable to provide a single-family home for one's adult male children and their future families. Interviewees implied that the fear of such a stigma additionally precludes locals' willingness to take the social risk associated with even discussing other options (i.e., apartment dwelling) with fellow townspeople.

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[29] The Druze communities of Mt. Carmel have two different, parallel governance structures in place. One is a secular, elected local municipal leadership, with fixed terms of office. It is this group to which we refer here, specifically. There is also, simultaneously, a traditional leadership structure wherein mostly religious elders congregate to make consultative decisions for and about the wider community. Due to the secretive nature of Druze religion and custom, we are unable to detail, here, the specifics of how these leaders are chosen, or precisely what powers, formal or informal, they exert over or within their communities.

Finally, and again tied to the 'spiral of silence', we posit that there may be a further stigma associated with making statements or suggesting changes that could be perceived as specifically calling into question tenets of local Druze identity, or inciting the ire of powerful or respected spiritual leaders who are assumed to hold more socially conservative views. As such, ideas that promote unfamiliar changes remain largely unarticulated, causing those who share similar sentiments to underestimate the degree to which others in the community may agree with them.

3.10 Conclusion: cognition, affect and new avenues for research

A mutually acceptable pattern of sustainable development has thus far been elusive on the multistakeholder landscape of southern Mt. Carmel. Our initial round of interview-based research suggested that locals and managers alike perceived this to be a problem largely of entrenched local tradition, tied to what was also perceived to be a stagnant, ossified religion and culture. Local Druze also appeared to attribute cynical or outright nefarious motives to the Israeli authorities, precluding the sort of trust necessary for agreeing upon mutually acceptable development plans (Slovic 1999).

Our second round of field research confirmed that both these opinions (i.e., that Druze culture is stagnant, and that state authorities are entirely disingenuous) were in fact quite common amongst local Druze residents. However, it also revealed a simple but surprising fact: most local Druze appeared to be mildly to strongly supportive of high-density housing as a sustainable development solution in their towns. Crucially, however, as we have described above, most Druze also appeared to believe that most other Druze would disagree with them on the issue. This is a variety of what has been called “pluralistic ignorance,” and, more specifically, the “spiral of silence”: a phenomenon whereby most people hold one view, but incorrectly assume most others reject it, because it goes largely or entirely unspoken in the public sphere (Noelle-Neumann 1993, Dalisay, et al. 2012). In the case of religious Druze respondents, the opposite, but just as well-documented, cognitive phenomenon appeared to be at work. This phenomenon is known as the ‘false consensus effect,’ whereby people who hold what they perceive to be a strong majority position on an issue dramatically overestimate its popularity (Wojcieszak and Price 2009).

Thus, in answer to our original question regarding the accuracy of our in-depth interviewees’ theories, our research does indeed suggest that the social dynamics of the MCBR are characterized by persistent, but apparently inaccurate, essentialist tropes about both the Druze, and the Israeli state authorities. Nonetheless, the fact that these essentialisms may be largely (if not entirely) the product of a series of simple, already well-studied cognitive biases, in turn suggests that it may be less challenging to arrive at a workable new status quo than any of the relevant stakeholders has, to this point, assumed.

We felt that documenting and publicizing data that alerted the relevant parties to information otherwise obscured by the heuristics upon which they were relying was a potentially useful preliminary step towards crafting a space for new lines of thinking and negotiation. As such, we presented our findings both to local residents in the form of short pamphlets in Arabic and Hebrew, and to a group of relevant managers at a regional conference on forest fire. As of this paper's publication, we will also have delivered our findings directly to decision makers amongst the relevant Israeli authorities in the region.

We believe the sort of basic efforts we made at testing and deconstructing the pervasive essentialisms, and other simplifying cognitive heuristics, dominating the social landscape of Mt. Carmel constitute just one small example of the synergistic overlaps amongst the emerging field of culture-and-cognition[30] and the field of sustainable development.

With respect to future research, cognitive science suggests (Slovic, Finucane, et al. 2004, Haidt 2001) that people's rational faculties are in fact expert at constructing rationales for fundamentally emotional, or 'affective,' preconceptions that exist *a priori* in people's minds. Applied to the current case, for example, this suggests that many Druze's beliefs about the Israeli authorities' supposed malicious intentions *vis à vis* Mt. Carmel's Biosphere Reserve status may be rooted less in considerations of local social-ecological dynamics, and more in an affective association of distrust with respect to the state. These are understandably rooted in emotionally salient past experience, which drives some Druze to create mental models consistent with this emotional appraisal. The implication in such a case is that effective co-management will likely require going beyond addressing factual inconsistencies in stakeholders' mental models, and instead require openly examining the affective associations Druze may have with relevant Israeli authorities, the roots thereof, and vice versa.

[30] This field includes integrated insights from disciplines such as cognitive and applied anthropology, behavioural and experimental economics, and social, cultural and cognitive psychology, alike.

Cognitive approaches to human behaviour of the kind considered here suggest that addressing this deeper, emotionally-valenced quality of multistakeholder relations is a fruitful option. It may be more methodologically challenging than conducting factual surveys, or suggesting technical solutions to specific problems, but it may ultimately prove to be a more effective approach to ensuring long-lasting positive change (Atran and Axelrod 2008). Simultaneously, the practical application of anthropology to the study of sustainable development stands to progress both by drawing more readily from the cognitive science literature on a broad level, by explicitly investigating how actors tend to reduce complexity *in situ*, as well as by specifically developing and experimenting with different methods for eliciting, articulating and addressing actors' 'affective' appraisals of contextually relevant actors.

Chapter 4: The Silence of the Goats—*cognitive management of complexity and Israel's 2010 Carmel disaster*

4.1 Introduction

There is a popular aphorism that history is written by the winners. When a catastrophe occurs, however, often there appear to be only losers, and bigger losers. Powerful actors are wont to distance themselves from responsibility in such cases, not claim it triumphantly for themselves. How is a dominant narrative woven under these conditions? What role does an unchallenged narrative itself have in catastrophe? The answers to these questions have important implications for the recovery, adaptive capacity and resilience of communities in the wake of disaster. As such, this constitutes a critical space of potential collaboration between humanities and social science research, on one hand, and the heretofore largely ecology- and institutions-focused study of social-ecological systems on the other (Folke 2006, Folke, Carpenter, et al. 2002, Ostrom 2009).

In this paper, we make an initial contribution to this emergent collaborative space. We do so through a multi-method study of the history and discourse surrounding a catastrophic forest fire that occurred on Mount Carmel, in northern Israel, in December of 2010. This was the deadliest fire in Israel's history, inextricably intertwined in public consciousness with the tumultuous and often traumatic history of Jews' and Arabs' respective use of afforestation and fire as tools of competing nationalistic claims since the era of the British Mandate in Palestine (El-Eini 2006).

We root our investigation in a theoretical foundation informed by empirical studies of human cognition, which suggest people are fundamentally motivated to manage the deep complexity of their environments by massively reducing that complexity in efficient ways in their minds (see Chapter 2). This internal 'reduction' of complexity is often essential to avoiding paralysis or self-defeat in the short run but, if left unchecked, can produce potentially disastrous figurative blind spots in the long run (Peterson and Flanders 2002). We apply this analytical lens to three different sources of material: mainstream Israeli online print media coverage of the so-called 'Carmel disaster,' in-depth interviews with government managers and local residents of the Mt. Carmel UNESCO Biosphere Reserve and, finally, historical accounts of how people have perceived and interacted with the landscape of Mt. Carmel through deep time.

We begin with a fuller description of the fire itself, as well as some characterization of the social and ecological context of the disaster in question. We then follow this with a discussion of the theoretical advantages of considering this case through emerging theories of cognition and motivation, so as to better explain how and why particular narratives of cause have emerged at the expense of others. We then proceed to present, discuss and compare our findings from each of our three different sources.

4.2 The Carmel disaster

On 2 December 2010, a massive forest fire ignited on the southwestern slopes of Mt. Carmel, in what is today northern Israel. The area is a UNESCO Biosphere Reserve, comprised of a patchwork of national park, nature reserve and human settlement. Despite the area's protected status, government authorities were ill prepared for a fire of this magnitude in the Carmel range, and ultimately required airborne firefighting support from the international community (Haaretz 2010). In the process of evacuating a military prison in the heart of the reserve, a bus full of prison guards became trapped in the flames, and 44 people died, making the 'Carmel disaster,' as it was soon dubbed in local media, the most deadly fire in Israel's history (Oster 2010). The ecological damage was also significant: over 4,000 hectares (Waldoks 2010) of the 11,500-hectare Mt. Carmel National Park were consumed in the disaster, including parts of the Hai Bar Nature Reserve, home to recovering populations of threatened fauna such as the Persian fallow deer (*Dama dama mesopotamica*) and griffon vulture (*Gyps fulvus*) (UNESCO 2012).

As much as it was an ecological disaster, the fire was also a deeply political conflagration and socially-charged event. Popular criticism of government ill preparedness was scathing, and intense controversy ensued amidst calls for the resignation of key ministers (Hovel 2012). Moreover, from the earliest days of the disaster, speculation over the source of the fire intensified already extant ethnic tensions amongst the Hebrew-speaking Jewish majority and the Arabic-speaking Muslim, Christian and particularly Druze religious minorities who have continually inhabited the region for centuries.

4.3 Mt. Carmel as a chessboard of identity politics

Mt. Carmel National Park was created in 1971 by the Hebrew-speaking, Jewish-majority Israeli state. Consisting today of vast tracts of pine forest and dry scrubland, the park sweeps up from the Mediterranean coastline right to the town limits of 'Isfiyya and Daliat al-Karmel, two centuries-old mountaintop Arab villages. These villages are home to approximately 11,300 and 16,000 Druze residents respectively (ICBS 2012), as well as a small number of Arab Muslims and Christians. Druze are an Arabic-speaking religious minority in Israel. Like the secular Jewish majority, and unlike other Israeli Arabs (i.e., Arab Palestinians with officially recognized Israeli citizenship), Druze serve as conscripts in the Israeli army, a defining feature of 'loyal' citizenship in the modern Israeli state (Nissan 2010, Lis 2011). However, Druze are otherwise culturally and linguistically distinct from the Jewish majority, and the relationship between the Druze and the Jews has been a complex and ambivalent one since the beginning of Jewish immigration to Palestine near the turn of the 20th century (Parsons 2000).

As we show in the following section, this perception of cultural and ethnic difference was central to how people made sense of the fire, as Arab citizens have indeed been charged in the past with attempting to start fires on Mt. Carmel as a form of 'nationalistic' arson[31] (Frankenberg 2009). Moreover, the planting and subsequent burning of forests by Jews and Arabs respectively date back to as early as the 1920s as methods of demarcating, and refuting, who has ultimate ownership over land in what was then British-controlled Mandate Palestine, now Israel (Liphschitz and Biger 2004).

[31] I.e., as a form of protest against what is largely perceived as the Jewish-majority establishment's mistreatment of Arabs both inside and outside Israel's internationally recognized 1967 borders.

Unverified but popular rumours also exist within Jewish Israeli circles that Druze have sometimes set fire to the forest surrounding their villages as a semi-clandestine form of protest against unpopular state policies, such as the placement of cellphone antennas in their communities. The 2010 fire thus served as a reminder of the ambivalences and tensions between Arabs (including Druze) and Jews in Israel's north. In the immediate wake of the disaster, this led some to speculate that the blaze was either an 'act of terror' (Ronen 2010), or alternatively the result of Mt. Carmel Druze abusing the surrounding forest, a 'symptom' of the supposed lack of aesthetic or ecological 'sensitivity' that is inherent in their 'Arab culture' (Ynet 2010, Boneh 2012).

Prior to the 2010 Carmel disaster, tensions between the Druze of Mt. Carmel and the Jewish state authorities had already been rising due to conflict over land-use. Under Ottoman property law, which is largely recognized by the Israeli state, many Druze claim to have hereditary ownership over parcels of land in what is now Mt. Carmel National Park. However, many of these same Druze claim it is exceptionally difficult to get permits to do what they want with their land[32] (see Chapter 3). The Israeli authorities, for their part, cite national park law, as well as the state's conservation and forestry prerogatives, as reasons for withholding permits (Rosenberg 2011). Leading up to the 2010 disaster, the effect of this smoldering low-level conflict had been a cyclical dynamic of 'illegal' construction, fines, and increasing tension and bitterness between the Druze community and the state authorities. The designation of the area

[32] This often involves plans for parents to build stand-alone homes for their sons' families, as per centuries-old local custom, or, in the case of district-level petitions, requests for industrial development permits so as to create jobs and boost the local economy.

as a UNESCO Biosphere Reserve in 1996 was meant to provide a new framework for the resolution of this strain between development and conservation on the southern Carmel, writ large (Safriel 2012). However, for a variety of reasons—lack of community consultation and local political dynamics chief amongst them (Frankenberg 2009)—the Biosphere Reserve designation had, as of 2010, largely failed to catalyze that aim.

The 2010 fire, and public contestation over its cause, thus further amplified this preexisting atmosphere of tension between Druze and the state. Within the first days of the fire, a series of accusations and arrests were made, targeting a number of Druze youth in particular who were blamed for starting the fire by negligently throwing smoldering water-pipe coals into the forest (Hovel 2011). Another theory held that illegal, makeshift Druze dumping grounds in the forest ignited, implying that the fire and its concomitant deaths were primarily the result of Druze disrespect for both nature and the rule of law (Edayat 2010). Nonetheless, despite this early outburst on the part of the Jewish establishment against local Druze, all Druze detainees were eventually released, and all charges against them were dropped due to lack of evidence (Hovel 2011).

Once it became apparent that there was no clear evidence of Druze or other Arab culpability for the initial blaze, public discourse shifted almost entirely towards blaming the acting government for massive negligence, targeting several key political figures in particular. Early on in this processes, special blame was leveled at then-Minister of Interior, Eli Yishai.

Yishai, being of Sephardic[33] (specifically Tunisian-Jewish) heritage, and a member of SHAS—a Jewish ultra-orthodox political party—in an Ashkenazi (European-Jewish) and largely secular parliament, claimed that he was being unfairly targeted for ethnic, anti-religious and political reasons (Ettinger 2010).

It took over a year for the disaster to be fully investigated. Once it had, the State Comptroller singled out a number of other, high-ranking politicians, including Ashkenazis in addition to Sephardic (North African-Jewish) Yishai. Collectively, these individuals were implied to bear responsibility both for the blaze itself, and also for the concomitant deaths, which had, at that point, become conflated under the one semantic label 'אסון הכרמל' or *ason ha-carmel* ('the Carmel disaster') in the Israeli public lexicon. This blurred distinction between related events with nonetheless multiple distinct causes helped, in our opinion, both create, and reinforce, a detrimental oversimplification of the event in the public sphere. This was both driven, and compounded, by a conspicuous lack of any robust discussion in the media of the systemic, ecological and historical-ideological causes behind the collective disaster (see Section 4.5). Such a lack is regrettable, as it largely precluded the Israeli public, or the country's political system itself, from drawing meaningful socially- or policy-relevant inferences. Rather, during the period in which we conducted our research (2011-2013), the Carmel disaster remained an arguably lost opportunity for the kind of well-informed experiential learning that sustainability

[33] 'Sephardic' Israelis trace their lineage to emigrants from North Africa and the former Ottoman Empire (originally exiles from Spain, or 'Sfarad' in Hebrew), while 'Ashkenazi' Israelis trace their lineage to emigrants from central Europe ('Ashkenaz' in Hebrew). The latter have historically enjoyed relative political dominance in the Israeli state (Shadmi 2003), particularly within the first few decades of the country's founding in 1948.

scholars have identified as core to building societal resilience in the face of largely unpredictable global change (Tschakert and Dietrich 2010).

4.4 The analytical value of a cognitive lens

Given the paucity of perspective-shifting insights wrought from the treatment of the Carmel disaster in the public sphere, we demonstrate how a combined application of cognitive theory and a social-ecological systems approach can play a uniquely revealing role in interpreting the events leading up to and following the 2010 catastrophe. One, by looking at the *particular* ways the complexity of the multifaceted disaster was reduced by the Israeli media, and by key individuals, we will be able to glean insights about the specific cognitive blind-spots that are liable to hinder the Israeli public from learning adaptively from such a tragedy. Two, by examining historical sources through this lens, we will be able to both enrich our understanding of the disaster's multiple causes (in contrast to what we demonstrate in Section 4.5 to be a reductionist, conflationary public narrative), as well as illuminate the ways in which previous actors' specific forms of complexity reduction continue to affect Israeli society today. Analyzing and articulating the *contextual*ly *specific* repercussions of *ubiquitous, generic* cognitive tendencies (Peterson and Flanders 2002) in this way will both help us better understand the disaster itself, as well as identify how research rooted in empirically-supported theory—relatively unbeholden to the market pressures and political influences that affect many other forms of knowledge generation in society—can contribute to a richer, more effective adaptive learning process in the wake of unexpected calamity.

4.5 The Carmel disaster in public discourse: searching for a scapegoat

We chose to investigate people's understanding of the Mt. Carmel landscape and the events surrounding its 2010 ignition using three different sources of material. The first of these was online Israeli print media, which we selected as a window into Israeli public discourse. Using the Hebrew search term "אסון הכרמל" or *ason ha-carmel* ('Carmel disaster'), as the fire and the subsequent loss of life was quickly dubbed by the media, we methodically searched the media archives of three of the most popular Israeli online news outlets for relevant articles: Ynet News, Nana10 News, and Ha'aretz. We analyzed articles from the period stretching from the outbreak of the fire in the first week of December 2010, to the release of a State Comptroller's report on the fire in the third week of June 2012. In total, this numbered 193 articles. For each article, we counted all causes of the disaster either stated or clearly implied by the author, including those phrased in the affirmative (e.g., "The scale of the fire was a result of severe lack of government preparedness") as well as in the negative (e.g., "The Druze youth arrested were later released due to lack of evidence"). This approach allowed us to track the variety of causal attributions made about the fire over time, as well as identify trends in which causes came to dominate the public discourse in subsequent months and years.

For each article, we also qualitatively evaluated the degree to which the given author conflated multiple fire-related events and their respective causes. We chose to measure this for a specific reason. Early on in our analysis, it became clear that the initial blaze itself, and the subsequent deaths during the evacuation of the military prison, were being conceptually combined and blurred in public discourse. This blurring appeared to be forging post-hoc narratives that pinpointed specific individuals as culpable for the entire sequence of events, with all the associated destruction and loss of life.[34]

4.5.1 Pointing the finger: "careless Druze," "spiteful Arabs" and "bad Jews"

Within the first month of the so-called Carmel disaster, there was an abundance of theories and attributions regarding its causes circulating in the public sphere. Over that four-week time period, the vast majority (89%) of popular attributions involved directly blaming either the national government (56% of all attributions), including specific government ministers, or Arab citizens (33% of all attributions), including and often specifically singling out Carmel Druze. (See Figure 4.2).

An additional five percent of the causes mentioned across media sources during this period invoked a theory, espoused by some prominent religious leaders, that God was punishing the Jewish nation for irreligious behaviour (Nachshoni 2010). Only one environmental factor—unseasonably arid weather—was cited in any of the surveyed articles published during this period. Aridity accounted for a mere three percent of all those theories or

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[34] To measure this phenomenon, we converted our qualitative assessments of narrative conflation into quantitative rankings on a discrete numerical scale of 1 (representing no conflation of multiple events or causes), to 10 (complete conflation of multiple events and/or their respective causes). This portion of our analysis thus provided us with a basic measure of how severely complexity was being reduced in the public sphere at different times, and by different outlets.

We should note that, for the purposes of our analysis, we excluded articles that contained extensive wording identical to other articles written by the same author or source. If such articles were to be included in the analysis, it would imaginably amplify the reported effects even further.

causes mentioned in our data within the first month of the disaster, while merely two percent addressed the possibility of firefighting errors.

In contrast to this absence of environmental focus or emergency response, one of the most oft-cited theories was ‘negligence amongst government officials,’ accounting for 29% of the theories put forth in those articles that discussed public sector culpability. In close second (22%), was the assertion that the disaster was caused, intentionally or otherwise, by young Druze males. Indeed, this theory of Druze criminal negligence was so immediately appealing to local state authorities that the Israeli police had soon arrested and temporarily incarcerated a series of local Druze boys and youths suspected of involvement. However, it eventually became clear that there was, in fact, no compelling evidence incriminating any of the detainees, and they were released. Months later, after significant protest from local Druze families, all charges were ultimately dropped (Hovel 2011).

The next most-cited theory within the first month of the disaster was that the fire was caused intentionally by non-descript ‘Arab’ arsonists (12% of all theories proposed). Some proponents of this theory, including Member of Knesset[35] Anastasia Michaeli, labeled it an act of terrorism, going so far as to claim it was tantamount to attempted genocide (Ronen 2010, Nana10 News 2010). This narrative clearly invoked the militaristic overtones and pervasive fear of existential threat so familiar to Israelis from decades of media reporting on the unresolved Arab-Israeli conflict (Bar-Tal 2001). As Michaeli stated on the floor of the Knesset within the first week of the disaster:

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[35] The Knesset is the Israeli parliament.

> What I saw in the Carmel today wasn't just any fire—I saw a war. People are losing their homes, parts of the land were completely destroyed, animals running to save their lives, and 41 people were killed. All of these sights are part of war. The arsonists should sit in jail for the rest of their lives and lose their privilege to [Israeli] citizenship (JPost 2010).

Despite how fully this narrative of genocidal intent might have resonated with some sectors of the Israeli public, over time, it became clear there was no actual evidence for claims of Arab arson. Thus, this particular theory began to disappear from the print media, diminishing slowly, until reaching a period of virtually no mention of it in our sources from November of 2011 to June of 2012. Nonetheless, beliefs that Druze or other Arabs were in some way culpable for some or all of the disaster appeared to persist in the minds of many Israelis over time, sometimes surfacing months later in venues such as talkback radio, or as rumours we personally heard circulating amongst Jewish Israeli acquaintances.[36]

An additional 11% of theories cited in this period placed blame specifically on then-Minister of the Interior, Eli Yishai. As described in Section 4.3, Yishai comes from the historically disenfranchised Sephardic community, and was serving at the time as a representative of the minority ultra-orthodox Jewish party, SHAS. The largely secular detractors of Yishai singled him out for spending too many of his office's resources promoting the affairs and furthering the interests of his narrow religious constituency. Yishai neglected to spend enough time and

[36] During our fieldwork, we encountered several instances of this first hand.

money, his critics argued, on maintaining or upgrading the sub-standard state of emergency services in the country, namely the fire brigades (Haaretz 2010).

By January 2011, public discourse surrounding the causes of the disaster had clearly begun to shift. During the month of January, only two percent of all causes mentioned amongst our source material made reference to Druze youth. None made reference to the theories of Arab arson or attempted genocide that had been circulating in the immediate aftermath of the blaze. Rather, print media had shifted decisively to pinning blame on specific minsters. Approximately 29% of all causes mentioned made broad reference to the fact that particular ministers were to be held accountable for 'the disaster', writ large. On an individual level, Eli Yishai received the brunt of public scrutiny (26% of all causes mentioned referred to him). Prime Minister Benjamin Netanyahu was also singled out, accounting for 12% of all causal attributions mentioned in our source material in the month of January. General government negligence was still a highly cited cause in its own right, accounting for an additional 26% of all causes mentioned. Theological arguments and recriminations of the previous Ariel Sharon-led government were also minimally cited, accounting collectively for two percent of all attributions mentioned.

As public attention began to fix on more temporally urgent concerns, the period from February 2011 to June 2012 saw a marked drop in the number of articles dealing with the Carmel disaster and its repercussions. However, media attention once again returned to the Carmel in June 2012, as State Comptroller Micha Lindenstrauss began to release his findings on government accountability for the 2010 disaster. Once the disaster was back in the public spotlight, a full 59% of all causal attributions mentioned in our source material for that month were directed at specific government ministers, either as a group (six percent) or, now much more explicitly, at single individuals themselves: Interior Minister Eli Yishai (16%), Finance Minister Yuval Steinitz (14%), Prime Minister Benjamin Netanyahu (12%), and Public Security Minister Yitzhak Aharonovitch (10%), all of whom were named in the so-called Lindenstrauss report as bearing 'particular responsibility' for the disaster (Zarchin 2012). (See Figure 4.2).

General government negligence was, at this time, also still being cited regularly as a casual force behind the disaster (18% of all attributions mentioned during the month of June). However, after more than a year and a half had passed since the fire, more systemic factors such as a dysfunctional police response (seven percent of all attributions mentioned), as well as missteps on the part of firefighting officials (eight percent of all attributions mentioned), were now also finally being acknowledged.

These patterns of reporting and causal attribution in the media reveal two main trends. One, the initial response of the public (as informed by and reflected through the mainstream print media) was to grope in a knee-jerk fashion for particular social groups and individuals that could believably be held directly culpable for all that went wrong. As evidenced in the freely accessible record of online print media, this search for a satisfyingly tangible scapegoat began virtually immediately, despite the considerable ecological, social[37] and even climatic complexity of the event (Helmholtz UFZ 2010).

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[37] See the subsequent sections of this paper for a thorough discussion of the ecological and social factors elided by mainstream media treatment of the disaster.

This impulse to scapegoat is unsurprising from a social psychological perspective. Similar patterns of group reaction to emotionally distressing disasters have been documented and theorized for over six decades.[38] Early accounts focused on the emotional impulses driving such group behaviour. These included the desire to resolve uncomfortable levels of fear and uncertainty in the wake of unpredicted collective trauma, emotions which are then cathartically released through direction of animosity at a coherent target (Veltfort and Lee 1943). Subsequent studies built on this theory of sublimation, reduction of uncertainty and catharsis. In particular, it was found that events without an easily understood naturalistic cause, such as a tornado or earthquake, led with even more certainty to scapegoating of individuals and opaquely defined groups with relative social power, such as 'bigwigs,' or 'government' writ large (Drabeck and Quarantelli 1967). Anthropologist Rene Girard developed an entire theory of society revolving around the group impulse to scapegoat, which he argues is a periodic virtual inevitability, whereby people reach an intolerable level of dissatisfaction with their relative lack of perceived success, and then channel said dissatisfaction at an easily accessible victim—a process ultimately ritualized and stylized by religion (Girard 1978).

[38] One of the most noteworthy early studies of disaster scapegoating is Veltfort and Lee's 1943 analysis of the popular response to the so-called 'Cocoanut Grove' fire in Boston, in which just under 500 people trapped in a burning night club died in a span of 20 minutes. Veltfort and Lee document how, rather than search for the systemic causes of the fire, public attention catapulted itself from one individual scapegoat to another, eventually exonerating the apologetic underage busboy responsible for the accidental first spark in place of a fixation on powerful city administrators and the owners of the club in question. Ironically given the context of this current paper, the nightclub owners were in fact Jewish, and the result was an anti-Semitic backlash. Veltfort and Lee conclude that the motivation towards this kind of scapegoating has its own internal emotional logic. Fear that such a horrific event could happen to innocent citizens was melded in the public's mind with 'tabloid thinking' that was driven by an emotional desire to reduce the discomfort of not knowing all the details of what happened. Latent hostilities towards 'political bigwigs' and Jews were then given an ideal outlet in the form of the fire that broke out in a Jewish-owned nightclub that had been given permits to operate by local city politicians.

Each of these generally mutually consistent theories is additionally supported by more recent empirical and theoretical insights into human cognition. For instance, the 'certainty effect' is an empirically observed tendency for people to choose simple, emotionally satisfying accounts of events over more nuanced, less conclusive ones, presumably due to an aversion towards the emotional discomfort people associate with uncertainty (Keren and Gerritsen 1999). Additionally, the 'defensive attribution effect' is a phenomenon whereby the more severe or traumatizing an accident appears, the more likely people are to assign concerted blame to an identified culprit, an effect that is magnified significantly to the degree that a given suspect is seen as 'different from oneself' (Burger 1981) (e.g., from another ethnic or socioeconomic group). Finally, on a more general level, it has been found that as humans, our indispensable human drive to reduce overwhelming complexity simultaneously prevents us from becoming paralyzed by excess information, yet also impedes us from crafting fully accurate accounts of complex phenomena (Peterson and Flanders 2002, Peterson 1999). Instead, we tend to settle for sufficiently believable accounts that are easily grasped and which allow us to maintain our stable self-image or social image (Gausel and Leach 2011), while avoiding the potential for endless negative affect that confrontations with uncertainty can produce (Peterson and Flanders 2002).

Unfortunately, as first documented decades ago (Veltfort and Lee 1943, Drabeck and Quarantelli 1967), people's predisposition to this kind of knee-jerk response to catastrophe can often hinder society's ability to properly understand a disaster's more probable or fundamental causes, thus detracting from a community's ability to learn adaptively and successfully modify institutions, regulatory protocols or even surrounding ecosystems to a more optimal degree. This is because people's drive towards emotional ease and cognitive simplicity can affect both their understanding of causal mechanisms of events, but also their clarity on just how many independent—or non-independent—factors are in fact involved in those mechanisms.

To this effect, a second main trend to emerge from our analysis was the degree to which public discourse conflated various aspects of the Carmel disaster as time progressed. (See Figure 4.1). Rather than develop an increasingly nuanced account of the particular causes and factors that constituted different elements of the tragedy (i.e., the initial blaze, the ineffective firefighting and police response, the subsequent deaths, etc.), our data reveal that the print media, as both a mirror and driver of public discourse, in fact did the precise opposite. Even as the specific roles of individual actors and state bodies gradually became clearer, the various components of the disaster were, in fact, *increasingly* conflated in the discourse over time (i.e., media articles used phrasing that increasingly blurred multiple causes, and made fewer clear distinctions amongst multiple causal factors, as time progressed). This was facilitated by the media's early and repeated used of the semantic shorthand 'אסון הכרמל' / 'the Carmel Disaster' to refer collectively to the entire series of events. This single umbrella term simultaneously simplified the discussion for the public, and for time-pressured journalists, but it also irredeemably *blurred* reality, insofar as the disaster was in fact not one monolithic event, but rather consisted of a number of separate incidents with very different causes, each offering a different potential lesson to improve future resilience.

The end result is that public discourse was characterized almost entirely by a quest to determine *who* was to blame for 'the disaster' broadly conceived, not *what* was to blame for which particular elements thereof. As such, this sort of discourse precluded a meaningful discussion about key underlying, systemic causes. The Israeli state apparatus did little to remedy this lost opportunity for learning. Rather than pursue an in-depth expert analysis of both individual- and system-level causes of the disaster, the State Comptroller essentially mirrored the public by conducting an investigation focusing almost exclusively on *who* should be held accountable. This effort appears to have been modeled somewhat uncritically on previous state-commissioned reports conducted in the aftermath of specifically military failures (e.g., the 1973 war, the second Lebanon war) (Ynet 2008, Knesset 2008). Ironically, this serves as yet another example of how defaulting to easy, familiar patterns of complexity-reduction (i.e., treating ecological disasters like military disasters, as the template for the latter is more familiar than the former in the Israeli context) can in fact hinder a society's ability to mine genuine insight from otherwise tragic catastrophe.

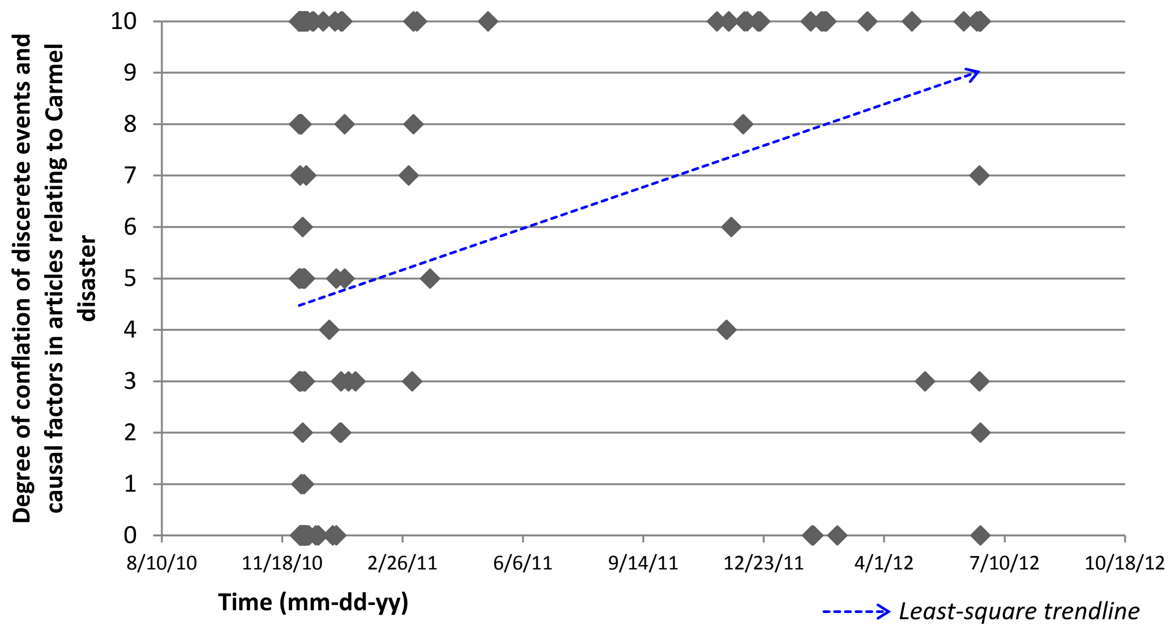
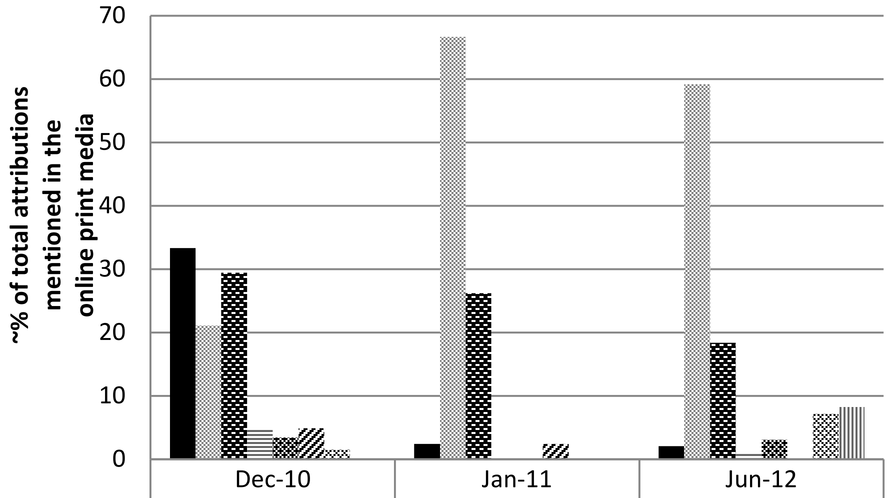


Figure 4.1 Increasing conflation of multiple fire-related events and their causes in Israeli online print-media

Each point on this figure represents an article containing the Hebrew term ason ha-carmel ('אסון הכרמל'), or "the Carmel disaster," that was published online by any one of three mainstream Israeli Hebrew-language internet news sites: Ynet, Nana10 or Haaretz. We tallied all such articles over the period from the outbreak of the Carmel fire (3 December 2010), to the release of a State Comptroller's report on the causes of the disaster, approximately 18 months later (20 June 2012). For each article, we rated the content on a qualitative scale of 1 to 10, where a rating of 1 was given for an article that did not conflate in any way the multiple fire-related events (i.e., the initial blaze, a bus tragedy in which 44 civil servants died trying to escape the flames, or the subsequent missteps in the state response), while a rating of 10 was given for an article in which all related events and their suspected causes were conflated *together as one single tragedy. As highlighted by the least-square trendline crossing the graph, the average degree of conflation in fact rose over time, from 4.3 within the first month of fire, to 8.7 during the month the Comptroller's report was released. This demonstrates how, in the absence of a proactively nuanced narrative proffered by the state, and in combination with the pressures of a fast-paced, for-profit media environment, public discourse is liable to lead over time towards simplified, conflated understandings of complex events, not the inverse. This has implications both for social-ecological systems theory—which has yet to integrate the reality of such pressures into its dominant analytical frameworks for resilience (e.g., Ostrom 2009)—and for the study of how dominant narrative is forged.*



	Dec-10	Jan-11	Jun-12
Arabs (total incl. Druze)	33	2	2
Individual ministers (sum)	21	67	59
Government negligence	29	26	18
Entire government (general)	5	0	1
Arid conditions	3	0	3
God's wrath	5	2	0
Firefighting officials	1	0	7
Police dysfunction	0	0	8

Figure 4.2 Causal attributions of the events surrounding the 2010 fire in the online Israeli print media over time

This figure shows the change over time in the relative frequency of the most oft-cited causal attributions for the 2010 fire and its concomitant deaths in the Hebrew-language print media. Source material is from all articles that contained the Hebrew term ason ha-carmel (‘אסון הכרמל’), or “the Carmel disaster,” that were published by three mainstream Hebrew-language online Israeli print media outlets (Ynet, Nana10 and Haaretz) in the months of December 2010, January 2011 and—after a lull in media attention owing to other events—again in June 2012, upon release of the State Comptroller’s report on the disaster. Note how in December, at the outset of the disaster, the largest proportion of attributions mentioned in the online print media *consisted of recriminations of Arabs in particular (including Druze). Once it became clear there was no actual evidence of Arab involvement, however, attention shifted largely to individual government ministers. Only after considerable time had passed, and the State Comptroller began to release findings from his report on the disaster, did some attention begin to shift towards missteps taken by the firefighting and police forces. Individual minsters, however still received a sizable majority of recriminations. Crucially, only one ecological factor was mentioned with any frequency (arid weather), and even it was only cited very rarely. Not a single historical factor, nor critique of forest management ideology, was mentioned with any frequency. Collectively, this contrasts starkly with the findings both from our in-depth interviews (see Section 4.6) and from our analysis of historical materials (see Section 4.7). We discuss some implications of this for theory in Section 4.8.*

4.6 Local actors' causal narratives of the 2010 disaster

4.6.1 Israel Nature and Parks Authority: "too much 'man,' unwelcome pines, and disappearing goats"

In addition to using media analysis to gain insight into the modes and effects of complexity reduction in the public sphere (see Section 4.5), we also wished to gain a deeper understanding of the specific ways in which various influential actors on the Mt. Carmel landscape tended to reduce the complexity of the environment, and make sense of the traumatic disarray (Peterson 1999) unleashed by the fire. To do this, we interviewed key informants from three different stakeholder groups in the Mt. Carmel social-ecological system.

The first of these were select managers and administrators in the Israel Nature and Parks Authority (NPA), which is the government branch responsible for management of the Mt. Carmel National Park and its adjacent nature reserves.

For their part, the NPA officials we interviewed described the recent 2010 fire as a purely anthropogenic harm to the local ecosystem. As managers with virtually no authority to affect human behaviour outside of the park boundaries, NPA interviewees implied that they as individuals, and as an organization, were thus effectively powerless to prevent the disaster.

Bolstering this narrative of relative incapacity, NPA officials assured us that, unlike much of Western Europe and North America, fires in Israel are ‘entirely man-made.’ They specifically implied that any catastrophic event such as the Carmel disaster must therefore be, *a priori*, the result of excessive human interference in the otherwise stable ‘natural’ ecosystem. The fact that modern humans have been present in the Carmel region, shaping and evolving alongside the ecosystem, for well over 200,000 years (Valladas, et al. 2013), is a confounding factor that NPA officials seemed clearly aware of as trained scientists, but which (during interviews) they openly found cumbersome. That is, any effort to fully incorporate long-standing human presence into the logic of their frankly stated biocentric[39] narrative was conceptually awkward,

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[39] The Encyclopedia of Environmental Ethics and Philosophy defines ‘biocentrism’ as:

> “…a life-centered outlook that rejects the view that humanity alone matters in ethics and accepts the moral standing of (at least) all living creatures. It has played a formative role in the development of environmental ethics since the study of this subject became a self-conscious discipline in the 1970s; it was also influential among some key earlier thinkers, including Albert Schweitzer (with his belief in “reverence for life”) and Mohandas Gandhi… Not all biocentrists condemn all destruction of life, however, although they all regard the good of living creatures as a morally relevant element in decisions affecting their treatment” (Attfield 2009, 97).

a fact in no way lost on the interviewees themselves. As one NPA official (O, for official) explained to one of us (R, for researcher):

> O: There are no natural fires here in Israel.
> *R: And there never were?*
> O: No, no. You get natural fires where you get summer storms, there are no summer storms in Israel.
> *O: Hmm, so, [the implication is that] the ecology itself isn't [at all] adapted to regular fires, to summer fires?*
> O: *[pauses] …* Well … the thing is, all the fires here are man-made … and you have man here for 10,000 [sic] years, so… it's difficult to say…
> *R: [nods in understanding]*
> O: … [Regardless,] even in the areas that you do have natural fires, like Spain for example, over there like 95% of fires are [still] man-made.

In terms of how they accounted for the cause of the fire itself, the NPA officials we interviewed expressed a belief, at the time, that the fire was likely ignited accidentally by Druze youth smoking in the forest. However, this proximate cause seemed relatively unimportant to our NPA interviewees, who appeared to view the reality of Mt. Carmel's flammability in more biophysical terms. Specifically, our NPA interviewees appeared to reduce the complexity of the 2010 catastrophe down to one key issue: that the Mt. Carmel region today is inherently flammable because of its high density of the western variety of Aleppo pine (*Pinus halepensis)*.

As described by historical sources (see Section 4.7), this tree is not 'native' to the region, but rather was first introduced either by late 19th century German colonists, or by British occupation forces in the early 20th century (Liphschitz and Biger 2004). It was subsequently actively planted by the Jewish National Fund (see Section 4.6.2) for political, nationalistic purposes.[40] For NPA officials, the current pine-dense regime is therefore entirely anthropogenic in origin, inherently 'unnatural,' and thus, in the context of their professional, and individual, biocentric worldviews, laden with negative normative associations (Rosenberg 2011, see below).

Complicating matters, there is what is locally regarded as an eastern variety of Aleppo pine (called *oren yerushalmi,* or 'Jerusalem pine,' in Hebrew) that is indeed native to the area, but which over the past century has been outcompeted by the more populous nonnative western variety. This is a process NPA interviewees said may increase in the aftermath of the latest fire, which they argued will likely see an increased germination of the opportunistic, fast-growing western variety of Aleppo pine in its wake. One NPA interviewee explained his stance on pines in the Carmel as follows, once again reflecting the challenge of integrating humans' ancient and continuous presence in the ecosystem into the NPA's biocentric narrative (italics signal the interviewee's spoken emphasis):

> Well… [Jerusalem pine, the eastern variety of Aleppo pine] is the natural one, so obviously we want to keep it. And you know, when you get cross [breeding] you lose it. … [The big specimens] probably died [in the fire], most of them. So it'll be a lot of work [preserving that population] ... [Yet], you know in an area like Israel you have agriculture for like 7,000, 10,000 years, [so] it's very difficult to say what's natural and what you want to protect. … It's easier to say what you *don't* want … and we *don't* want foreign

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[40] We treat this process in more detail in our discussion of the historical source material in Section 4.7.

> species… and [western Aleppo pine is] *definitely* [a] foreign species [sic], so we don't want them in our ecosystem.

Here the interviewee makes clear the particular heuristic—i.e., complexity management strategy—he uses to parse the multifactorial social-ecological system he is charged with managing. This heuristic—"eliminate foreign species"—is a straightforward way to reduce the messy complexity of a landscape that has seen humans shape and live in it for literally hundreds of millennia (Naveh 1990). However, beyond the relatively clear-cut issue of differentiating native from nonnative flora, this one particular approach to complexity-management begins to fall short of adequately capturing other relevant nuances in the system. Echoing work in psychology (Peterson 1999, Peterson and Flanders 2002), we argue that it is at precisely this point where things are liable to go awry.

One notable way this manifested in the course of our interviews is as follows. Owing to the particular narrow focus and inherent ontology of their principal "native-versus-nonnative" heuristic, NPA officials' broad application of the same general schema (see Figure 2.2) across the landscape led them to exhibit a continual, semi-conscious ambivalence about what is 'natural' to the region (and hence worthy of protection) versus what is 'unnatural' to the region (and hence worthy of eradication). This carried over directly into how they described their thinking, and ultimately the narrative they constructed for us, about another historically pivotal but now largely forgotten phenomenon on Mt. Carmel: the once ubiquitous practice of goat grazing.

On one hand, NPA interviewees stated that the ever-present possibility of 'overgrazing' was a threat to the 'naturalness' of the region. This concern appeared to be premised on beliefs about the earlier effects of grazing, prior to its gradual decline in the area over the course of the 20th century. As one interviewee explained:

> [In earlier times] there were a lot of … goat herds, Arab goat herds, that didn't allow anything to, you know, to grow… because they just … grazed like crazy… they eat *everything*.

Yet on the other hand, NPA interviewees also acknowledged the benefits of (much) earlier grazing patterns, whereby shepherds would trim trees to provide fodder for their flocks, and goats would eat up otherwise flammable underbrush. When actively prompted to consider this earlier dynamic, in which indigenous Arab shepherding practices had a much more direct and widespread impact on the 'nature' of Mt. Carmel than is allowed today under the current biocentric ideology, NPA interviewees readily admitted that, despite their authority's history of actively discouraging grazing in an effort to minimize 'unnatural' effects on the ecosystem, this earlier modus operandi likely once contributed to a much more fire-resistant landscape on Mt. Carmel (INPA 2012). Such a manicured hillside, they admitted, devoid of the large volume of flammable underbrush characterizing the contemporary goat-absent conditions, would have been far less likely to succumb to the massive scale of fire witnessed during the deadly 2010 catastrophe.

Thus, in the wake of the fire, some NPA officials we spoke with in fact began to publicly express an interest in actively encouraging more grazing (albeit in a controlled way, so as to minimize damage to the fragile shoots of endemic species such as oak and pistachio). In one forestry conference in the region in February 2012, some NPA officials even began to discuss the feasibility of a 'payment for ecosystem services' (PES) scheme, whereby local Carmel Druze or other Arabs could be directly compensated by the government for reviving the virtually eradicated cultural practice of goat herding in the forest.

With respect to our argument about the usefulness of investigating actors' patterns of complexity reduction, it is crucial to note that it literally took a massive, deadly forest fire for the positive role of once heavily-derided goat herding (see Section 4.7) to begin to gain traction amongst the NPA. This is not, we argue, because the NPA is a particularly myopic or ill-informed government agency. To the contrary, it is staffed with many university educated biologists and ecologists highly practiced, and regularly engaged, in nuanced thinking. The NPA's slow pace of change in strategy is, rather, testament to the power of a core, foundational belief system—in this case, a deeply biocentric conservation narrative[41]—gone critically unexamined. Collectively, this core biocentric framing bolstered by its supporting heuristics can successfully reduce the daunting complexity of social-ecological systems down into simpler, more manageable prescribed actions. However, as evidenced by the scale of the 2010 fire, a lack of critical analysis of these entrenched complexity-reduction techniques can lead to sometimes catastrophically dangerous figurative blind spots. The role of the researcher here, then, can be to bring these techniques to light, and help elucidate their context-specific repercussions.

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[41] Such an approach to conservation is ironically itself a 'foreign entity,' introduced to the Middle East from the largely Anglo-American context in which it developed (Sarkar 2002).

4.6.2 Jewish National Fund foresters: "too much biocentrism, not enough forestry and more disappearing goats"

While the NPA is responsible for conservation policy and enforcement within Mt. Carmel National Park writ large, segments of the Mt. Carmel forest are in fact administered by the Israeli state's *de facto* forestry body, the Jewish National Fund (JNF). Known in Hebrew as the *Keren Kayemet Le'Israel* (KKL), the JNF is a nominally non-governmental organization originally formed in 1901 with the purpose of purchasing and securing land in Palestine for Jewish immigrants. Over the course of the early 20th century, afforestation came to play a central role in the JNF's efforts to demarcate purchased land as Jewish (see Section 4.7.3), a central process in the consolidation of the emerging Jewish nation-state, which took place against a backdrop of intense indigenous Arab resistance (El-Eini 2006).

Since the signing of an official agreement with the state in 1961, the JNF has expanded its activities beyond JNF-owned land, and now engages in planting and forestry activities on state-owned land, through piecemeal division-of-labour agreements with other relevant agencies such as the NPA. Mt. Carmel National Park is an example of one such area. Large segments of the park, particularly those closest to Druze town limits, are in fact planted and maintained by the JNF.

The JNF foresters we interviewed expressed their primary aim in the region as actively managing the Carmel landscape in a "balanced" fashion (Adar 2012). Ideally, in their view, this would result in tracts of green, lush, but fire resistant forest, while simultaneously allowing for a range of other human uses in the region, such as suitable forms of agriculture and tourism (Adar 2012). According to our JNF interviewees, the slopes of Mt. Carmel are a human-managed system that need to be actively tended so as not to become overgrown, and liable to large-scale canopy fire.

In their capacity as foresters, JNF interviewees expressed the belief that avoiding and preventing such large-scale fire requires a number of active measures to be taken on a continual basis: pruning and thinning of trees, clearing of underbrush, creation of firebreaks by either making strategic clearings in the forest or planting rows of fire-resistant species (even if they are nonnative), encouraging controlled grazing, and constructing roads, where necessary, to allow better access for managers and fire crews. Unlike NPA officials, JNF interviewees supported the notion of active human intervention in the forest as a necessary, desirable phenomenon, which they appraised positively. NPA interviewees, in contrast, recoiled at the notion of increased man-made firebreaks and road construction in the Carmel as anathema to their own mandate of preserving contiguous livable habitat for threatened endemic fauna. JNF interviewees, in turn, decried the NPA approach as rooted in an excessively biocentric, impractical ideology. As one JNF forester insisted:

> The NPA saw this area like a wilderness… [they said] let’s not touch [it], [let’s] not manage [it], what will be will be. … [But our] main challenge as land managers, as both NPA and [JNF], is [to figure out] how to build this picture from all parts of this mosaic, to have parts protected and managed for humanity, on the very borders of the communities, [to include] areas of agricultural land, [and] on the other [hand] to decide

> where are the main areas or points where there must be harsh protection, for [ecological] values.

JNF interviewees went on to describe how the NPA's strict preservationist ideology has combined with the drastic decrease in goat grazing over the past half-century to create an extremely flammable forest that is virtually always on the cusp of ignition. This, according to JNF interviewees, is what led to the devastating 2010 fire. As one interviewee explained to us:

> [Early on,] forests on Mt Carmel were more fragmented… [there was] still lots of goat grazing, the forest was still quite young. [But over time] goats [came to be seen as] the most important enemy of the forest… [this is because], at that time, grazing pressure [was still] very intensive, and [it] didn't allow the forest to recover… [However,] we understand now that [minimizing human activity and embracing only] natural processes [doesn't] always lead to the best forest composition… It's important to try and [actively] manage a natural forest, even if it's declared as nature reserve… Because if you don't have grazing, and you don't have fragmentation of the landscape, you have a very dense mixed forest… this is like a bomb.

The solution, JNF interviewees argued, is rolling back the NPA's hands-off management style, and actively intervening in the forest to minimize its fuel load. They noted that, in addition to the techniques described above, this may also require controlled burning, something the NPA may well find unacceptable.

4.6.3 ‘Isfiyya locals: “maybe God, maybe Satan and definitely Zionist discrimination”

Finally, to gain an understanding of how local Druze were making sense of the chaos (Peterson 1999) unleashed by the 2010 disaster, we conducted two months of ethnographic observation, and a series of semi-structured in-depth interviews with a range of local residents in ‘Isfiyya and Daliat-al Karmel. When the topic of the fire was broached in our interviews, interviewees would frequently recount personal experiences of witnessing the fire in its early stages, highlighting its enormous scale. Many interviewees expressed a degree of fatalism about its cause. Some called it an ‘act of God,’ unstoppable given the unseasonably dry conditions at the time. Others called it an ‘act of Satan,’ whose face some people claimed could literally be seen billowing from the smoke, a phenomenon that a local man claimed to capture on video using his cell phone.[42] This image, widely shared on digital media, appears to be burned to a degree into local Druze consciousness.

The way in which the fire scarcely avoided the perimeter of ‘Isfiyya town limits, and appears not to have damaged tombs of local holy figures in the area, was highly salient for local Druze residents. Some interviewees attributed their apparent luck, albeit often with a degree of ambivalence or skepticism, to a ‘higher power’; namely God, or the spirits of the entombed holy figures themselves.

Some interviewees cited the theory that a local Druze teenager started the fire by negligently throwing a lit water-pipe coal into the forest. Even those who did cite this theory, however, were quick to assert that it was nonetheless useless to blame or charge underage

[42] One interviewee showed us this video, and there is, indeed, a moment in time at which a huge cloud of smoke over the smouldering forest does resemble the face of a sinister being.

Druze. Rather, the fire's unprecedented destructiveness—which, in contrast to the mainstream Israeli print media (see Section 4.5), the Druze seemed motivated to distinguish from the initial blaze itself—was largely caused by more systemic, insidious factors, which we describe below.

Namely, many Druze interviewees vociferously cited government ill-preparedness as the primary cause for the sheer scale of the fire. Those we spoke to in the village would consistently cite the several hours it took for emergency crews to respond to the blaze. As one group of male interviewees explained at a local carpentry studio:

> You can't blame kids, because they're less responsible than the firefighters … Two hours [and] 45 minutes for one fire fighter? … They [*the nearest government authorities*] have 10 trucks of fire fighters! They could have brought them here and it would have ended fast. … [There was such a] bad smell [that it should have been obvious]. … It's their mistake. …. They thought it was a [routine] fire and underestimated it and sent one truck, but [it's as if] they didn't know that it was full of this [*points to a sketch of a pine branch, with cone and needles, drawn by an interviewee]*, and this is really… it's like gasoline… benzene, benzene, benzene!

One of the interviewees added immediately:

> [Eventually] they sent one truck. But [it wasn't enough to put out the fire]. They underestimated it. [That truck] called the cops, [and it was] two hours until [another] truck came … and [the fire] got bigger… [It was] two hours more until the third truck came and it got bigger [still]… [It took] 12 hours until the airplanes came… [By] then, it was an inferno.

Other interviewees went on to highlight a fundamental lack of proper firefighting equipment in the area suitable for handling such a large-scale fire. For many Druze, this latter fact appeared directly tied to an additional core theme to emerge from our interviews in the community. Namely, many interviewees described the government's slow and ineffective response to the fire as a symptom of the Druze's status as virtual second-class citizens in the majority-Jewish, Hebrew-speaking Israeli state. This is a central, shared proposition amongst Druze interviewees, and one that appeared, to us, associated with a deep sense of indignation.

If the Druze were regarded as equal citizens, interviewees claimed, there would have been a proper fire brigade established in the area years ago, and the government response to the fire would have been swift and decisive. Instead, according to our interviewees, because the Druze minority is of a lower priority to the Jewish-dominated government than the Jewish majority, non-Jewish communities such as 'Isfiya and neighbouring Daliat al-Karmel receive less funding for, and hence poorer, social services.

For several interviewees, this perceived government prioritization of the well-being of Jewish, over Druze, citizens is more than a simple case of latent racism. While many interviewees denounced what they perceived as the government's ethnic favouritism, some were clear in stating their belief that it has very obvious, evenly openly acknowledged, causes.

Namely, some Druze interviewees appeared to believe the Israeli government openly assists its Jewish citizenry at the expense of its non-Jewish citizenry because that is the inherent logic of Israel's founding Zionist movement itself: the creation and defense of a homeland of Jews, by Jews and for Jews. The reason such a logic persists with such intensity to this day is seen, in turn, as a product of Jewish Israel's ongoing, unresolved conflict with both the Palestinians and neighbouring Arab states. According to this narrative, while the regional conflict still simmers, Israel's limited funds must be sunk largely into defense, subtracting from what is left for social services. When it does come time to deliver social services, Jewish communities inevitably receive relatively more than non-Jewish ones, because the raison d'être of the state is Jewish welfare, not total welfare. When pressed, in turn, to explain the underlying causes of the ongoing conflict, interviewees cited meddling foreign interests including the United States, but, most significantly, they highlighted 'poor political leadership,' both within Israel, and amongst the neighbouring states and peoples with which it is at conflict.

While parts of this broader-scale narrative about the overriding political dysfunction of the region may have resonated well with our interviewees from both the NPA and JNF alike, it is telling that the Druze were the only ones to connect these more long-cycling, regional political dynamics specifically to the disastrousness of the 2010 fire. Relatively unfamiliar with the ecological nuances dwelled upon by NPA and JNF officials, Druze interviewees looked for a coherent narrative of the fire that fit neatly with their own lived experience of community-level discrimination. At the same time, some of these same interviewees also hinted at a sense of guilt or shame over the villages' illegal garbage dumps in the surrounding forest, which rumours were suggesting was where the fire started. Together, this narrative suggests a complexity-management strategy amongst the local Druze wherein a familiar "blame the state" heuristic worked quite well to make sense of how the fire got to the scale of destructiveness that it did. However, that limited heuristic simultaneously failed to fully capture interviewees' suspicion that dysfunction in the local Druze community itself also had a role to play in allowing for, or even fostering, the conditions and attitudes that led to the initial spark itself. Local Druze's initial reluctance to explicitly incorporate this latter dimension into the narrative they constructed for us during the interviews is—just as with the self-serving aspects of both NPA and JNF interviewees' narratives, above–consistent with psychological studies of people's innate drive towards preserving positive social- and self-image (Gausel and Leach 2011, Keren and Gerritsen 1999, Taylor 1983). In this light, a positive role for research can be to identify and alert local stakeholders to the ways in which each of us naturally tends to reduce complexity in self-favourable ways, demonstrating the potentially invaluable knowledge and lessons that are otherwise unwittingly sacrificed to the psychological need for coherence and emotional equilibrium (Peterson 1999, Peterson and Flanders 2002).

4.7 Mt. Carmel in historical context: from ancient fire-shaped hillside to European fantasy forest

While in-depth interviews allowed us to explore the particular narratives and complexity-management techniques of individual actors and stakeholder groups, and while media analysis enabled us to do the same for the public sphere, we feel this still lacks a dimension of explanatory richness that can only be gained by looking at a social-ecological system across a wider time span. Therefore, our third and final set of source material consists of previously published studies and historical documentary sources detailing how the Mt. Carmel landscape has (been) changed over deep time. Crucial to our methodology, we focus on information that allows us to infer how various actors appear to have been reducing the complexity of the social-ecological system into prescriptions for how to act in and towards the landscape. This allows us to construct a sense of how cognitive and cultural factors themselves may have been culpable, long-term drivers of the 2010 disaster, creating a path-dependence replete with lessons for resilience that are nonetheless insufficiently captured by more mainstream public narratives.

We begin below with a brief account of the historical causes of the fire, highlighting in particular the complexity-reducing role of ideology, idealized ‘natures’ and the concomitant decline of goat herding. We elaborate more on the connections amongst the latter concepts, and cognitive theory, in the conclusion.

4.7.1 Early history

Confounding the NPA’s attempts to discern what is natural from what is man-made, material evidence attests to early hominids inhabiting caves in the Carmel region from at least as early as one million years ago (ZIA 2014). By the Early Upper Pleistocene (from 100,000 BP through to 12,000 BP), a discernable process of human-environment co-evolution began to develop in the area (Naveh 1990). Notably, in contrast to contemporary perceptions of fire as a modern blight on the ecosystem, the archeological record attests that it was, specifically, humans’ increasingly sophisticated use of fire that in fact characterized this formative co-evolutionary process. First, humans would burn patches of forest on and near the Carmel mountain range to create ‘pastures’ used to attract game such as gazelle. Increasingly inventive uses of fire in this manner eventually led to a qualitatively different stage of co-evolution, in which humans began to fell some of the dense oak and pistachio forests covering the area at the time, burn the wood, and use the ashes in a process of reseeding with more suitable species (Naveh 1990).

As this process continued, the area became increasingly dominated by cereal culture, and animal husbandry (Naveh 1990). While the crops changed, this land-use pattern continued steadily throughout the millennia, ultimately being adopted by the Druze upon their settlement on the Carmel sometime in the 17th century CE (Parsons 2000). It was only during the 20th century, in the context of major socioeconomic and political transformations, that agriculture and animal herding began to wane in importance (Nissan 2010).

4.7.2 Changing natures: Mt. Carmel in the modern period

The modern history of the southern Mt. Carmel social-ecological system has been deeply shaped by at least two key dynamics of change. One of these has been a relatively rapid shift amongst local Druze from ancient agro-pastoral practices to integration into the modern state, specifically through industry and army careers (Nissan 2010, Parsons 2000, Dana 2003). The second major shift has been a consecutive inscription onto the landscape of a series of new, foreign conceptions of 'ideal nature' inherited first from early modern Europe (Liphschitz and Biger 2004), and later from the modern conservation movement (Paz 2012, Tal 2002). These 'ideal natures' comprise specific, normatively-laden, often aesthetically-concerned reductions of the otherwise overwhelming complexity of social-ecological relations. As we detail below, these idealistic reductions served as cultural blueprints for management decisions, launching long-term trends of path-dependence in the Mt. Carmel social-ecological system that, by the unseasonably dry winter of 2010, had inadvertently conspired to create ideal conditions for disaster.

Beginning in the late 19th century CE, historic Palestine saw several new waves of Europeans arrive on its shores both to visit, and to settle. This process began with visiting Western geographers and Christian German settlers, but soon shifted largely to Eastern European Jews who began to migrate to the land described in their scripture to escape and, ironically ultimately reproduce, the rising logic of exclusionary ethnonationalism that was coming to define life in early modern Europe (Stanislawsky 2001). The sort of landscape these waves of Europeans encountered in Palestine did not match what many 19th century western imaginations apparently construed as the "image of a green and lush Eretz Israel[43], covered in ancient times with thick forests containing tall trees, … densely populat[ing] vast areas" (Liphschitz and Biger 2004, 34-35). While these images seem to have been popular, likely owing to voluminous anachronistic European artistic portrayals of Biblical scenery (see Figure 4.3), such imagined landscapes in fact do not match the existing evidence for any period of time in historic Palestine. Rather, historians Liphschitz and Biger (2004) argue:

[43] Eretz Israel is the Hebrew term for the 'Land of Israel,' and refers broadly to historic Palestine, a region circumscribed by the Mediterranean Sea in the west to the Jordan River in the East, and the Litani or Qasimiyeh River in the north to the Gulf of Aqaba in the Red Sea to the south.

[D]escriptions of the landscape of Eretz Israel in times long gone, which tell of thick forests covering vast areas of the plains and mountains, are mostly a desire of the heart that is not based on comprehensive archeo-botanical research (35).

Thus, German, and later Jewish and British, afforestation efforts in what is today Israel-Palestine were in fact initiated, Liphschitz and Biger (2004) submit (italics added):

> …in an attempt to restore the country's [imagined] past scenery, [which stemmed from a particularly] European way of thought, brought forth from that continent by the new settlers…[A]fforestation was…based on new species and varieties that were introduced…and planted on lands that *had never been covered by forests* (35).

That said, we should not overstate Mt. Carmel's barrenness prior to modern forestry efforts. Accounts by Western travellers note that, in contrast to many other parts of Palestine, Mt. Carmel was not entirely bereft of foliage in the late 19th century[44] (Liphschitz and Biger 2004).

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[44] Henry Baker Tristam visited Palestine in 1863-1864, and recorded the following description of the Carmel:

> *Apparently—a proper, so-called forest does not exist here, other than the Pines on its peaks…Most of the area is covered by thick shrubbery. It is nearly arid near Haifa—where the groves were cut down for the making of coal…but the rest of the region comprises of an impenetrable thicket. Other than the Pines, Oaks are the dominant tall-trunk trees present. Some of these evergreen, flat-leafed trees have an elegant appearance. In addition, there are Chestnuts (Castaneas) and single representatives of all Eretz Israel's trees* (Liphschitz and Biger 2004, 37-38).

And in 1879, traveller R.C. Conder reported that:

> *The country's natural vegetation consists of a few trees, bushes and shrubs. …[However,] A dense Oak forest backed by a lower sub-forest exists between Mt. Carmel and Nazareth, [a]n open Oak forest grows on the low hills south of Mt. Carmel … and it is what has survived from the large forest described by [earlier travellers]—and is one of the prettiest spots in the Holy Land* (Liphschitz and Biger 2004, 38-39).

Such records describe a predominance of the sort of oak-and-shrub landscape one would expect of a rural eastern Mediterranean hillside heavily manicured by goat grazing.

Indeed, due to their voraciousness, extensive goat grazing would have had a truly pivotal effect on the terrain. Aside from goats' consumption of shoots and underbrush, shepherds themselves would have shaped the landscape as they pruned trees with a sickle-like tool called a 'manjal', removing higher branches to provide added fodder for their flock (INPA 2012). The result was, imaginably, a sparsely forested slope of short, bush-sized oaks, pistachios and eastern Aleppo pines, with relatively little flammable underbrush. This heavily grazed brushscape (or 'maquis') would have been interspersed with terraced agricultural plots of varying productivity, breaking up the landscape and mitigating the possibility of large-scale fire.

In the relatively dry Mediterranean climate, with its long hot summer months, followed by wet, stormy winters, such agricultural and grazing pressures would have also presumably led to a gradually worsening cycle of soil erosion. It seems that it was said soil erosion, combined with extensive deforestation elsewhere in Palestine, that jarred German settlers, Jewish immigrants and later British colonists, into attempting a large-scale reshaping of the local landscape to match their culturally inherited western ideals (Liphschitz and Biger 2004).

Figure 4.3 Biblical landscape in the European imaginary, c. 1650, and an actual Palestinian landscape, c. 1866

Above is an iconic 17th century European depiction of the Biblical landscape, entitled 'Saint John the Baptist preaching in the Desert,' painted by Pier Francesco Mola c. 1650-1655.[45] *Note the lushness of the foliage. Below, is an early photograph of the actual Palestinian landscape encountered by early British expeditionary forces in the late 19th century (c. 1866)*[46]*. The contrast was likely jarring for European arrivals on Palestinian shores, who then proceeded to reshape the landscape to better match their own imagined schema (Liphschitz and Biger 2004). On Mt. Carmel, this led unwittingly to a dynamic of path-dependent expansion of planted pine forest that culminated in unprecedentedly flammable conditions in the winter of 2010.*

4.7.3 Zionism and the afforestation of pines: a mutually reinforcing cycle

Afforestation was not initially core to the vision of founding Zionist ideologue Theodor Herzl. However, as soon as it was realized that the Palestinian landscape did not match that of the European Jewish imaginary, forestry very soon became a central multi-purpose activity for Jewish colonists (Liphschitz and Biger 2004).[47] At first, Zionist planting efforts appear to have

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[45] Public domain, via Ciudad de la Pintura, http://pintura.aut.org/BU04?Autnum=12.277, accessed 30 July 2014

[46] Original source: Jacob's Well, near Shechem, Frank Mason Good (English, 1839–1928), 1860s. Getty, http://blogs.getty.edu/iris/files/2011/06/jacobs_well.jpg, accessed 30 July 2014

[47] As Liphschitz and Biger (2004) write:

> [Although] [a]fforestation of Eretz Israel did not [at first] seem an important issue for the [early] Zionist leadership…when they were exposed to the gloomy landscape of a country stripped of trees, they could not remain indifferent. … [T]he first manager of the Jewish National Fund (JNF)…pushed for afforestation. Theodor Herzl offered to establish a planting association that [would] also deal with donations. Herzl visited Eretz Israel in 1898, and observed the bareness and emptiness. Upon returning to Europe he turned to [tropical forestry specialist] Prof. Otto Warburg and asked him to prepare a detailed memorandum regarding the plants of Eretz Israel and the possibilities of settling the country…In 1899 [Warburg] presented Herzl with a detailed survey concerning the different climatic zones of Eretz Israel, and the possibilities of tree planting. Warburg was certain that afforestation would contribute to climatic and economic improvement in the desolate [imagined] homeland (57-58).

had a largely, if not solely, agricultural focus. Hopes were placed on fruit trees, including palm, coconut, and especially olive, which European Zionist minds imagined could birth a new self-supporting agricultural industry for Jews in Palestine. However, early efforts at olive grove planting stuttered. Soon, focus began to shift towards 'barren' (fruitless) forest trees, and for aesthetic and nationalist, not merely productive, purposes (Liphschitz and Biger 2004, Zerubavel 1996).

Planting trees of this sort (i.e., evergreens), and for these purposes, came to be a central raison-d'être of the JNF, which, as mentioned above, remains one of the central actors on Mt. Carmel today. This early shift towards fruitless and flammable, but fast growing, pines is evidenced in a 1911 communication from early JNF chairman, M. Bodernheimer:

> [During my last visit to Erezt Israel] I witnessed that the [so-called] olive orchards [were in fact] nothing but a failure … In addition to that, one must not think of "forests" in Eretz Israel in the manner that forests are perceived in Europe. After [local consultation] I have decided to make dramatic changes. According to my own advice—Eucalyptus, Cypress and [Pine] trees, which hold the ability to improve the country's appearance and climate, were planted. Forests of this type demand a long-term investment of resources, but they carry some real value. Such a project can only be undertaken by a public organization, which is why I accepted it as an obligatory and important task for the JNF (Liphschitz and Biger 2004, 63-65).[48]

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[48] Liphschiz and Biger (2004) describe how this shift came to dominate forestry policy in mandate Palestine in the years to come. They emphasize the key political role it came to have for the Zionist project:

> [The new forestry policy was encapsulated in a Zionist] memorandum titled: "On the Deforestation of Eretz Israel and a Suggestion for its Renovation." [This] policy was later adopted by the British regime, as

It was at this point that Jewish forestry in Palestine began to morph from an agricultural and economic activity, albeit for colonial aims, to a predominantly nationalistic one. In so doing, proto-state foresters began eliciting a series of motivational images and narratives that bolstered Zionist goals (Liphschitz and Biger 2004, Zerubavel 1996). These narratives give us a useful window into the particular ways that European Jewish settlers were reducing the historical, social and ecological complexity of the 'Biblical' landscape into a field for a specific kind of political action. In a particularly telling example, a 1921 JNF forestry policy stated:

> Forests occupy an important part of human history, from the days of Genesis to these times. A forested country holds a blessing and becomes an attractive force bringing people to settle and live in it because forests dictate three of the most influential conditions related to man and his environment: Water, Air and Soil. Woe and anguish are the fate of a deforested land. Without trees—the harmonious natural creation is unbalanced, and an opportunity is given to destructive factors that ruin the air breathed by the land's inhabitants. The people of Israel were commanded by God to plant—as they inherited the country, and our forefathers were keen and meticulous in filling this Command…but from the day our people left for the Diaspora—the land lay in waste. The numerous enemies stripped it of its tree-jewels and it became emptier and treeless

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> well as the State of Israel when it finally controlled the country**.** The afforestation guidelines [therein] … have not changed significantly since then. Afforestation was regarded as necessary for the Zionist aspiration of changing the landscape of Eretz Israel and settling Jews in it. The [JNF] whose initial task was to purchase land, became an operative body leading the afforestation of areas that could not be cultivated—in order to both reaffirm ownership and supply work to the incoming immigrants. The core activity had moved to the uncultivated mountainous lands … following the new scheme of planting forest trees (63-65).

> during the centuries, until it stands in front of us—completely bare (Liphschitz and Biger 2004, 67).

As mentioned above, Liphschitz and Biger (2004) inform us that "this romanticized image captures more imagination than reality" (67). Later research has shown that historic Palestine was likely never covered by forests as per western conceptions of the term. The climate is simply not suitable. "Even the [Biblical] command of planting trees," speculate Liphschitz and Biger (2004), "had fruit trees and not barren ones [such as pines] in mind" (67). Nonetheless, it was an attitude of fighting back centuries of perceived human, specifically non-Jewish, 'mistreatment,' and preventing "demolition of the land" (67) by means of erosion that came to infuse Zionist forestry discourse (Liphschitz and Biger 2004).

However, beyond a mere greening of the newly adopted 'homeland,' JNF afforestation also served a more directly tactical, political goal: marking land purchased by Jews against the competing claims of dispossessed Arab peasants (El-Eini 2006). Liphschitz and Biger (2004) argue that immediately after WWI, this was done on Mt. Carmel, specifically (76). The Arabs, for their part, repeatedly used both arson, and goat grazing, as ways of refuting Jewish claims to newly-forested lands throughout mandate Palestine (El-Eini 2006). This dynamic continued for decades, up to the outbreak of all-out war between the two sides in the wake of the 1948 withdrawal of British forces (El-Eini 2006). Thus, both forests, and fire, have heavily laden meanings for the residents of present-day Israel, evoking century-old themes of politics, nationalism and tragically lethal ethnic strife.

That said, while Zionist afforestation was largely about securing both land rights, and, through forestry campaigns, foreign support from the Jewish diaspora, early Zionist afforestation did also serve other purposes. New forests provided both timber for local industry, as well as employment for new settlers (Liphschitz and Biger 2004, 77). These latter, economic purposes, in conjunction with agricultural and aesthetic concerns, were what motivated British colonial forestry efforts in Palestine.

4.7.4 The British in Palestine: copy, paste, colonize—and down with the goats

When the British wrested control of Palestine from the Ottomans in 1917, they found themselves stewards of a largely unforested land. As described above, this landscape did not reflect the ideal image of the 'Holy Land' likely held by many western imaginations (Zerubavel 1996). Sir Herbert Samuel, the first British High Commissioner of Palestine, described the situation in the following terms:

> Worn-out from war and exhausted was the land, as [British] General Allenby's forces swept across it…. The few forests have been all but cut down…mountain tops and their slopes are indeed suitable for the planting of trees, but nevertheless—there are no forests. Many desolate sandy hills are awaiting their saviours as they expand and endanger the nearby cultivated fields (Liphschitz and Biger 2004, 171).

It was in light of such perceptions that the British implemented a series of forestry policies and afforestation initiatives. However, rather than design a new set of policies from scratch, the British approach was essentially imported wholesale from its forestry efforts in other colonies.

These domains of previous forestry experience included mainly India and Cyprus. Application of principles developed in those two colonies were then combined in Palestine with the literal importation of species from Egypt and Australia (El-Eini 2006).

The policies that the British put in place in turn directly influenced the Israeli policies that followed them. Setting a precedent for state intervention that lives on to this day in Israel, in a 1920 ordinance, the colonial government reserved the right to protect and govern public forests, newly labeled 'State Forests,' but also to manage *private* forests. With this document, the felling of most tree species were prohibited without written permission, and permits were now required (*de jure* if not *de facto*) for coal and wood collection, resin extraction and, significantly, goat grazing (Lipschitz and Biger 2004, 172).

Much of British forestry policy hinged on the issue of how and to what degree to control grazing. Documentary sources reveal disagreements within the colonial administration over how seriously, and to what extent, to place limits on locals' grazing activities. Gilbert N. Sale, Palestine's first Conservator of Forests and head of the Department of Forests, attributed much of the region's apparent soil erosion to 'over'-grazing, and advocated a policy of strict grazing controls.

In a classic example of how pre-supposed axioms (e.g., the 'need' for lush greenery) can tragically reduce important elements of a complex reality, Sale seemed either entirely unable or unwilling to view goats as an integral part of the millennia-old social-ecological system. Rather, he insisted that Arab herders' flocks were none other than "highly dangerous beasts" whose voracious appetites had to be curbed (El-Eini 2006, 196). Sale did not keep his opinion private. Forests, he wrote, simply could not simultaneously grow, and provide fodder (El-Eini 2006, 196). Thus, despite the irreplaceable centrality of goats to the local Arab economy, in a publicly distributed pamphlet on combating soil erosion, Sale literally had goats labeled Palestine's "Public Enemy No. 1" (El-Eini 2006, 222). This was followed by a series of educational calendars, which contrasted Palestine's imagined, verdant, conspicuously goatless future with an artist's depiction of barren hillsides riddled with voracious black goats. The typical Palestinian goat-grazed landscape was described explicity as "neither beautiful nor useful" (El-Eini 2006, 216) (see Figure 4.4).

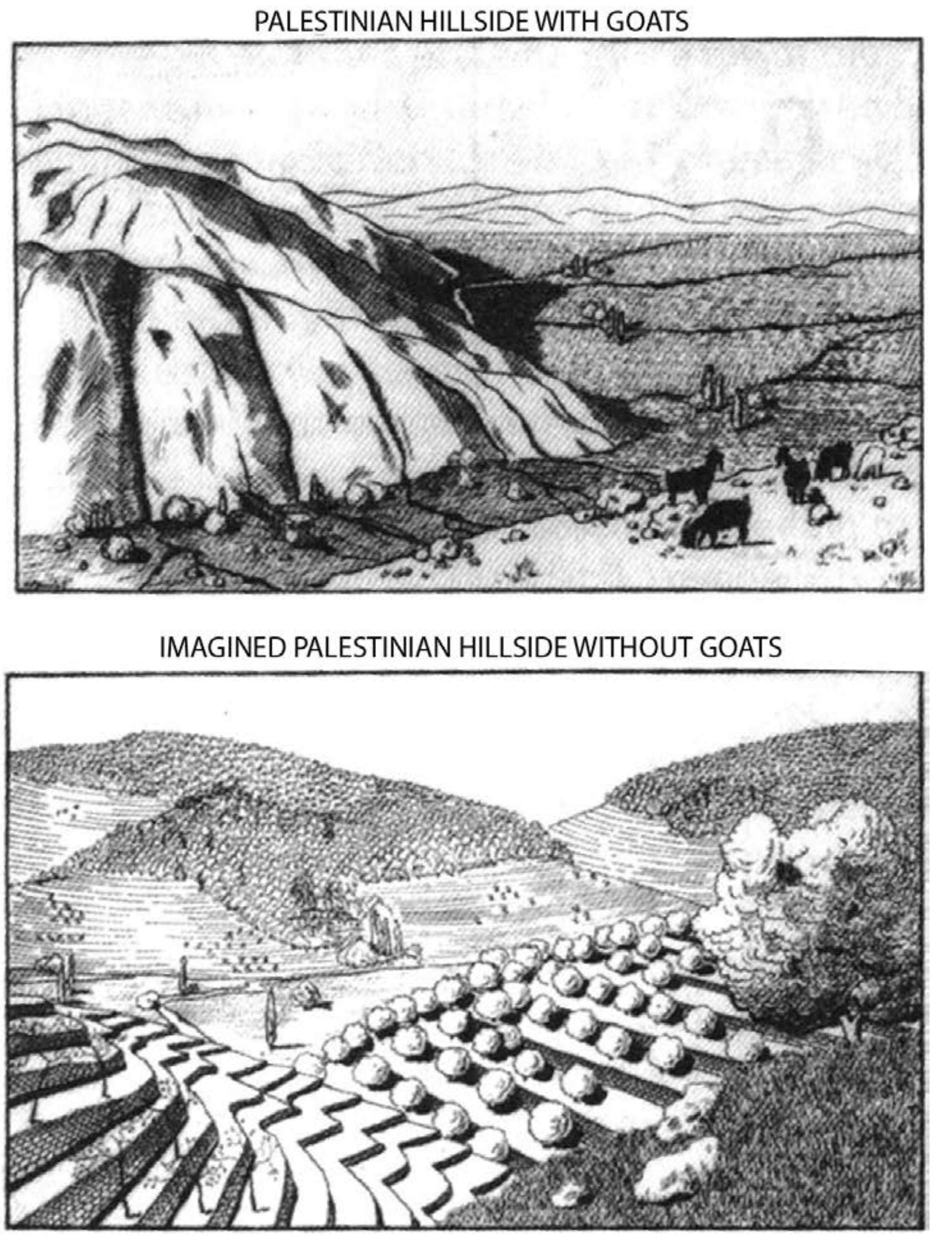

Figure 4.4 Illustrations from a 1943 British Mandate calendar promoting soil conservation and denigrating goats

These illustrations depict what the British colonial administration derided as a "neither beautiful, nor useful" typical Palestinian landscape (above). This is contrasted with what the colonials suggest to be the ideal future Palestinian landscape, below. Note how the image *above features several black goats dominating the foreground, while the image below is entirely 'goat-free' (El-Eini 2006, 218). (Modified. Original source: Soil Conservation Board and Department of Forests Calendar, 1943, enclosed: Sale, Manuscript Collections, RHL/MSS.Medit.s.23. The Bodleian Library, University of Oxford, Rhodes House. G. N. Sale, Manuscript Collections, Mss.Medit.s.23. via El-Eini (2006, 218)).*

When the British withdrew from Palestine in 1948, it was this psychological disconnect between state-decreed, idealized green space and the dry eastern Mediterranean scrub, that they left in their wake. After the Jewish defeat of Arab forces in the same year, the newly recognized State of Israel began to remedy the lingering cognitive dissonance immediately.

4.7.5 Mt. Carmel after Jewish victory: from Druze means of production to Jewish State jewel

The culturally inherited European longing for a 'lush and productive' holy land, combined with the Jews' lack of reliance on goat-grazing as an economic mainstay, helps explain how, over the course of the 1950s and 1960s, the southwestern slopes of Mt. Carmel evolved from a patchwork of oak forest, agricultural plots, grazing land and maquis, to the densely forested mix of national park and nature reserve that it is today. This process was partly catalyzed by the Israeli state's passing of the so-called 'Black Goat Law' in 1950 (Falah 1985, Rosenberg 2011). This law outlawed grazing the 'black goat'—a goat variety that was perceived, rightly or wrongly, to be especially voracious—on land other than that owned by the shepherd (Falah 1985). This was largely aimed at curbing the grazing activities of nomadic Arab (Bedouin) shepherds (Falah 1985), but it is indicative of a generally disapproving attitude towards all goat herding at the time, partially inherited from the earlier British forestry strategy championed by Sale.[50]

On the Carmel, specifically, it was around this time that the socioeconomic dynamic of Druze life began to change substantially. With increasing integration into the new Israeli state, Druze life began to revolve more around military service, capital accumulation and the town centre, and less around agro-pastoral activities on the surrounding mountaintop (Nissan 2010, Dana 2003). As both the number of active shepherds and the intensity of grazing itself declined, the landscape on the Carmel began to morph from a heavily-grazed, shepherd-trimmed maquis, to a denser, underbrush-rich forest. Over time, the composition of this forest shifted from mainly slow-growing, fire-resistant oak to mainly fast-growing, flammable pine, presumably spurred by germination from nearby plots of Aleppo and Stone pine planted in earlier years by the British and JNF.

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[50] Siddle (2009) writes how early modern European attitudes toward goats were themselves deeply structured by cultural and mythological narratives:

> So the goat has three separate images, the first as a provider of good things to poor people, the second as a ravager of land and crops, the third as a manifestation of unpleasant habits and behaviour both on their own account and as surrogates for those semi-savages who tended them. Out of the derogative aspects of the animal's place in mediaeval and Renaissance and early modern cosmology and mythology, it is primarily represented to all as the animal closest in nature to the Great Satan. How easy it became to ban the bête noire, framed for disapproval by a millennium of developing fear and distaste. Goat bans were, at the same time, a means of controlling the most anarchic elements of the population, a means to ease the path to commercial woollen enterprise and a means of improving timber supplies for the navy. Bans also better preserved the hunting grounds for hawk and hound. In such circumstances the poor manbeast, the Caliban of the periphery, stood no chance (531).

In 1963, sustained protests on the part of Jewish nature enthusiasts coincided with the government's new state-building strategy to successfully transform southern Mt. Carmel into Israel's first national park (Tal 2002, Paz 2012). However, while a major accomplishment for Jewish Israeli nature lovers, the declaration of the park set the stage for two significant problems that were to emerge decades into the future. One problem is a contemporary dispute between the Druze and the state over access to privately owned Druze land in the park (see Chpater 3)[51].

For the purposes of this paper, however, the second of the two problems is most central. Namely, it is the inconvenient fact that the park's creation, and subsequent management as a zone free of human influence, cannot be realistically construed as anything other than the central cause of Carmel's increased flammability. Over time, Mt. Carmel National Park came to be managed less like an agro-pastoral landscape serving multiple human-centered functions—including aesthetic beauty, which was in fact the primary concern of the park's early proponents (Paz 2012)—and more like a nature reserve, meant to limit all human impact and preserve as much biodiversity as possible as an end in and of itself.

This change in strategy mirrored a gradual shift in ideology amongst the wider western conservation movement, whereby parks first cordoned off for the aesthetic, psychological and recreational benefit of those who could afford to enjoy them were becoming recast instead as precious repositories of planetary genetic heritage (Adams and Hutton 2007). Thus, once an

[51] This dispute has become increasingly acrimonious in recent years, as Druze population has grown and town limits have expanded (see Chapter 3).

ancient mosaic shaped by agriculture, prescribed burning and grazing, then later re-imagined as a fantastically verdant hillside as per the European Biblical ideal, the 'nature' of Mt. Carmel has, in recent decades, once again been reinvented by the imaginations of the powerful. This time, it has been cast as a last bastion of habitat for species whose existence is—quite truthfully—threatened by the surrounding state's hyper-development. Awkwardly, however, the result of putting this vision into practice has been the creation of a landscape—directly adjacent to densely inhabited human settlements—that has likely never been so flammable in over a million years.

The eventual refashioning of the southern Carmel as a UNESCO Biosphere Reserve in 1996 was an attempt on the part of key NPA officials and other interested parties to mitigate these two problems, and provide a more flexible land-use framework that could allow a wider range of human uses of the forest, while still maintaining its protected status (Frankenberg 2009). For a number of reasons, however, including a lack of local buy-in, and a dearth of funding, the Biosphere Reserve designation had, as of 2010, not succeeded in its aims.

Perhaps in the wake of the brutal Carmel disaster, the relevant parties will reexamine the potential of the Biosphere Reserve schema as a context for better balancing human use of the mountainside with current conservationist priorities. For that to happen, however, a multistakeholder decision-making context that examines seriously the multiple, interconnected factors contributing to the triple challenge of fire risk, habitat destruction, and environmental conflict would most likely have to take shape. As of the writing of this paper, such a forum has yet to materialize.

4.8 Discussion and implications

Let us return briefly to our initial questions. What can our findings tell us about how and why particular narratives of cause emerge at the expense of others in the wake of disaster? What role do dominant narratives themselves play in such events? Finally, what inferences can be drawn from the Mt. Carmel case that may be instructive for the wider study of social-ecological systems on the one hand, and the sort of 'citizen historiography' or contention over public discourse that can take place in the wake of major change (Langenohl 2000, Briggs 2004), on the other? In the previous sections, we explored these questions by applying an empirically-informed cognitive lens to three different sources of material on Mt. Carmel and its 2010 combustion. Here we highlight a number of persistent patterns across what emerged from our above analysis, and reflect on the potential meanings of these insights for research.

Our first set of data, compiled directly from mainstream Israeli press media, clearly suggests that the most immediate popular reaction to the fire was *not* to consider a range of multifactorial causes and conditions that were likely to have contributed to the blaze's ignition and subsequent tragic spread. Rather, media and state authorities were immediately and specifically focused on identifying *human* 'culprits.' While this may seem banal, it is worth noting that this is in fact a very particular form of complexity management: myopically fixating on clearly identifiable, single-factorial, human-scale causes for otherwise complex, multifactorial phenomena.

As the work of psychologist Haidt (2001) and others suggests, this sort of emotion-driven response to a highly affect-laden event is in fact the standard reaction (Roemer, et al. 1998, Taylor 1983, Peterson 1999). Emotion, here, precedes and provides context for subsequent rational processes. As unsettling as it may be, people intuitively select subjectively believable explanations for distressing events (e.g., 'Arabs are genocidal against Jews,' or 'God is punishing the Jews for flouting religious law') not on the basis of demonstrable evidence, but rather on the basis of how well they appease immediate emotional impulses to resolve the discomfort of uncertainty, offset blame, and stabilize self-image (Campbell and Sedikides 1999, Keren and Gerritsen 1999, Peterson and Flanders 2002). Counteracting this tendency drains peoples' limited time and energy, and thus generally occurs only in contexts that expressly foster self-awareness and reflexive critique (see Chapter 2).

In the early stages of the Carmel disaster, it appears a fractious and embarrassed state was unwilling or unable to proffer a coherent account of what had happened, and why. As a consequence, individual politicians and citizens immediately began to replace the disturbing ambiguity of the situation with a search for emotionally-convenient 'culprits,' many of whom were later revealed to be imagined: 'genocidal' Arab arsonists or negligent Druze youth. At the same time, blame was also laid specifically at the feet of the nebulous, dysfunctional 'government,' implied to be spoiled by the private interests of corrupt or incompetent ministers. As with the convenient ethnic other, this latter choice of culprit offered accusers consolation by simultaneously reducing the fear of chaos that emerges in association with a catastrophic unpredicted event (Peterson 1999), while also enhancing the accusers' own self-image by enabling them to feel, however fleetingly, superior to the otherwise powerful 'culprits' (Campbell and Sedikides 1999, Girard 1978, Drabeck and Quarantelli 1967, Veltfort and Lee 1943)[52]. This drive towards selectively crafting a narrative in which the self is able to claim the moral high ground relative to another has been shown repeatedly in the laboratory setting. It has also been shown to increase in intensity the more disastrous an accident is, and the more dissimilar from oneself one perceives the accused 'culprit' to be (Burger 1981).

Predictably, then, only after more than a year had passed, and the State Comptroller had begun to divulge early conclusions from his report on the fire, did a wider range of more 'relatable,' popularly respected, less emotionally compelling human targets (i.e., previously lauded politicians, the police service, and the fire brigades) begin to receive a comparable degree of scrutiny for their role in the disaster. Even then, the information released from the Comptroller's report focused almost entirely on *human* culprits, apparently unreflectively mimicking the mode of previous inquiries that have characterized Israel's reactions to the more familiar events of military failure or criminal scandal. This is important, because people's apparent disposition to this particular approach of meaning-making from a disaster can have major impacts on subsequent policy making, collective memory, and learning.

Specifically in the case of the 2010 Carmel disaster, kneejerk wholesale scapegoating of outgroups and suspect individuals with political power—a pattern that was merely refined, but not challenged, by the 2012 State Comptroller's report—appears to have crowded out any in-depth public consideration of the environmental, contextual and historical factors that our

[52] This is a well-documented phenomenon that has been described and observed in numerous other contexts over the course of history (Girard 1978, Drabeck and Quarantelli 1967, Veltfort and Lee 1943).

subsequent research revealed as crucial to fully grasping the multiple distal causes of the disaster. Left unchallenged, this unreflective, reactionary form of complexity management therefore limits the degree to which root causes and slower, less obvious, but highly consequential drivers of the tragedy can or will be addressed in a meaningful way.

We argue that this simple insight—the high cognitive salience of other *people* relative to the comparatively low salience of underlying ecological or social processes and conditions—is critically important to social-ecological systems theory. This is because popular frameworks for the study and governance of social-ecological systems tend to assume that people are responding primarily to ecosystems (or 'resource' systems), as mediated by institutions (Ostrom 2009, Fischer, et al. 2012, Folke 2006, Johnson, Williams and Nichols 2013, Garmestani and Benson 2013). This assumption is central, and largely dictates the range of hypotheses and solutions proposed for fostering the sustainability of a given system.

What our study of Mt. Carmel suggests, however, is that when sufficiently catastrophic 'surprises' emerge, the ensuing cognitive chaos (Peterson 1999) drives people to respond less to the ecosystem itself, and more immediately to fellow individuals and groups, as people scramble to maintain their self-image and status in a flurry of mutual scapegoating (Branscombe and Wann 1994, Campbell and Sedikides 1999, Fein and Spencer 1997). This, of course, favours the construction of a public discourse—and ultimately a dominant narrative—focused on the actions and reactions of immediate human actors, rather than on the historical, ecological, and especially combined historical-ecological factors that drove the disaster. Ironically, because social-ecological systems are so inherently non-linear (Folke 2006, Folke, Carpenter, et al. 2002), there is strong path-dependency. Thus, it will often be a grasp of precisely these opaque historical-ecological drivers that prove to be most relevant to effectively reforming a society's adaptive capacity (Boonstra and de Boer 2014). Efforts to manage a problem or 'surprise' based on proximate causes is, in contrast, often futile or even counter-productive in the long run (Haque and Etkin 2007).

Yet, this is not all. Turning back to the specific case of Mt. Carmel, the myopic public response described above was further abetted by a second major pattern to emerge from our analysis of the Israeli online print media: an increasing conflation in the public sphere, over time, of (1) the fire, (2) its origins, (3) the death of the 44 individuals who perished in the blaze, and (4) the managerial and logistical missteps that ultimately led to the tragic loss of life, human and non-human. This conflation was both reflected in, and reinforced by, the print media's labeling of the twin events with the single term: 'the Carmel disaster' (אסון הכרמל). A mere shorthand of convenience, the repeated use of this term in the public sphere has nonetheless bundled together the series of otherwise quite separate contextual factors and causes associated with the disaster into one lumped entity in the public memory, thus making it even more difficult for the public and the state alike to make useful distinctions and draw useful lessons for future resilience.

Of course, the drive for complexity reduction is by no means limited to mass media. It is, in fact, a ubiquitous, inevitable aspect of being alive (Peterson and Flanders 2002). However, insights from our in-depth interviews demonstrate how even highly educated individuals, intimately familiar with the landscape, communities, flora, and fauna of Mt. Carmel, were liable to reduce the complexity of the very same social-ecological system in remarkably different, sometimes mutually incompatible ways. This implies that, without a formal or informal institutional mechanism for reconciling these mutual incompatibilities, prospects for multistakeholder collaboration to effectively learn from the disaster and prevent future catastrophe remain precarious at best.

To reiterate, while the NPA officials we interviewed stressed the negative, 'un-naturalness' of JNF forestry practices, as well as the Druze's apparent endemic disregard for zoning law, JNF foresters pointed their finger in the precise opposite direction. JFN interviewees stressed the negative impact of what they regarded as the NPA's overly ideological commitment to a purely non-interventionist, biocentric, preservationist form of land management, which precluded the degree of tree pruning, fire break creation, and road construction necessary to minimize risk of catastrophe. This latter issue was hardly mentioned by NPA interviewees, while their focus on the negative repercussions of earlier pine planting programs at the hands of the British and the JNF were, in turn, almost entirely excluded from JNF interviewees' narratives.

The centrality of Druze interviewees' self-perception as second-class citizens in Israel, for whom—the argument goes—state authorities provide conspicuously sub-standard services, including police and fire-fighting, was in turn entirely absent from the causal narratives provided by JNF and NPA interviewees alike. In fact, some NPA interviewees asserted that the

Druze in fact have a disproportionately *high* amount of political power relative to the size of their community.[53]

These divergent, and sometimes directly contradictory, accounts of the social-ecological dynamics on Mt. Carmel yet again demonstrate the primacy of emotion in weaving coherent causal narratives, or 'mental models' (Gentner and Gentner 1983) of complex systems, whereby 'blame' for a threatening negative situation or event is intuitively shifted to an outgroup (Branscombe and Wann 1994, Campbell and Sedikides 1999, Keren and Gerritsen 1999), and only then rationalized ex-post-facto. An uncritical acceptance of the comprehensiveness of any one of these individual narratives, or a chalking-up of differences *entirely* to power relations, risks losing the point completely: that virtually anyone is liable, if not inevitably bound, to reduce the complexity of a given situation in ways that are emotionally self-serving, even at the cost of more comprehensive understanding (Campbell and Sedikides 1999, Fein and Spencer 1997, Haidt 2001, Branscombe and Wann 1994, Peterson and Flanders 2002).

Finally, the historical materials we presented attest to the fact that unchecked intuitive habits of complexity management not only constrain current understandings of the 2010 disaster, but were also integral to the particular forms of land use that colonialism, Zionism and ultimately the states conservation agencies, put in place throughout Mt. Carmel's modern history. By applying partial, culturally-informed ideological lenses to the landscape, each

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[53] The implication was that this is due to their strategic importance as the Israeli state's sole reservoir of Arabic-speaking army conscripts, as well as because of related historical security alliances between the Druze and the Jewish state since 1948.

consecutive authority built upon the slow-changing socioecological path forged by its predecessor. In this sense, people today are now the inheritors of earlier, particular complexity reduction strategies adopted, consciously or otherwise, by previous, even long-deceased actors.

Specifically in the case of Mt. Carmel, the sources cited in the sections above illustrate how neither the Zionist foresters, nor the British nor the Germans from whom they adopted their afforestation practices, approached the landscape of the Carmel from a position of unbiased rationality. Rather, each of these groups reduced the infinite number of ways one could interpret the Palestinian landscape they encountered by drawing on their particular cultural heritage and emotionally-guided goals, simplifying and interpreting what they witnessed and encountered through the lens of their own group identities, cultural assumptions and previous experiences. The result is that some visions, some potentialities, of what the Carmel could have become, were again crowded out by those that were narrowly assumed or implied to be preferable by the cultural 'scripts' and mental 'schemas' most familiar to the actors with the power to impose them (see Chapter 2).

The sequence of colonists and settlers to make their mark on the Carmel drew upon European ideals (imagined Biblical landscapes, high-yield German forests) and, in the case of the British, previous colonial models (Cyprus, India, Egypt, Australia) to shape their actions towards the Carmel. This reliance by colonists on previous institutional memory and stored, vaguely analogous experience, constituted what is today referred to as 'distributed cognition': a common cognitive technique whereby people offload the time and effort required to make a sound decision by drawing on the accumulated experiences stored in one's social or technological environment (Giere and Moffat 2003). This can afford huge efficiencies. However, as became tragically clear on Mt. Carmel in 2010, such forms of complexity reduction can have majorly consequential—if temporally remote—downstream effects. Namely, in the case of the Carmel, it became apparent nearly a century after concerted European attempts at refashioning the landscape that, in an eastern Mediterranean climate, a dense pine forest, entirely absent of the 'voracious' and 'dangerous' goat, is in fact more than just verdant and deeply satisfying to a European Judeo-Christian aesthetic (and, later, to the sensibilities of modern conservationists). It is also remarkably, even lethally, flammable.

4.9 Conclusion

It seems implausible that the relevant historical actors could have foreseen the loss of life and value that would ultimately follow from their predilection to view the Carmel hillside as a Biblical landscape in need of 'revitalization,' or, later, as a fragile 'natural' ecosystem that had to be cordoned off as much as possible from people and voracious livestock. Rather, actively inscribing said values onto the landscape likely seemed, to them, a self-evident necessity during their respective periods of authority. That said, in light of our comparative study, we do feel that both the landscape of Mt. Carmel and the contemporary public consciousness in Israel have been heavily shaped, if not warped, by the particular, largely unthinking ways in which efficacious actors have intuitively sought to reduce and manage complexity.

Taking Mt. Carmel and its fiery fate as an example, we therefore submit both that societies on the whole, and the researchers who study them, have much to gain from paying explicit attention—as we have here—to the *specific* ways in which actors (including ourselves as researchers) are predictably liable to wrestle with the complexity we continually encounter. Success in this endeavour will require an even fuller critical integration of contemporary insights from the behavioural and cognitive sciences into the methodological lexicon of disciplines at the nexus of the humanities and social sciences. At the level of public policy, academic calls for improving 'adaptive capacity' to learn from 'surprises' and create more sustainable, resilient systems (Liu, Dietz, et al. 2007), while prudent, may in many contexts be a case of jumping the allegorical gun. Before genuine 'experiential learning' (Tschakert and Dietrich 2010) can occur, there must first be a *psychosocial* context in which genuine critical reflection is made possible. Inferring from the example presented in this paper, we suggest this requires creative institutional buffering from the sorts of immensely compelling, everyday, affect-driven cognitive shortcuts otherwise stoked by the models of (for-profit) information dissemination and (short-term, partisan) governance that currently characterize many if not most 21st century societies. Theorizing how such change is possible is as much the domain of political economy as it is of social-ecological systems research, anthropology, or historiography. We argue that the humanities and both the social and ecological sciences are ripe for more interdisciplinary collaboration of this kind in order to address civilizational resilience in the 21st century.

Chapter 5: Sea Otters and White Men For The Win—*demographic asymmetries in perceived benefits and losses under a trophic cascade in Clayoquot Sound UNESCO*

5.1 Introduction

Clayoquot Sound is a visually stunning but contested space on the west coast of Vancouver Island, British Columbia, Canada. The region has a history of forestry and fishery conflicts amongst local First Nations, successive colonial and Canadian governments, industry, environmental groups and a diversity of local non-First Nations actors. In recent years, however, the locus of acrimony has begun to shift to the perceived ecological effects of one relatively small marine mammal: the unassuming but voracious sea otter (*Enhydra lutris*).

A reintroduction (see Section 5.2) and recent boom in the once decimated sea otter population is having substantial and rapidly cascading effects on the local nearshore ecosystem. As sea otters continue to multiply and, with the protection of Canada's *Species at Risk Act*, spread unimpeded, the mammal has been coming into direct competition with humans for edible shellfish and other marine invertebrates. This has proven particularly troubling for First Nations in the remote northern region of the west coast of Vancouver Island (WCVI), where otters were first reintroduced. There, many locals perceive the animal's resurgence to have severely reduced their access to prized traditional foods, hence harming their food security, their sense of cultural continuity and arguably even their health.

As otters continue to expand their range southwards throughout Clayoquot Sound and beyond, we wanted to know how this phenomenon was likely to be perceived by local residents. This is not a clear cut issue. Despite northern First Nations' experience, ecologists and many non-First Nations laypeople alike see the otters' spread as a largely positive return to an earlier, more 'natural,' biodiverse equilibrium (Fisheries and Oceans Canada 2013, Espinosa-Romero, et al. 2011, Gregr 2014). The otter's return is also being vaunted by a range of interests as a golden opportunity for the local ecotourism industry (Fisheries and Oceans Canada 2004, Loomis 2006). However, these positive assessments are relatively low-resolution, in that they do not highlight who is likely to immediately gain, and who is likely to immediately lose, from otters' expansion. While ecological data suggest that the cascading effects of the otter's presence are likely to increase both the density and diversity of some nearshore marine species populations (Espinosa-Romero, et al. 2011, Markel 2011), the ambiguities of current ecological models (Espinosa-Romero, et al. 2011, Gregr 2014) suggest that some projected effects—e.g., increased demersal fish abundance (Markel 2011), reduced edible shellfish abundance (Singh, et al. 2013, Watson and Estes 2011)—are more immediately certain to materialize than other, vaguely hypothesized effects—e.g., increased shelter for juvenile salmon or herring (Gregr 2014). If different groups of locals are found to value different things in their environment, these asymmetric certainties in the ecological models could translate into the perception of socially asymmetric benefits and losses from the so-called 'trophic cascade' (see Section 5.2) at the *disaggregate* level.

The possibility of unequally distributed benefits and losses—be they real or perceived—intrigues us for two reasons. One, the importance of disaggregating who benefits and who loses from environmental change is a frequently mentioned but woefully under-studied phenomenon in the conservation literature (Daw, et al. 2011). Two, relations amongst First Nations and multiple other stakeholders on the WCVI are already inherently tense (Okerlund 2007, Sullivan 2006, Schreiber and Newell 2006). In this light, divergent normative interpretations and perceived asymmetric benefits of the ongoing otter-driven 'trophic cascade' (see Section 5.2) threaten to further strain multistakeholder relations and hence impede effective, socially-inclusive management.

In light of this complex social-ecological dynamic, we wished to apply methodical scrutiny to the question of what, exactly, local residents of Clayoquot Sound considered important about their local ecosystem as it stood, and why. With this information, we could then infer what the projected effects of the trophic cascade were likely to mean to various relevant stakeholders.

To do this, we conducted a series of structured interviews both with a wide range of local residents and with a number of key government managers in the region. We elicited two specific sets of data from participants. First, we looked at how participants ranked the relative importance of multiple local species across various framings. Second, we looked at how participants appeared to conceptualize 'ecosystem services' in Clayoquot Sound—i.e., the things that 'nature' 'provides' and 'does' for people (Daily 1997). We then proceeded to ask participants to rank those items in terms of relative importance, as well.

As we detail below, we observed stark contrasts amongst the responses of different demographic groups. In combination with predictive uncertainties surrounding the longer-term ecological effects of otters' resurgence (Gregr 2014, Espinosa-Romero, et al. 2011), these demographic differences suggest substantial asymmetries in who will perceive the most immediate benefits—versus who will perceive the most immediate losses—as otters continue their expansion throughout the wider ecosystem.

Below, we first provide a basic account of the dynamics of the study site (Section 5.2), followed by a description of our interview methods (Section 5.3). After outlining the logic of our analytical approach (Sections 5.4.1 and 5.4.2), we then present our findings in the order that the respective interview questions were asked (Sections 5.4.3 to 5.4.7), followed by a discussion of the findings as a whole (Section 5.5). We conclude with a reflection on the implications of our results, both for Clayoquot Sound, as well as for future work on the elicitation of disaggregated environmental values data and its integration into multistakeholder management.

5.2 A trophic cascade in Clayoquot Sound UNESCO Biosphere Reserve

Sea otters were once common throughout the coastal north Pacific. However, owing to their prized pelts, they were hunted intensely throughout the 19th and early 20th centuries, culminating in their complete eradication from the WCVI by 1929 (Fisheries and Oceans Canada 2013). When the sea otters disappeared, one of their main prey—sea urchins—began to balloon in numbers. Sea urchins, in turn, subsist almost entirely off of kelp. The result of the sea otters' extirpation was therefore a major shift from a nearshore ecosystem dominated by biodiverse kelp beds, to one characterized by 'urchin-barrens': large patches of the sea floor replete with urchins, but relatively bereft of kelp beds and the associated plethora of marine life that dwells amongst them (Espinosa-Romero, et al. 2011, Wilmers, et al. 2012, Markel 2011).

This new, latter ecological regime also meant decreased trophic pressure on a range of shellfish and other edible invertebrates once preyed on by otters, including abalone, mussels, dungeness crab and multiple varieties of clams, chitons, and barnacles. Along with sea urchins themselves, these species thus came to play an increasingly important role in the diets of local people over the 19th to 20th centuries. This was particularly true for the surviving Nuu-Chah-Nulth First Nations, whose access to other fisheries was drastically reduced over time, as the British colonial and later Canadian governments limited these indigenous communities to ever-more circumscribed "Indian reserves" with ever-more restricted access to their traditional fishing grounds (Harris 2008).

In the early 1970s, however, the social-ecological system once again began to shift. From 1969 to 1972, Canada's federal Department of Fisheries and Oceans worked with the United States government to transplant a small population of otters from a nuclear testing zone in Alaskan waters, to the remote northwest corner of Vancouver Island (Fisheries and Oceans Canada 2013). This was done without local First Nations' consultation. What has followed is known as a 'trophic cascade': sea otters began to once again prey heavily on sea urchins, thus releasing kelp from trophic pressure, and changing the nearshore ecological regime from one dominated by urchin barrens, back to one dominated by thick, habitat-forming kelp beds (Espinosa-Romero, et al. 2011, Markel 2011).

At the same time, otters—the only marine mammal without blubber—have to consume nearly 25% of their bodyweight daily merely to survive the cold north Pacific waters (Jessup, et al. 2004). Thus, in addition to rapidly eating through the most easily accessible urchin populations, the reintroduced otters began to prey on the very marine invertebrates that over the past century had become cultural and caloric staples of the local Nuu-Chah-Nulth. Since then, the otter population has boomed, and is now rapidly expanding southwards.

In the spring of 2012, we thus began research in the Clayoquot Sound region, the most densely and diversely populated segment of WCVI, located approximately 140km south of where the otters were first introduced. Earlier political strife over forest resources in the region was largely quelled in 2000, with government acceptance of the conclusions of a specially appointed scientific panel that examined the ecological sensitivity of the area (Lertzman and Vredenburg 2005). At that point, Clayoquot Sound was declared a 'Biosphere Reserve' by UNESCO, and a trust was established by the Canadian government to help fund sustainable development projects in the region.

Biosphere reserves are a unique form of protected area in a number of important ways. First, they are given their title and demarcation by the United Nations, but are proposed and enacted domestically. Second, biosphere reserves—of which there were a global total of 621 in 2014 (UNESCO 2013)—are not protected areas in the pure sense, but are rather identified as spaces ideal for experimenting with a range of different economic and people-centered conservationist activities in a quest for sustainability (Jaeger 2005, UNESCO-MAB 2008).

As such, in 2008, UNESCO's Man the Biosphere program (MAB), which oversees the global network of biosphere reserves, began to explicitly champion the use of an anthropocentric 'ecosystem services' framework for balancing development and conservation in each reserve (UNESCO-MAB 2008). The purpose behind this push was both to ensure further consistency between UNEP and UNESCO in terms of aims and nomenclature, as well as to allow for greater ease of comparison and contrast across the wider biosphere reserve network (UNESCO-MAB 2008).

Given this pre-suggested rubric, we were interested in exploring just what, exactly, such an approach could mean in practice, *in situ*, in Clayoquot Sound. Ecosystem services are commonly defined as the benefits rendered to people by nature (or, alternatively the processes that render such benefits, specifically) (Daily 1997, Millennium Ecosystem Assessment 2005). As such, the concretization of these phenomena hinges directly both on humans' perceptions and on humans' 'values' (whether they be perceived and explicit, or deduced and implicit). Given this, we chose to structure our investigation largely around the question of what locals perceived, or otherwise disclosed, as being important to them in their environment. However, being skeptical of any unidimensionality (Chan, Satterfield and Goldstein 2012)—let alone the ontological and contextual robustness (Warren, McGraw and Van Boven 2011)—of such 'values,' we were also keen to investigate how these values varied, both across individuals and groups, as well as across different framings of similar questions. Ultimately, we combined this inquiry with our interest in exploring potential social asymmetries using the methods we describe below.

5.3 Methods

The primary methodological tool we applied in the field was a structured interview protocol involving a number of listing and sorting tasks (see below). We ran this protocol with a variety of Clayoquot-region residents and government managers. To achieve as broad and diverse a sampling of the resident population as possible, we recruited local interviewees by several means: advertisements on various local poster boards, word of mouth, placement of information cards with contact information in stores around the local towns of Tofino and Ucluelet and, in the case of interviews within First Nations communities themselves, personal introductions by the relevant tribal authorities.

The interviews were conducted at a place of the participants' choosing. These sites ranged from personal residences, to public cafés, to local NGO offices. Questions progressed sequentially from the relatively broad, to the relatively specific. Participants were first asked to state their name, where they were from, how long they had lived in the Clayoquot region and, if they were comfortable sharing, their year of birth and their occupation(s). To cue thoughts about the local region, we then asked the participants to describe to us the things they most liked and disliked about living and working there. Next, all participants were provided with an identical set of coloured pens, and a notepad, and were asked to visually depict for us "where [it was] they live and/or work." The drawings were then photographed and digitally stored for later analysis.

At this point in the interview, we would begin to ask participants to make lists of various sorts. Participants were initially asked to verbally list "as many species and/or resources they could think of on the west coast of Vancouver Island." As they did so, we requested that participants write the name of each species or resource down on small individual cards in the order that they came to mind. Once this order had been recorded, we then asked participants to engage in a number of ranking tasks. First, we asked participants to choose an approximate top five to ten species from their list that were "especially important to them, personally." We then encouraged participants to order that sub-selection from most important to least important. This task, while intellectually or morally difficult for some people, was made somewhat more straightforward by virtue of the fact that each species had already been written down on a card, which participants were then free to physically move around on the table as needed. After recording their top five to 10 most personally important species in rank order, we encouraged participants to share the rationale behind their rankings. Some participants were comfortable and able to proffer explanations, while others were not.

We then changed pace slightly, and asked participants to choose and rank the top five to 10 "tastiest" species from the list, as a measure of subjective food preference. After this, we followed the same pattern, requesting that participants rank their selections. We then asked participants to provide a similar ordered list of the top five to 10 most "valuable" species, once again encouraging them to describe their rationale. Sometimes participants would immediately come up with their own definition of 'value' and order their chosen species accordingly. Others would proceed to ask us what 'kind' of value we meant, to which we would reply encouragingly with the question “What kinds of value can you think of?” Often, people mentioned economic value, and proceeded to make and rank a selection as such. Regularly, however, participants would combine multiple different kinds, or ‘dimensions’ (Chan, Satterfield and Goldstein 2012), of value (e.g., personal, economic, communal) into a single ranking. Some participants explained their rationale as they were completing the ranking, while others tendered a post hoc explanation only after they had completed their ranking.

Next, we asked participants for another top five to 10 ranking, this time on the basis of ‘ecological value,’ which, when necessary, we elaborated upon further as meaning species or resources that were “important for the functioning of the local ecosystem.” Following this, we led into questions that dealt more directly with the notion of ‘ecosystem services.’ While avoiding use of the somewhat unfamiliar term ‘ecosystem services,’ we asked people to make a list of “the things that nature does for people, or gives people, here on the west coast of Vancouver Island.” Participants rarely stated more than five services, each of which they wrote down on a separate small card, as with the previous freelisting task. Similarly, we then asked participants to rank those ‘things’ (i.e., ecosystem services), in order from most to least important, providing us, when possible, with a rationale of their ranking.

Next, we wished to examine participants’ knowledge and values surrounding sea otters and kelp beds. We asked participants “what can you tell me about sea otters?” After they had shared some of their knowledge and beliefs, which we coaxed with further questions when necessary, we then followed with “and what can you tell me about kelp, or [as they are often called locally] kelp forests?”

After participants had shared their beliefs about otters and kelp, we then proceeded to ask them which of two scenarios they would personally prefer: (a) more otters, more kelp, less shellfish, or (b) less otters, less kelp, more shellfish. Once they stated their preference, we once again encouraged participants to explain their rationale.[54]

In total, we interviewed 71 individuals. Four of these participants were government managers, who for the purposes of this paper we regard as a separate group altogether due to our prior working relationships with them. This leaves a total of 67 citizen interviewees, ranging from the ages of 20 to 80. There were 29 females, and 38 males. 41 participants self-identified as non-First Nations, while the remaining 26 were self-identified First Nations, primarily from the Ahousaht and Toquaht nations, with a few participants from the Tla-oh-qui-aht and Yuułuʔiłʔath nations. Participants from the latter two nations granted interviews outside of their communities, in Tofino and Ucluelet proper, while interviews with the former were conducted on tribally-administered lands. All participants were offered financial compensation for their time at a rate of CAD$15 per hour.

5.4 Results

5.4.1 Logic of analysis

As mentioned in Section 5.1, a primary aim of our method was to generate a meaningful impression of Clayoquot Sound residents' stated environmental 'values.' Using those results,

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[54] Finally, we followed this first part of this protocol with a number of similarly structured questions pertaining, amongst other things, to trophic and classificatory relationships amongst species, and to human actors in the system. The results of these questions are reported in other papers (e.g., Chapter 6).

we could then confer with projections from ecological models (Espinosa-Romero, et al. 2011, Gregr 2014) to approximate how these stated values were likely to be affected by the impending trophic cascade.

In addition to this first-cut level of analysis, we were also curious to see what degree of (in)consistency existed *across* answers to the differently-framed questions relating to relative values. In other words, did asking people which species were *personally* important to them yield significantly different results from asking them which species were most *valuable*, or most desirable *as food*? If such framing effects were large, we were curious to consider the implications of these framing or 'dimensionality' (Chan, Satterfield and Goldstein 2012) effects for community-centered conservation on WCVI, and for conceptual approaches to people-centered environmental management in general.

Achieving a demographic disaggregation of projected benefits and losses was also a key impetus for our analysis. In other words, we wanted to know whether there were any notable differences in stated environmental values *amongst* or *between sub-groups*. Apart from being an important, if potentially divisive, research question in its own right (Daw, et al. 2011), we also posed it for a contextually specific reason. Namely, if our data suggested such differences do indeed exist, this could mean that certain groups of people may have a systematically and predictably harder time adapting to the otters' spread than others. Due to the pivotal centrality of marine resources for local residents' economic and dietary subsistence on the WCVI, the answer to this question has important implications both for social justice and for multistakeholder management in the politically and ecologically contested region (Lillard 2013, Okerlund 2007, Schreiber and Newell 2006, Sullivan 2006).

5.4.2 To disaggregate or not to disaggregate

While we did have a clear logic for investigating disaggregate benefits and losses, we did not want to assume *a priori* that we knew who constituted which subgroups, or if statistically meaningful subgroups could be said to exist at all. Based on earlier ethnographic work we had conducted in the remote northwest corner of WCVI, where sea otters were first reintroduced decades ago, it seemed likely to us that First Nations' and non-First Nations' values would differ in systematic ways. However, we did not want to base an analysis around this demographic marker on mere speculation. Thus, we conducted a statistical test on participants' answers to the most pivotal and clearly interpretable question in our survey: whether people preferred a scenario involving more otters, or less otters.

To do this, we conducted a binary logistic regression of otter preference on three demographic variables: age (a continuous variable), gender and First Nations status (both dichotomous variables). The results were stark: neither age nor gender were significantly predictive of otter preference, but the odds of non-First Nations favouring more, rather than less, otters, was 10 times greater than that of First Nations, OR = 0.10 (CI 0.022-0.447). This finding was highly significant ($p=.003$).

Given these exploratory results, we deemed it worthwhile to further examine differences between First Nations and non-First Nations participants' responses at the group level. However, we also noticed a second demographic pattern emerge in the course of our interviews. When participants were asked to visually depict their local environment (see Section 5.3), men seemed much more likely to draw maps, and describe space in an overhead, abstract way, while women seemed much more likely to draw three-dimensional visual scenes, often involving water, mountains, animals and sometimes people. To test this, we again conducted a binary logistic regression, this time of participants' drawing style (map vs. scenes) on the three demographic variables listed above. As suspected, the odds of males drawing maps, specifically, was 6.77 time greater than that of females, OR=6.77 (CI 1.78-25.72), p=0.005.[55]

To be clear, we are by no means arguing that this implies genetic or chromosomal determinants of environmental values. Rather, while we realize highlighting such differences can be provocative, we are reflecting the fact that due to social, experiential, and likely occupational factors, there appear to be differences both between First Nations and non-First Nations, as well as between males and females, that merit further examination.

Finally, because of the nature of their professional involvement in biological conservation and government mandates, we regard the values of government-employed ecosystem managers, as contrasted with those of the rest of our sample, to similarly merit exploration. For terminological clarity, from this point on we refer to the former group as

[55] (Conversely, the odds of First Nations and younger people drawing maps was lower than their respective counterparts, although these effects were relatively small, with only the latter being statistically significant, at p=0.008.)

‘government managers’ or simply ‘managers,’ and the latter group of 67 non-government affiliated participants as either the ‘civilian’ population or the ‘general public,’ interchangeably.

5.4.3 Important species: kelp, kelp dwellers and the people who love them

Our first goal of analysis was to arrive at a measure of which species the participants in our sample, as a whole, identified as being particularly important to them. To do this, we calculated a *Smith’s salience index* (Smith and Borgatti 1997)—or simply ‘salience score’—for each species mentioned by participants in answer to the question, “[Out of the list of WCVI species that you compiled earlier,] what are the top five to 10 species that are most important for you, personally?”

Calculating salience indices is a cognitive anthropological technique for analyzing interviewee-generated lists of terms, which has since been adopted across multiple disciplines (Smith and Borgatti 1997, Gravlee, et al. 2013, de Morais 2009, Dongre and Deshmukh 2012, Pradhan and Ram 2010, Sutrop 2001, Barg, et al. 2006, Thompson and Juan 2006, Ghorbani, et al. 2011, Malan and Neuba 2011). A given term’s Smith’s salience index (*S*) is a function of the *frequency* with which the term is mentioned during a freelisting exercise—i.e., the number of participants who include a given term on their respective lists—and the term’s average *position* on participants’ lists. Words that are mentioned most frequently *and* are positioned highest on people’s lists obtain the highest saliency scores, and vice versa (Barg, et al. 2006). Scores range from 1 (highest) to 0 (lowest).[56] For our purposes (see Section 5.4.1), we adapted saliency analysis to estimate species' relative importance to our participants. We did this by using the specialized software package ANTHROPAC (Borgatti 1996) to calculate the salience index (*S*) for each term listed in participants' *rank orderings.*[57]

As a whole, our sample of 67 civilian locals ranked the following five species as most important to them personally (listed in descending order of *S*, as shown in parentheses, rounded to the nearest 1000th): *salmon* (0.254); *halibut* (0.147); *eagles* (0.121); *bears* (0.106); and *crab* (0.101). Participants gave a range of rationales for why these species were important to them—we touch on some of these in more detail in our intergroup comparisons, below.

Often, participants would mention a genus or group of species (e.g., "salmon") in place of actual individual species (e.g., "sockeye salmon"). We regarded this as important information, as it reflects the phylogenetic resolution at which participants appear to think about their local ecology. For that reason, we preserved these species-versus-genus level differences when calculating salience scores. This means that when a participant listed, e.g., "sockeye salmon," it was *not* counted as the same term as simply "salmon." The result is that our list of salience scores is somewhat disaggregate, but also reveals a considerable amount

[56] "This is based on the formula:

$S=((\Sigma(L - R_j + 1))/L)/N$

where *S* is the average rank of an item across all lists in the sample, weighted by the lengths of the lists in which the item actually occurs; *L* = the length of (number of items in) a list; R_j = the rank of an item in the list (first = 1); and *N* = the number of lists in the sample" (Smith and Borgatti, 208-209).

[57] I.e., not their initial freelists—*S* scores for those later data will be reported in a separate paper.

about participants' individual and comparative ecological cognition, in addition to being (merely one) measure of their environmental values.

With that in mind, for our civilian sample as a whole, the five next most highly ranked species in terms of importance were: *trees* (*S* = 0.097); *sockeye salmon* (*S* = 0.090); *wolves* (0.080); *spring salmon* (*S* = 0.066); and *whales* (*S* = 0.065). These were followed by: *oysters* (*S* = 0.059); *red cedar* (*S* = 0.059); *humans* (*S* = 0.056); *lingcod* (*S* = 0.055); *cod* (in general) (*S* = 0.054); and *cedar* (in general) (*S* = 0.052).

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Salmon	1	0.254
Halibut	2	0.147
Eagles	3	0.121
Bears	4	0.106
Crab	5	0.101
Trees	6	0.097
Sockeye salmon	7	0.090
Wolves	8	0.080
Spring salmon	9	0.066
Whales	10	0.065
Oysters	11	0.059
Red cedar	11	0.059
Humans	12	0.056
Lingcod	13	0.055
Cedar	14	0.052

Table 5.1 Important species (personal): general public (top 15)

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Humans	1	0.250
Eelgrass	1	0.250
Abalone	1	0.250
Sea otters	1	0.250
Sharks	2	0.200
Chinook salmon	2	0.200
Shearwater	3	0.167
Giant kelp	3	0.167
Eagles	4	0.150
Rockfish	4	0.150
Sculpins	5	0.100
Prawns	5	0.100
Understory kelp	6	0.083
Humpbacks	6	0.083
Douglas fir	7	0.050

Table 5.2 Important species (personal): government managers (top 15)

There were stark, revealing differences between these results, and those generated from the responses of the four government-employed ecosystem managers[58] who we also interviewed using the same protocol (see Tables 5.1 and 5.2.) For managers, the 15 most important species were: *humans* (*S* = 0.250); *eelgrass* (*S* = 0.250); *abalone* (*S* = 0.250); and *sea otters* (*S* = 0.250), all tied for first place; followed by *sharks* (*S* = 0.200), which were tied with *Chinook salmon* (*S* = 0.200). Following these species were: *sooty shearwater* (*S* = 0.167); *giant kelp* (*S* = 0.167); *eagles* (*S* = 0.150); *rockfish* (*S* = 0.150); *sculpins* (a genus of small intertidal fish) (*S* = 0.100); *prawns* (*S* = 0.100); *understory kelp* (*S* = 0.083); *humpback whales* (*S* = 0.083); and *Douglas fir* (*S* = 0.050).

Remarkably, the single most important species for civilian interviewees, "salmon" (which is in fact not a species but a genus, *Oncorhyncus*), was, conversely, not within the government managers' top 15.[59] One specific salmon species, Chinook, did appear elsewhere on the managers' list, but with a salience score somewhat lower than that of "salmon" for the general public (0.200 versus 0.254). Conversely, the general public ranked "spring salmon" (another term for Chinook) in ninth place, below sockeye salmon, at a salience score of only 0.066.

Apart from the minimal, but mismatched, overlap in importance of salmon species, the two lists appear to diverge considerably. *Humans* occupy top place on the managers' list, with a salience score of 0.250, while they only appear in 12th place on the general public's list, with a

[58] Three of these participants were employees of Fisheries and Oceans Canada, all of whom do work specifically in the Clayoquot and broader WCVI regions, while the fourth was an employee of Parks Canada, stationed on the Pacific Rim Highway between Tofino, in Clayoquot Sound, and Ucluelet, in Barclay Sound.
[59] *Salmon* was, in fact, ranked by ANTHROPAC in 16th place, just below *Douglas fir*.

salience score of 0.056. *Eelgrass*, *abalone*, and *sea otters* all share top rank with humans on the managers' list, but do not even appear within the general public's top 15. Managers listed two different kinds of *kelp*, and also mentioned *rockfish*—a genus that thrives in kelp beds. Yet, neither of these groups of species appears on the public's top 15 list, either. From this preliminary analysis, at least, it appears that, on a personal level, the regional managers' values (with their focus on sea otters, multiple kelp species, and rockfish), stand to be fulfilled with much more certainty—or at least much more directly—by the impending trophic cascade than those of the general public. We discuss some implications of this in subsequent sections.

There were also noteworthy differences amongst sub-groups of the general public on this particular question (see Tables 5.3 to 5.6). *Trees* (the general term) occupied second place on females' list, with a salience score of 0.175, preceded only by *salmon*. For males, however, *trees* did not appear until 24th on the list, with a salience score of only 0.030. *Halibut*, on the other hand, ranked second on males' list, right after *salmon*, with a salience score of 0.212, whereas *halibut* were ranked only 14th by females, with a score of merely 0.071. *Sea otters* were ranked relatively low by both genders, but were nonetheless viewed more favourably by males (S = 0.034) than by females (S = 0.007). Males also listed a much greater diversity of fish—particularly demersal, kelp-dwelling species that are especially likely to thrive under the impending trophic cascade—than did females (e.g., multiple varieties of rockfish, including *cabezon* and *rock cod*). Females, on the other hand, listed a considerable number of terrestrial species (e.g., *moss, cats, worms, woodbugs, dogs*) that males did not. Finally, *tourists/visitors*, as a specific item, appeared within males' top 10 list, with a salience score of 0.061. However, this term did not appear at all on females' list. Once again, from this cursory examination, it appears one group—males—stands to gain from the trophic cascade more directly, and with more certainty, than do females.

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Salmon	1	0.254
Trees	2	0.175
Eagles	3	0.170
Bears	4	0.138
Wolves	5	0.107
Crab	6	0.090
Whales	7	0.089
Red cedar	8	0.086
Fish	9	0.080
Sockeye salmon	10	0.079
Cedar	11	0.078
Prawns	12	0.077
Human	13	0.071
Halibut	13	0.071
Oysters	14	0.064

Table 5.3 Important species (personal): females (top 15)

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Salmon	1	0.259
Halibut	2	0.212
Crab	3	0.109
Sockeye salmon	4	0.100
Spring salmon	5	0.091
Eagles	6	0.080
Bears	7	0.079
Lingcod	8	0.078
Tourists/visitors	9	0.061
Clams	10	0.058
Wolves	11	0.056
Oysters	12	0.055
Rockfish	13	0.048
Cod	13	0.048
Whales	14	0.045

Table 5.4 Important species (personal): males (top 15)

Differences between First Nations and non-First Nations were numerous, both in terms of content and logic of selection. (See Tables 5.5 and 5.6). Topping First Nations' list was *eagles* (referring to the bald eagle, endemic to the BC coast), with a score of 0.270. The rationales First Nations provided for this species' position of prominence were overwhelmingly cultural and spiritual.[60] By contrast, eagles only featured 19th on non-First Nations' list, with $S = 0.037$. The rationales provided by non-First Nations for the eagle's importance included "personal emotional attachment" and "something to show [ecotourism] clients."

While the personal importance of salmon, as a genus, represents an important point of agreement amongst First Nations and non-First Nations alike, First Nations ranked *sockeye salmon*, as a species, far higher than did non-First Nations (second place versus 53rd place, respectively, with $S = 0.227$, versus $S = 0.013$). First Nations universally cited food as the reason for ranking sockeye so highly, demonstrating the unique status of that species to First Nations' present sense of food security. By contrast, non-First Nations described salmon species' importance as due to "livelihoods"; "[because] my family friends are commercial salmon fishermen" or alternatively "historical reasons [connected to their sustenance of First Nations for 1000s of years]."

Urchins featured in First Nations' top 20 list of most important species ($S = 0.055$), due, as one participant described, to the fact that "we collect them, but they seem to be getting farther and farther away." By contrast, not a single non-First Nations mentioned *urchins* as important. Inversely, *sea otters* were ranked by non-First Nations in the top third of their collective list ($S = 0.034$), whereas not a single First Nations mentioned otters. The same holds true for *bull kelp* ($S = 0.035$) and *rockfish* as a group ($S = 0.041$), plus several individual rockfish species. Tellingly, non-First Nations also ranked *humans* generally, and *tourists/visitors*

[60] E.g. "[Eagle] is the controller of the sky"; "[Eagle] is the most highly respected [animal], on the top of most totems"; "[Eagles are] sacred."

specifically, as relatively important (S = 0.087 and S = 0.051, respectively), whereas not a single First Nations participant mentioned either.

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Eagles	1	0.270
Sockeye salmon	2	0.227
Halibut	3	0.143
Salmon	4	0.139
Bears	5	0.134
Clams	6	0.132
Wolves	7	0.118
Cod	8	0.100
Crab	8	0.100
Spring salmon	9	0.091
Whales	10	0.089
Killer whales	11	0.086
Fish	12	0.083
Elk	13	0.082
Deer	13	0.082
Prawns	14	0.080
Urchins	15	0.055
Herring	16	0.045
Cats	16	0.045
Whale meat	16	0.045

Table 5.5 Important species (personal): First Nations (top 20)

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Salmon	1	0.320
Halibut	2	0.150
Trees	3	0.138
Crab	4	0.101
Red cedar	5	0.092
Bears	6	0.090
Humans	7	0.087
Lingcod	8	0.065
Fish	9	0.058
Wolves	9	0.058
Whales	10	0.052
Hake	11	0.051
Spring salmon	11	0.051
Tourists/visitors	11	0.051
Pine martens	11	0.051
Rockfish	12	0.041
Eagles	13	0.037
Prawns	14	0.036
Bull kelp	15	0.035
Sea otters	16	0.034

Table 5.6 Important species (personal): non-First Nations (top 20)

Recall the fact that under the impending ecosystem shifts, urchins are virtually sure to decline, while kelp is equally certain to thrive, and that rockfish are highly likely to thrive, while it is not known with any certainty what effects there may be on sockeye salmon (Espinosa-

Romero, et al. 2011, Markel 2011, Gregr 2014). As such, the results in this section suggest that–at least on a personal level—First Nations are, indeed, likely to perceive fewer benefits and more immediate losses from the impending trophic cascade than are non-First Nations.

5.4.4 Food species: urchins are not for everyone, but neither are rockfish

The second species ranking question we put to participants asked them to order their favourite “five to 10 species by relative tastiness” (see Section 5.3). While perhaps frivolous at first glance, we nonetheless deemed this an important question, given that people’s environmental values on the WCVI are so intimately tied to the procurement and accessibility of wild foods. As a potential testament to humanity’s shared palate, and in support of the hypothesis that values questions can generate significantly different responses depending on framing, the results for this question were far more homogenous than for the previous question. *Salmon*, *halibut* and *crab* were favoured strongly by the civilian sample, with a high degree of agreement (S = 0.305; S = 0.305; and S = 0.261, respectively). (See Tables 5.7 and 5.8). *Prawns* and *clams* also featured highly, with prawns being notably more popular with non-First Nations.

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Salmon	1	0.305
Halibut	1	0.305
Crab	2	0.261
Sockeye salmon	3	0.150
Clams	4	0.132
Prawns	5	0.131
Deer	6	0.085
Lingcod	7	0.080
Oysters	8	0.079
Dungeness crab	9	0.071

Table 5.7 Favourite food species: general public (top 10)

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Halibut	1	0.550
Lingcod	2	0.517
Crab	3	0.450
Prawns	4	0.250
Sockeye salmon	5	0.233
Tuna	6	0.200
Salmon	7	0.150
Gooseneck barnacles	7	0.150
Coho salmon	8	0.100
Dungeness crab	9	0.050

Table 5.8 Favourite food species: government managers (top 10)

At this point, similarities begin to break down. First Nations listed a significant number of items that non-First Nations did not list at all. (See Tables 5.9 and 5.10). These included, tellingly, *urchins* (*S* = 0.168), as well as *herring roe* (*S* = 0.132), *elk* (*S* = 0.104), and *herring* (*S* = 0.040), in addition to a greater diversity of specific marine invertebrates: *chitons* (*S* = 0.024); *acorn barnacles* (*S* = 0.016); *butter clams* (*S* = 0.016); and *littleneck clams* (*S* = 0.008). This appears to be a testament to the relatively high resolution at which First Nations tend to think about edible shellfish and, by implication, the relatively prominent position these species play in First Nations' food culture, past and present (McKechnie 2007). It is worth noting that all of these shellfish species, in addition to urchins, are eaten by sea otters.

Conversely, non-First Nations listed a wide range of rockfish—both as a genus, and as specific varieties—that First Nations themselves did not: *rockfish* (in general) (*S* = 0.055); *rock* *cod* (*S* = 0.050); *quillback* (*S* = 0.035); *yelloweye rockfish* (*S* = 0.034); *copper rockfish* (*S* = 0.030); *rougheye rockfish* (0.025); *cabezon* (0.025); and *China rockfish* (0.015). None of these species is eaten by otters, and all of them are anticipated to thrive under trophic cascade conditions.

Thus, as otters inevitably expand their range southward down the coast, it appears that, at least in terms of preferred foods, First Nations are positioned for some certain losses, while those non-First Nations who enjoy a variety of rockfish can expect to gain significantly. This is not to say that some food species particularly favoured by First Nations, such as herring and their roe, or sockeye salmon, will not also do well as otters move south. However, these other species' yearly fates seem to depend on a relatively wide range of oceanic variables, and guesses as to how they will fare under trophic cascade conditions are, currently, only guesses (Gregr 2014). Rockfish, inversely, are quite stationary, and have been shown to flourish as kelp beds expand (Markel 2011). Moreover, beyond anecdotal accounts on the part of locals, some invertebrate species have also been empirically

demonstrated to decrease in size and abundance in the presence of sea otters (Singh, et al. 2013, Watson and Estes 2011), making First Nations losses relatively likely on that front.

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Sockeye salmon	1	0.357
Crab	2	0.240
Halibut	3	0.218
Clams	4	0.190
Salmon	5	0.184
Urchins	6	0.168
Herring roe	7	0.132
Deer	8	0.126
Elk	9	0.104
Abalone	9	0.094
Oysters	10	0.080
Prawns	11	0.078
Lingcod	12	0.072
Spring salmon	13	0.064
Fish	14	0.056
Box crab	15	0.040
Steelhead	15	0.040
Herring	15	0.040
Cod	15	0.040
Chum salmon	15	0.040
Dungeness crab	16	0.032
Blackberries	16	0.032
Chinook salmon	17	0.027
Coho salmon	18	0.026
Chitons	19	0.024
Red snapper	19	0.024
Scallops	20	0.020
Acorn barnacles	21	0.016
Butter clams	21	0.016
Ducks	22	0.010

Table 5.9 Favourite food species: First Nations (top 30)

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Salmon	1	0.381
Halibut	2	0.359
Crab	3	0.273
Prawns	4	0.164
Clams	5	0.095
Dungeness crab	5	0.095
Lingcod	6	0.085
Fish	7	0.080
Oysters	8	0.079
Cod	9	0.074
Coho salmon	10	0.068
Red snapper	11	0.060
Deer	11	0.060
Scallops	11	0.060
Spring salmon	11	0.060
Rockfish	12	0.055
Tuna	12	0.055
Rock cod	13	0.050
Shrimp	14	0.045
Chinook salmon	14	0.045
Mussels	15	0.040
Quillback	16	0.035
Yelloweye rockfish	17	0.034
Octopus	18	0.030
Copper rockfish	18	0.030
Giant Pac. barnacles	19	0.025
Rougheye rockfish	19	0.025
Cabezon	19	0.025
Petrole sole	20	0.020
Sablefish	20	0.020

Table 5.10 Favourite food species: non-First Nations (top 30)

The results of our food-preference analysis also demonstrate a gender dimension. (See Tables 5.11 and 5.12). While a wide diversity of respondents appear to agree on the desirability of *salmon*, *halibut* and *crab*, females ranked *clams* more than twice as highly as males did (S = 0.198, versus S = 0.078, respectively). They also scored a range of other shellfish, including *urchins*, *oysters, scallops* and *mussels* more highly than their male counterparts.

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Crab	1	0.349
Salmon	2	0.290
Halibut	3	0.266
Clams	4	0.198
Fish	5	0.159
Sockeye salmon	6	0.145
Prawns	7	0.114
Oysters	8	0.088
Herring roe	9	0.086
Urchins	10	0.083
Coho salmon	11	0.080
Scallops	12	0.072
Shrimp	13	0.062
Cod	14	0.057
Deer	15	0.055
Chinook salmon	16	0.048
Mussels	17	0.036
Dungeness crab	18	0.034
Herring	18	0.034
Elk	18	0.034

Table 5.11 Favourite food species: females (top 20)

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Halibut	1	0.336
Salmon	2	0.318
Crab	3	0.189
Sockeye salmon	4	0.154
Prawns	5	0.144
Lingcod	6	0.12
Deer	7	0.110
Dungeness crab	8	0.100
Spring salmon	9	0.083
Clams	10	0.078
Oysters	11	0.072
Red snapper	12	0.067
Cod	13	0.064
Rockfish	14	0.061
Urchins	15	0.050
Abalone	16	0.049
Elk	17	0.044
Tuna	18	0.039
Quillback	18	0.039
Yelloweye rockfish	19	0.038

Table 5.12 Favourite food species: males (top 20)

Inversely, males mentioned a wide variety of rockfish species that—like First Nations—females simply did not mention. Males also ranked *lingcod*, another kelp-dwelling species, more than four times as highly as did females (*S* = 0.122, versus *S* = 0.028, respectively). The same holds true for managers, as compared to the general public: the former scored *lingcod* a massive 0.517, in second place only behind *halibut*, while the general public ranked it in eighth place, at *S* = 0.080, beneath *deer*. Thus it appears that, at least in terms of food preference, the clearest winners under trophic cascade conditions are non-First Nations, males, and to a lesser degree, managers, while First Nations and females stand to lose the most, with the most degree of certainty.

5.4.5 Valuable species: for money or love

Participants' next ranking task was to make and order a list of the five to 10 "most valuable" species they had mentioned during their initial freelist. As described in Section 5.3 above, we intentionally left the meaning of the term "valuable" undefined. Sometimes participants would ask what we meant by the word, in which case we would encourage them to brainstorm various meanings or dimensions of value, and use that to inform their ranking. Others would simply perform the task with no questions asked, often, but not always, citing economic reasons when encouraged to explain their rationale.

The results were as follows. (See Tables 5.13 and 5.14). The general public's top five species were, in descending order: *salmon* (in general) (*S* = 0.328); *halibut* (*S* = 0.285); *crab* (*S* = 0.199); *sockeye salmon* (*S* = 0.122); and *wolves* (*S* = 0.107). The first three species were listed most often for economic reasons, with participants frequently citing market price and employment value, as well as sometimes mentioning the species' importance for locals' subsistence needs or the regional ecology. Sockeye was listed for a combination of both economic and subsistence reasons. Wolves were cited for both cultural reasons (e.g., "clan identity," "because of how they sit in our traditions") and ecological reasons.

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Salmon	1	0.328
Halibut	2	0.285
Crab	3	0.199
Sockeye salmon	4	0.122
Wolves	5	0.107
Oysters	6	0.096
Prawns	7	0.085
Eagles	8	0.084
Cedar	9	0.079
Killer whales	10	0.077
Trees	11	0.074
Bears	12	0.071
Whales	13	0.069
Sea otters	14	0.064
Clams	15	0.059

Table 5.13 Valuable species: general public (top 15)

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Salmon	1	0.333
Killer whales	1	0.333
Tuna	1	0.333
Humpback whales	2	0.286
Halibut	3	0.278
Grey whales	4	0.238
Prawns	5	0.222
Eelgrass	5	0.222
Sea otters	6	0.190
Abalone	7	0.167
Marine mammals	8	0.143
Forage fish	9	0.111
Giant kelp	9	0.111
Eagles	10	0.095
Understory kelp	11	0.056

Table 5.14 Valuable species: government managers (top 15)

Oysters (S = 0.096) and *prawns* (S = 0.085) were the next most highly rated species (sixth and seventh respectively), cited almost universally for economic reasons, including market price and employment value. *Eagles* (S = 0.084) were ranked eighth, for a mix of both their cultural and tourism value. *Cedar* (S = 0.079) came in ninth, for a combination of economic reasons (forestry), cultural reasons, ecological reasons (as a habitat provider), and as a local construction material. The public ranked *killer whales* (*S* = 0.077) as the 10th most valuable species, for a mix of cultural reasons (e.g., "how they sit in our traditions"), feelings of personal connection, ecological reasons (e.g., "top predator in the ecosystem") and, by one person, for their economic value as a tourist attraction.

Government managers also included *salmon* (*S* = 0.333), *halibut* (*S* =0.278) and *prawns* (0.222) in their top 10, ostensibly for these species' market value. Entirely absent from the mangers' list, however, were *crab* or *oysters*, both of which are valuable species for the public and, importantly, potential prey for sea otters. *Sea otters*, in turn, ranked in managers' top 10, with a salience score of 0.190. In comparison, the general public ranked *sea otters* only 14th (*S* = 0.064). Managers cited sea otters' importance as charismatic megafauna (i.e., for aesthetic and tourist value). In contrast, those civilian participants who mentioned otters as valuable cited their role in local ecology (e.g. "keystone species", or "top predator") as well as their "entertainment" value (i.e., they are, for some locals, amusing to watch).

The general public's relatively low ranking of otters is consistent with their explicit focus on a range of additional otter prey that managers did not list at all. These included *clams* (*S* = 0.059), *urchins* (*S* = 0.035), *geoduck* (*S* = 0.020), *scallops* (*S* = 0.009) and *mussels* (*S* = 0.009). Conversely, managers mentioned two varieties of kelp in their top 15, which the general public did not list at all: *Macrocystis pyrifera, or* so-called *giant kelp* (*S* = 0.111) and the more general category of *understory kelp* (*S* = 0.056). The manager who listed these flora particularly highly explained she did so for a combination of reasons, including bequest value for future generations, and for their ecological role in providing habitat for other species (such as abalone). She also mentioned one reason as being her own employment as a government biologist specializing in kelp.

Several civilian participants also mentioned kelp, and specifically for ecological reasons. However, the collective salience score of the 'kelps' mentioned by managers was more than five times that of the 'kelps' mentioned by the general public. Together, these findings suggest once again that the immediate ecological changes precipitated by the trophic cascade are likely to fulfill managers' values much more directly and with more certainty than they are the general public's.

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Halibut	1	0.283
Sockeye salmon	2	0.278
Salmon	3	0.214
Wolves	4	0.181
Eagles	5	0.162
Crab	6	0.101
Herring roe	7	0.095
Clams	8	0.090
Killer whales	9	0.086
Bears	10	0.084
Fish	11	0.080
Cod	12	0.054
Urchins	13	0.052
Chum salmon	14	0.050
Spring salmon	15	0.048

Table 5.15 Valuable species: First Nations (top 15)

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Salmon	1	0.396
Halibut	2	0.286
Crab	3	0.258
Oysters	4	0.145
Cedar	5	0.127
Prawns	6	0.114
Whales	7	0.110
Sea otters	8	0.103
Trees	9	0.090
Killer whales	10	0.072
Tuna	11	0.067
Bears	12	0.064
Wolves	13	0.063
Red cedar	14	0.059
Pine martens	15	0.057

Table 5.16 Valuable species: non-First Nations (top 15)

The results of this ranking also demonstrated similar asymmetry on cultural and gender dimensions. (See Tables 5.15 to 5.18). Within our sample of the general public, non-First Nations males were the group to rank *sea otters* most highly (in sixth place, at *S* = 0.119). Non-First Nations females ranked them the second-most highly (in 10th place at *S* = 0.086). Tellingly, not a single First Nations participant even listed *sea otters* as a valuable species.

In another reflection of this asymmetry, First Nations scored both *clams* (*S* = 0.090) and *urchins* (*S* = 0.052) twice as highly as did non-First Nations (at *S* = 0.041 and *S* = 0.024, respectively). These species groups are both primary sea otter prey. However, this asymmetry was attenuated somewhat by the fact that non-First Nations did score several other otter prey more highly than did First Nations: *crab* at *S* = 0.258, *oysters* at *S* = 0.145, and *geoduck* at *S* = 0.029 for non-First Nations, versus *S* = 0.101, *S* = 0.014 and *S* = 0.007 for First Nations, respectively. Most participants described these species as valuable for purely economic reasons, not for their importance to local culture or subsistence.

The attenuation itself was also minor, as non-First Nations once again ranked a range of demersal fish that thrive in thick kelp beds more highly than did First Nations. These included *lingcod*, which non-First Nations scored just above what First Nations called simply *cod* (*S* = 0.056 versus *S* = 0.052, respectively), but also a wide diversity of rockfish varieties that First Nations did not list as valuable at all: *rougheye rockfish* (*S* = 0.037), *yelloweye rockfish* (*S* = 0.016), *quillback* (*S* = 0.016), *canary rockfish* (*S* = 0.010), *copper rockfish* (*S* = 0.080), *silver-grey rockfish* (*S* = 0.050), *yellow rockfish* (*S* = 0.004) and even simply *rockfish* (*S* = 0.004).

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Salmon	1	0.341
Crab	2	0.245
Halibut	3	0.177
Oysters	4	0.166
Trees	5	0.148
Wolves	6	0.140
Cedar	7	0.122
Killer whales	8	0.119
Eagles	9	0.117
Bears	10	0.088
Sockeye salmon	11	0.078
Fish	12	0.074
Urchins	13	0.069
Clams	14	0.065
Tuna	15	0.060

Table 5.17 Valuable species: females (top 15)

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Halibut	1	0.393
Salmon	2	0.315
Sockeye salmon	3	0.166
Crab	4	0.153
Prawns	5	0.130
Whales	6	0.128
Sea otters	7	0.077
Wolves	8	0.074
Lingcod	9	0.070
Bears	10	0.054
Spring salmon	10	0.054
Clams	12	0.053
Eagles	13	0.050
Rougheye rockfish	14	0.046
Red cedar	15	0.043

Table 5.18 Valuable species: males (top 15)

It is telling that none of these rockfish species was mentioned by females, either: they were an entirely Caucasian male value domain. Inversely, not a single male listed *urchins* as valuable: these were an entirely female-valued species. Females also scored three other otter prey species more highly than males did: *crab* (S = 0.245 versus S = 0.153), *oysters* (S = 0.166 versus S = 0.026), and *clams* (S = 0.065 versus S = 0.053), as well as *blue mussels* (S = 0.036), and *scallops* (S = 0.018), neither of which males listed as valuable at all. In sum, this values data does suggest that males and non-First Nations, specifically, appear far better poised to both enjoy the immediate benefits and avoid the immediate costs of the trophic cascade than do their respective female and First Nations counterparts.

5.4.6 Ecologically valuable species: the great wall of kelp

The final species ranking question we put to participants was to make and order a list of specifically *ecologically* valuable species. As mentioned above (see Section 5.3), if participants asked us to elaborate on the term "ecologically valuable," we explained that we meant "species that are especially important to the functioning of the ecosystem." Likely because this particular framing of the values question touched to a greater degree than others on participants' perceptions of actual ecosystem dynamics, as opposed to personal favourites, responses to this question differed somewhat from those of previous questions. In this particular case, there was one clear axis on which participant groups' responses differed from one another: that of the importance of kelp. (See Tables 5.19 and 5.20).

For government managers, kelp was scored as by far the most ecologically valuable species. The general term *kelp* topped managers' list with a salience score of 0.300. This was six times the score attributed to *kelp* by the general public (S = 0.050), who ranked it a full nine places lower than did managers. Moreover, managers' second most highly ranked term was *understory kelp,* a virtual subset of the first term, which nonetheless scored an additional S = 0.250 in its own right. Managers universally described their rationale for ranking kelps so highly as being these plants' crucial role in forming habitat for numerous other species. Conversely, of those civilian interviewees who did mention kelp, and the subset of those who provided a rationale for doing so, the reason they gave for their choice was kelp's perceived ability to "help keep the ocean clean." Clearly, a major gap exists between our managerial and civilian samples with respect to both their values and beliefs pertaining to the role of kelp in the nearshore ecosystem.

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Salmon	1	0.250
Trees	2	0.200
Bears	3	0.182
Wolves	4	0.167
Sea otters	5	0.143
Whales	6	0.072
Herring	7	0.058
Birds	8	0.056
Killer whales	8	0.056
Kelp	10	0.050

Table 5.19 Ecologically valuable species: general public (top 10)

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Kelp	1	0.300
Understory kelp	2	0.250
Eelgrass	2	0.250
Hemlock	2	0.250
Douglas fir	3	0.200
Salmon	3	0.200
Chum salmon	4	0.150
Forage fish	4	0.150
Sea otters	5	0.125
Sockeye salmon	6	0.100

Table 5.20 Ecologically valuable species: government managers (top 10)

Similarly, First Nations and non-First Nations also seemed to have somewhat different understandings of which species serve as lynchpins for ecological integrity on the WCVI. (See Tables 5.21 to 5.22). Both groups appear to agree that *salmon*, *bears* and *trees* are each crucial (the former two for their role in the food chain, the latter for their role in forming habitat for other species). However, while non-First Nations ranked *kelp* as a relatively important species (in seventh place), at *S* = 0.082, not a single First Nations ranked *kelp* as ecologically important.

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Salmon	1	0.286
Bears	2	0.164
Herring	3	0.114
Trees	3	0.114
Fish	4	0.071
Killer whales	4	0.071
Hemlock	4	0.071
Plankton	4	0.071
Herring roe	4	0.071
Squid	4	0.071

Table 5.21 Ecologically valuable species: First Nations (top 10)

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Trees	1	0.255
Wolves	2	0.245
Salmon	3	0.228
Sea otters	4	0.206
Bears	5	0.194
Birds	6	0.091
Kelp	7	0.082
Whales	7	0.082
Forests	8	0.045
Cedar	8	0.045

Table 5.22 Ecologically valuable species: non-First Nations (top 10)

In fact, some First Nations interviewees even appeared to view kelp in an expressly negative light. For example, one middle-aged male interviewee from the Ahousaht nation described the growth of kelp in the area as:

> like putting a blanket on [other species]…[it] smothers them… suffocates any life around it that's under it… [there's] too much kelp [and] not enough life around it anymore. I think…what it is, is lack of oxygen…like I said, putting a blanket over somebody's head… [makes it] not easy to breathe under there.

This view lies in stark contrast to the standard view in marine ecology, in which kelps are considered the indispensable base of the food chain, as well as critical habitat for many other species (Araujo, et al. 2013, Espinosa-Romero, et al. 2011, Markel 2011, Duggins, Eckman and

Sewell 1990). To the degree this participant's views reflect a more widely held belief amongst First Nations or other layperson communities, the importance of this apparently massive gap in belief surrounding the function and effects of kelp on local marine ecology can scarcely be overstated.

Perhaps unsurprisingly, our analysis also revealed a significant cultural gap in belief about the ecological importance of the sea otter as a critical "keystone species." While non-First Nations ranked *sea otters* as the fourth most ecologically valuable species in the area, at $S = 0.206$, only one First Nations mentioned otters as ecologically valuable at all, resulting in an S of merely 0.043. Tellingly, the one First Nations individual who did mention otters in this context had in fact lived most of her life away from her community's government-delimited reservation.

While First Nations participants appeared, on average, either unaware or expressly skeptical of the ecological value of either kelp and or sea otters, they did appear to have strong beliefs about the critical role of *herring* and *plankton* in the marine ecosystem (at $S = 0.114$ and $S = 0.071$, plus $S = 0.014$ for *phytoplankton*, respectively). In comparison, non-First Nations appeared far less focused on the ecological importance of these species, scoring *herring* at only $S = 0.023$ and *krill* at $S = 0.045$, without mentioning any other kind of plankton at all.

Interestingly, these same asymmetries were apparent between genders, as well (see Tables 5.23 and 5.24), with females neglecting entirely to mention *herring* or *plankton* as ecologically valuable, while only one male noted the ecological value of kelps, and even then as a relative afterthought. To our eye, this suggests that—at least in the particular case of ecological value—culture, gender and managerial status may merely be proxies for another, stronger driver of species valuation altogether: one's behavioural habits in the ecosystem.

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Trees	1	0.311
Salmon	2	0.249
Bears	3	0.215
Wolves	4	0.200
Sea otters	5	0.135
Kelp	6	0.100
Cedar	7	0.093
Eagles	8	0.078
Blue mussels	9	0.056
Worms	9	0.056

Table 5.23 Ecologically valuable species: females (top 10)

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Salmon	1	0.252
Sea otters	2	0.150
Bears	2	0.150
Wolves	3	0.133
Herring	4	0.177
Whales	5	0.100
Trees	6	0.089
Killer whales	7	0.078
Plankton	8	0.056
Krill	8	0.056

Table 5.24 Ecologically valuable species: males (top 10)

Namely, in Clayoquot Sound, the division of labour is relatively gendered, with men appearing to spend more time fishing than women, on average. There are also clear differences in the subsistence habits of First Nations—who have the legal right to fish for food, social and ceremonial purposes—relative to their non-First Nations neighbours, who do not. As such, one's gender or cultural affiliation could have major impacts on, for instance, the amount of time a participant spends on the open ocean, fishing for things that eat herring and plankton, versus time spent boating—or walking—close to shore, interacting with things that live in and amongst kelp beds. That mere difference in exposure could, in turn, account for differences in species' ecological salience amongst the demographic sub-groups reflected in our data.

5.4.7 Ecosystem service rankings: the world as an oyster, versus the world as a cloister

As mentioned earlier, we also had each participant engage in one more freelisting and ranking task. This time, we focused our questions specifically on the notion of ecosystem services. Because the term 'ecosystem services' itself is still unfamiliar to the general public, and arguably unclear even for many conservationists (Chan, Satterfield and Goldstein 2012, Wallace 2007, Fisher and Turner 2008, Constanza 2008), we decided not to use the term explicitly at all, but rather ask participants first to list, and then to order by relative importance, "things that nature does for people, or gives people, on the west coast of Vancouver Island."

The results were remarkable in a few ways. One, there was fairly broad commonality amongst participants with respect to which 'services'[61] occurred to them first (we say 'occurred' because here we are reporting the results of the freelisting exercise, not the ranking exercise, which we will discuss subsequently). *Food* scored extremely highly, at S = 0.540 amongst the general public and S = 0.929 amongst government managers. Food provision was clearly the most salient ecosystem service for the vast majority of Clayoquot Sound respondents.

Amongst the general public, *shelter* received the next highest score, at S = 0.161, followed by *water* at S = 0.146. This did not vary significantly by gender or culture. *Water* placed in managers' top five list of services mentioned as well, at S = 0.214, with *shelter* being

[61] Here we use the term ecosystem 'services' in a maximally broad way, meaning everything participants listed in answer to the question we posed. In actual fact, the answers consisted of a mix of tangible things, processes, and states of being, all of which participants appeared to toggle between fairly fluidly, without much concern for consistent definitions.

the seventh most readily listed service, at $S = 0.107$. Many participants also readily listed *recreation* and *employment*, although First Nations were an exception to this rule, and managers mentioned them much earlier and more often than did the general public. *Clean air* or simply *air* were also two relatively universally salient services for all groups examined.

ECOSYSTEM SERVICE	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Food	1	0.584
Water	2	0.210
Shelter	3	0.164
Employment	4	0.152
Everything	5	0.130
Recreation	6	0.115
Clean air	7	0.095
Tourism	8	0.089
Tranquility	9	0.078
Oxygen	10	0.073

Table 5.25 Important ecosystem services (ranked): general public **(top 10)**

ECOSYSTEM SERVICE	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Food	1	0.616
Employment	2	0.470
Air	3	0.333
Intrinsic value	3	0.333
Healthy environment	3	0.333
Water	4	0.286
Connection	5	0.190
Purpose	6	0.143
Recreation	7	0.133
Shelter	8	0.095

Table 5.26 Important ecosystem services (ranked): gov't managers (top 10)

Interestingly, in terms of 'kinds,' or classes, of services, 58% of those mentioned by the general public, and 50% of those mentioned by managers, did not clearly belong in any one of the United Nations'-endorsed ecosystem-service categories of *provisioning, regulating,* *supporting* or *cultural* (Millennium Ecosystem Assessment 2005, Daily 1997).[62] Many were either too vague or too multidimensional to merit being coded as belonging to only one of those categories. Rather, participants seemed to think of ecosystem services first in terms of how nature helps meet humans' basic needs, then in terms of employment and enjoyment opportunities, and then in terms of a range of less tangible benefits that were also quite difficult to code according to the United Nations-endorsed typology.

In fact, amongst the general public, no less than 30% of ecosystem services listed belonged to that latter hard-to-define group of less tangible benefits, which we coded for convenience of analysis as 'intangibles,' e.g., *tranquility, aesthetics, inspiration* and so forth. Some of these services were clearly examples of 'cultural services' as defined by the UN (e.g., *entertainment, recreation* or *spirituality*) but others were less clearly so (e.g., *happiness, respect, calm* or broader concepts like *quality of life, health,* or *well-being*). Amongst managers, an even higher proportion of ecosystem services listed—42%—fell into the category of 'intangible.'

Nonetheless, a larger proportion of services mentioned by all participants (42% for managers, 47% for the general public) could arguably be classified as what the UN calls *provisioning services*. In our sample, frequently mentioned items that were most clearly

[62] The Millennium Ecosystem Assessment (2005, vi) provides the following examples of services to characterize each of four categories, respectively:

Provisioning: e.g., food, water, fiber, fuel
Regulating: e.g., climate regulation, flood regulation, disease regulation, water purification
Supporting: e.g., nutrient cycling, soil formation, primary production
Cultural: e.g., aesthetic, spiritual, educational, recreational

examples of provisioning services included: *food, water, fish, trees, air, oxygen,* and *income*. At a disaggregated level, First Nations and males tended to list more of these kinds of services more readily than did their non-First Nations and female counterparts. The inverse was true with respect to list items that could be classified as 'intangibles' and/or cultural services (i.e., females and non-First Nations were more likely to list these classes of service than were others).

Curiously, however, this result inverts somewhat for First Nations when we analyze how different groups *ranked* ecosystem services by importance, rather than look at simply who recalled what with the most ease. (See Tables 5.27 and 5.28). While 'intangibles' were somewhat less salient for First Nations during the freelisting task than they were for non-First Nations, once they did mention them, First Nations tended to rank a particular subset of these intangibles much more highly than did their non-First Nations counterparts. Specifically, *well-being* (S = 0.157), *happiness* (S = 0.129), *tranquility* (S = 0.117), *health* (S = 0.102), *beauty* (S = 0.083) and *community* (S = 0.083) all were included in First Nations' collective top 10 list. The remaining four were *food* (S = 0.340), *trees* (S = 0.159), *fish* (S = 0.108) and *sunlight* (S = 0.083).

Remarkably, with the exception of *food*, First Nations' and non-First Nations' top 10 lists do not boast a single ecosystem service in common. Rather, non-First Nations' list is dominated by basic provisioning services (*water, shelter, clean air*), terms relating to income opportunities (*tourism, employment*) and two cultural services notably different in quality from those ranked highly by First Nations: *recreation* and *entertainment*.

ECOSYSTEM SERVICE	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Food	1	0.340
Trees	2	0.159
Well-being	3	0.157
Happiness	4	0.129
Tranquility	5	0.117
Fish	6	0.108
Health	7	0.102
Beauty	8	0.083
Community	8	0.083
Sunlight	8	0.083

Table 5.27 Important ecosystem services: First Nations (top 10)

ECOSYSTEM SERVICE	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Food	1	0.668
Water	2	0.258
Shelter	3	0.192
Employment	4	0.180
Everything	5	0.175
Recreation	6	0.126
Tourism	7	0.120
Clean air	8	0.105
Oxygen	9	0.098
Entertainment	10	0.077

Table 5.28 Important ecosystem services: non-First Nations (top 10)

The contrast between the two cultural groups' rankings appears to suggest two very different implicit framings of the role the natural world plays in human life. For non-First Nations, nature seems to be most importantly a source for meeting one's basic physical needs such as sustenance and shelter, as well as a site of opportunity for personal monetary and experiential enrichment. Conversely, for First Nations, nature is seen first as a provider of food, but then, and quite distinctively so, First Nations participants move on to highlight the value of nature precisely for the particular subjective states of wellness and calm that it can nurture, both at an individual and at a communal level. It is also worth noting that only First Nations listed items that would perhaps best be described as ecosystem *dis*services, i.e., *isolation,* *depression* and *fear*. As a whole, then, First Nations participants' ecosystem service lists appear to portray 'nature' not merely as a bountiful supplier of opportunity, but also as a figurative double-edged sword with considerable power to affect one's emotions in both positive and negative directions.

What this distinction means in the context of the impending trophic cascade is not entirely clear. However, insofar as the otter's return is most tangibly an opportunity for ecotour-based entrepreneurship, recreation and entertainment, it seems that non-First Nations would, on average, perceive more direct benefits from otters' presence than would First Nations. Moreover, while both First Nations and non-First Nations consider *food* the most important ecosystem service by a significant margin, First Nations' relative preference for the same foods that are targeted by otters, and non-First Nations' relative preference for demersal fish that thrive in kelp-beds (see Section 5.4.4), further cements the likelihood of this inter-group contrast in perceived benefits. This is yet further reinforced by the degree to which First Nations perceive their *health*, *well-being*, *happiness* or sense of *community* as dependent on access to the traditional foods likely to be targeted by voracious otters.

Once again, this is not to say that, over time, First Nations and non-First Nations may not experience equal benefits from the impending changes, or that the proverbial tables may even turn entirely. We cannot be sure. However, based solely on participants' subjective rankings of ecosystem services, it does appear that First Nations as a group do have less to gain, and more to lose, from the trophic cascade than do non-First Nations.

5.4.8 The devil is in the (dis)aggregation

The most basic impetus underpinning our research was to gain a general sense of Clayoquot Sound locals' environmental values, and to then use ecological projections to estimate how these values may be affected by the coming trophic cascade (see Sections 5.1 and 5.4.1). In Sections 5.4.1 to 5.4.7, above, we explored this question at a disaggregate level, highlighting the similarities and differences across various demographic subgroups' value rankings, as well as across a range of question framings, essentially eliciting and comparing different 'dimensions' (Chan, Satterfield and Goldstein 2012) of value from participants. Yet, one can also answer this question in a mono-dimensional *aggregate*. In fact, despite recognition of the social and justice implications of potential intergroup differences, it is precisely a low-resolution, aggregate approach to how 'people,' generally, experience environmental change that is still the norm in much conservation literature (Daw, et al. 2011).

One straightforward way to achieve such a measure of the aggregate Clayoquot public's values from our data is to simply average the general public's *S* scores for each species, across all four versions of the values ranking task (outlined in Section 5.3). This results in a synthesized ranked list of valuable species with equal weight given to *personal importance, taste, value (general)* and *value (ecological).* The results are as follows (see Table 5.29).

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Salmon	1	0.284
Halibut	2	0.194
Crab	3	0.142
Trees	4	0.124
Sockeye salmon	5	0.121
Wolves	6	0.118
Bears	7	0.092
Prawns	8	0.089
Eagles	9	0.081
Sea otters	10	0.076

Table 5.29 Top 10 most valuable species for Clayoquot residents (aggregate)

As seen here in Table 5.29, the top five most valued species amongst the Clayoquot public thus emerge in aggregate as: *salmon* (general) (*S* = 0.284); *halibut* (*S* = 0.194); *crab* (*S* = 0.142); *trees* (general) (*S* = 0.124); and *sockeye salmon* (*S* = 0.121). These are followed by: *wolves* (*S* = 0.118); *bears* (*S* =0.092); *prawns* (*S* = 0.089); *eagles* (*S* = 0.081); and, in 10th place, *sea otters* (*S* = 0.076). Note that, of these species, access to only one—*crab*—is expected to decline under the impending trophic cascade. *Sea otters* are, by definition, expected to thrive, whereas none of the other species can be expected with any degree of certainty to either thrive or decline under the impending shift in ecological regime (Gregr 2014, Espinosa-Romero, et al. 2011).

In other words, judging simply from this highly aggregate values ranking, one might expect local Clayoquot Sound residents to be relatively unaffected by the sea otters' return. However, as we have seen throughout our analysis of demographically *disaggregated* values, above (see Sections 5.4.1 to 5.4.7), this generalized conclusion masks quite distinctive asymmetries in *who* can be expected to perceive the most direct benefits from the trophic cascade (i.e., non-First Nations, males and managers), versus who can be expected to perceive the most certain losses (i.e., First Nations and females).

5.5 Discussion

To review, we conducted our interviews, and analyzed our data, with a number of central questions in mind. One, we wanted to gain a meaningful impression of the various kinds of things that Clayoquot Sound residents value in their natural environment. We also wanted to know whether participants' stated answers were stable across different framings of the question, or rather if the 'values' participants expressed tended to fluctuate with how the question was asked. Another question motivating our research was which kinds of ecosystem services locals readily perceive, and to what degree such a framework is functionally useful for values elicitation. Finally, and most importantly, we wanted to know if these data, when parsed demographically, suggested that there would be patterns of social asymmetry regarding who is likely to perceive the most direct benefits, as opposed to losses, from the impending trophic cascade.

Section 5.4, above, details the species and ecosystem services deemed valuable by various subgroups of participants, both at disaggregate and aggregate (see Section 5.4.8) levels. Further consideration of the patterns in those results also provides us with the following insights into our core research questions.

5.5.1 Consistently valued species: salmon, halibut, crab—then chaos

With respect to the second guiding question of our research—i.e., whether participants' valuations were relatively consistent across multiple framings of the values question—the results are somewhat mixed. *Salmon* was universally listed as the most important species regardless of how the question was asked. Clearly, this speaks to the robustness of salmon's perceived importance, implying a fairly stable and universal value. *Halibut*, too, was listed in second place amongst three out of four framings of the values question, suggesting this species, too, is valued with a fair degree of robustness. The caveat in this case is that halibut appeared to feature much less prominently in people's minds when we requested that they think about species' ecological value, specifically. *Crab* was also fairly consistently valued, featuring in the general public's top 10 lists under three of four possible framings.

Beyond these three species, however, stability across framings begins to noticeably dwindle. *Trees*, the species group with the fourth highest aggregate *S* score, appeared in the general public's top five list under merely one of four framing conditions. (It can be made to consistently appear across two framing conditions, but only if one expands the comparison beyond the top five species, to include the top 10). *Sockeye salmon*, with the fourth highest aggregate *S* score, appears to be a somewhat more consistently valued species, appearing in the public's top five list across two of four framing conditions. However, as we know from our earlier, disaggregated data analysis, this species' popularity is accounted for almost entirely by First Nations' values, as distinct from those of non-First Nations. This implies that First Nations are, as a group, relatively consistent in their high ranking of sockeye, but that this value is especially culturally relative.

The results with respect to values-consistency become rapidly more mixed the farther down the aggregate species ranking one progresses. In total, inter-framing comparisons suggest that, for the top two or three species that the public tend to think of as most important (*salmon*, *halibut*, *crab*), it appears reasonably defensible to argue that these values are somewhat independent of context and framing effects. However, beneath this veneer of consistency, the relative importance of various species begins to fluctuate quite noticeably depending on specifically which *dimension* of importance, or value, one is pondering. This suggests that local multistakeholder management efforts are well advised to be cognizant of the fact that Clayoquot residents appear to prioritize species populations quite differently depending on the exact issue being contemplated. As such, it appears that, in the Clayoquot context, to avoid miscommunication and confusion in decision making processes, a transparent and inclusive *framing* of a given management decision may be just as crucial as the transparency and inclusiveness of the decision-making process itself.

5.5.2 Ecosystem services: categories by cognition not committee

As for our question pertaining to the contextual usefulness of an ecosystem services framework, specifically, we can make a number of tentative conclusions. One, drawing merely from our own sample, it appears that the general public shares an intuitive typology of ecosystem services that differs considerably from that invoked in the academic and grey literature.[63] As detailed in Section 5.4.7, the 'expert' or 'academic' typology divides ecosystem services into four somewhat counter-intuitive categories (Millennium Ecosystem Assessment 2005, Daily 1997). Three of these—*provisioning, supporting* and *regulating*—were imaginably created for a combination of ecological and economic reasons, while the fourth, *cultural*, appears to serve as a virtual catch-all 'other' category, and has thus received relatively little serious attention in the ecosystem-services literature (Chan, Guerry, et al. 2012). Conversely, the general public appears to think in terms of more phenomenologically-relevant categories more immediately familiar to lived experience. These include a variety of basic-level 'provisioning' services (food, water, shelter, income), but also a staggering diversity of things that do not fit neatly into the aforementioned academic bins. For instance, rather than identify *processes* such as "the cleaning of water", as distinct from end *products,* such as "drinking water," people appear to think in terms that tend to combine both the process, and the ultimate 'benefit,' into one single, efficient, linguistic-mental object: e.g., "clean water," "clean air," "good weather," and so forth.

Beyond this, if one were to continue venturing hypothetical generalizations from our sample, it appears people intuitively think of, and differentiate between, a vast diversity of intangible things that could either be awkwardly but somewhat meaninglessly grouped together in the 'cultural services' category, or simply would not fit into any of the researcher community's *a priori* categories at all. Examples of such hard-to-categorize intangibles from our Clayoquot data include, for instance: *health*, *well-being*, *tranquility*, *isolation*, or *depression*.

[63] I.e., as ultimately presented and promoted by the UN's Millennium Ecosystem Assessment, itself originally derived from Daily (1997)

Another interesting point of note is that, even amongst managers, neither supporting, nor regulating, services appear to be especially obvious to people.[64] People may well have a figurative blind spot, it seems, for the very ecosystem services that the framework itself is largely designed to highlight.

Lastly, there is an issue of what we could call 'cognitive barriers.' Drawing from our experience on the WCVI, it seems some people have no palpable reservations about thinking in terms of so-called ecosystem services, even if we were not able to frame the subject using that term, precisely. However, there was a large segment of our sample that simply could not, or would not, willingly engage in the ecosystem-service listing-and-ranking exercise. In our case, the divide was specifically cultural: approximately 15% of non-First Nations were either cognitively or otherwise unable, or morally or otherwise unwilling, to engage in the ecosystem-service ranking task. By contrast, more than half of all First Nations participants (54%) were similarly unable or unwilling to engage in the task.

This suggests that the simple act of framing environmental decision-making or management in terms that explicitly emphasize distinct, itemized human benefits from nature, and trade-offs amongst them, may exclude a significant portion of the decision-making constituency from the process, simply by virtue of ontological discomfort, cognitive unfamiliarity with the approach, or both. If one adds to this the fact that these same groups

[64] E.g., even while "clean air" and "clean water" were cited fairly often, it was precisely in that cognitive-linguistically efficient form: water (or air) that *had been cleaned*. The regulating 'service' itself is arguably the *cleaning* or, more awkwardly, the *cleanliness,* of the air or water, not the air or water itself. Nonetheless, it seems even managers are predisposed to thinking in terms of *direct experience* and *observable objects*, not in terms such abstract or invisible processes.

may—as in the case of First Nations in Clayoquot Sound—be nonetheless subject to the most directly felt impacts of a given environmental change, the notion of using ecosystem services as a tool for more equitable, 'community-centered' conservation begins to look somewhat fraught. In such cases, we suggest it may be worth deliberating in terms that stakeholders might find more cognitively familiar, and ontologically less objectionable: e.g., choosing between two or more discrete possible scenarios, and then discussing means for achieving the preferred vision (Tapinos 2012).

5.5.3 Asymmetric benefits: perception, if not reality

Finally, we come to our last and most socially pressing research question: whether, when considered in the disaggregate, our data suggest significant asymmetry in who is likely to perceive more direct benefits, versus losses, as the trophic cascade proceeds. To be clear, if some ecologists' speculations hold true that higher densities of kelp will provide added shelter, food, or even spawning grounds for important fish species such as salmonids, halibut or herring (Gregr 2014), it is entirely possible that everyone will ultimately benefit. However, the question we ask here is whether any meaningfully distinct sub-groups of our sample are likely to perceive benefits more *directly*, more *immediately,* or with more *certainty* than others.

With this as the criteria, our results quite plainly suggest that, on average, non-First Nations are more likely to perceive benefits, rather than losses, from the trophic cascade than are their First Nations neighbours, and vice versa. This is because non-First Nations demonstrated, on average, a relatively strong enthusiasm for tourism, opportunities for fungible income, recreation, and entertainment, as well as a unique penchant for a variety of demersal, kelp-dwelling fish. This is good news for non-First Nations, because the inevitable increase in sea otter presence will almost certainly equate to greater tourism and entertainment opportunities, while otters' indirect positive effects on kelp beds have been observed to benefit kelp-dwelling demersals, specifically (Markel 2011).

First Nations participants, on the other hand, tended to express quite different priorities. Rather than favour kelp-dwelling demersals such as rockfish, it was specifically sockeye salmon, herring, herring roe and a wide diversity of shellfish that emerged as especially important species for First Nations. Unfortunately for First Nations, sea otters do prey voraciously on shellfish (Watson and Estes 2011, Singh, et al. 2013), and there have even been reports of sea otters decimating herring roe-on-kelp fisheries farther north along the Pacific coast (Lee, et al. 2009). In terms of the experiences and opportunities First Nations value deriving from their surrounding ecosystem, tourism, recreation, profit-making or entertainment were all conspicuously absent from their top rankings. This suggests that the opportunities afforded by sea otters' return will be disproportionately enjoyed by others.

Asymmetry on the gender axis is also clearly apparent in our results. Relative to their female counterparts, male participants demonstrated a relative disinterest in shellfish, and a relative enthusiasm for fish species—particularly a whole range of kelp-dwelling rockfish. Men's species rankings also suggested a positive attitude towards sea otters themselves more frequently than did those of women. Conversely, women seemed relatively concerned with the very shellfish species that otters directly target as prey, while also showing relative disinterest towards the fish species most certain to flourish in increasingly lush kelp beds. Finally, government managers, with their profound appreciation for the ecological role of kelp, relative disinterest in otter prey species beyond abalone, and their relative enthusiasm for ecotourism, also seem liable to experience the immanent trophic cascade more positively than will the general public.

5.6 Conclusion: where to now

The socially asymmetric benefits and losses that can be wrought by rapid environmental change are not merely interesting from a theoretical standpoint. Rather, the sense of inequality and unfairness they engender can have immediate, real-world consequences for social justice, community building and intergroup relations (Kemp-Benedict 2013, Burns 2008). When these social factors strain, this can in turn make managing a shared commons effectively even more fraught than it might have otherwise been (Adger 2000, Andersson and Agrawal 2011).

Quite a bit of attention has been paid in the academe and policy making spheres alike to planetary-scale asymmetries that we may face in the wake of global climate change (Nature 2009, Bierbaum and Zoellick 2009, Tol, et al. 2004). However, relatively little in-depth literature has thus far been published on how to identify and resolve even much smaller-scale, and thus theoretically simpler, problems of socially disaggregate environmental benefits and costs (Daw, et al. 2011). Thus, what we have presented here is a first-cut attempt at taking simple tools from cognitive anthropology (i.e., freelists, order rankings, and salience analyses) to convert largely qualitative data into meaningfully comparable quantitative data so as to concretize asymmetries that may otherwise be left to purely rhetorical argument, and ultimately ignored.

Based on this preliminary experience, here we offer a small number of suggestions for further research. One, while the kind of analysis we have demonstrated here is an important first step, what is now required is testing whether the explicit presentation and inclusion of this sort of disaggregate data can in fact help correct for problematic perceptions of asymmetry and inequity in local-scale multistakeholder management contexts. Alternatively, we do not discount the possibility that, by explicitly highlighting differences as well as similarities, this sort of work could in fact make some multistakeholder dynamics worse, thus jeopardizing effective management of social-ecological systems, rather than the inverse. We imagine the proverbial devil will be in the details, but it is a question that certainly must be addressed.

Second, what our particular results suggest is that there may be well be an under-recognized gender component to effective environmental or resource management. While this may come across as controversial, we are not in fact speaking here to issues of gender equity per se, so much as we are suggesting that in some contexts—such as Clayoquot Sound—gendered labour roles, and gendered environmental experiences, may in fact produce tendencies toward different habits of mind (Medin and Atran 2004), and even different value systems, as compared across genders. If so, *gender* balance in multistakeholder management contexts may sometimes be just as key to creative and durable decisionmaking as the socially valid representation of various communities or other stakeholder groups.

Finally, we feel that by drawing more extensively on the wealth of techniques already developed in fields such as cognitive anthropology (Smith and Borgatti 1997, D'Andrade 1995, Atran and Medin 2010, Medin and Atran 1999), psychology (Benet-Martinez, et al. 2002, Hart, et al. 2010, Kusev, van Schaik and Aldrovandi 2012, Storbeck and Clore 2008) or behavioural and experimental economics (Kahneman and Knetch 1992, Henrich, et al. 2001), sustainability researchers can leverage earlier work to better address important social aspects of conservation that have hitherto gone under-theorized, but also under-quantified, in the literature. We hope this paper has served as a basic example of how such work can be conducted, even with very simple analytical techniques.

Chapter 6: Theories of the Deep—*combining salience analysis and network analysis to compare cognitive models of a coastal Vancouver Island foodweb*

6.1 Introduction

It is now commonplace to note the failure of the rational actor model to adequately predict or explain the nuances of people's *in situ* behaviour across a range of social-ecological contexts (Atran, Medin and Ross, et al. 1999, Henrich, et al. 2001, Ostrom 1998). One response to this insight has been an increase in attention paid to the role of actors' 'mental models' in environmental decision-making (Lynam and Brown 2011, Lynam, et al. 2012, Jones, et al. 2011). Mental models are internalized, cognitive representations of the world that people use to understand their surrounding context and inform behaviour (Gentner and Gentner 1983, Jones, et al. 2011). Although disciplinary definitions vary, these models can be conscious and explicit, or unconscious and implicit (Johnson-Laird 2001). Studying them provides researchers with potentially invaluable information about how and why actors in a system do what they do.

In theory, such insights can help improve multistakeholder management of shared resource systems. Specifically, studies in organizational management have found that it is precisely the development of *shared* mental models amongst multiple parties that serves as the lynchpin for successful negotiations (L. A. Liu 2004, Brodt and Dietz 1999). This is so much so, in fact, that developing shared mental models appears to be more important to successful negotiation outcomes than does directly tackling concerns about dividing up resources, problem solving, or even reaching final agreements (L. A. Liu 2004, Brodt and Dietz 1999).

Yet, actively constructing shared mental models amongst different parties in a resource conflict or management context is not necessarily straightforward. One challenge is that people's innate beliefs about their social-ecological system are often tacit, and thus cannot be stated directly without adequate elicitation efforts (e.g., see Chapter 2). Another is that, in many resource conflict or multistakeholder management contexts, actors constitute not only individuals, with individual mental models, but also loosely affiliated groups, or blocs, more usefully described to each be acting within the logic of a more nebulous, 'aggregate' mental model.[65] These group-level 'aggregate' models can prove uniquely challenging to elicit, let alone represent with meaningful validity.

In this paper we contribute to that effort by demonstrating the first iteration of an approach we synthesized specifically to elicit and represent multiple stakeholders' aggregate mental models of a regional foodweb. In particular, we outline how it is possible to combine innovative freelisting tasks, salience analysis (Smith and Borgatti 1997) and network analysis (Gephi 2014) to ultimately create tangible, empirically responsible visual representations of various groups' aggregate mental models. Our case study was the Clayoquot Sound UNESCO Biosphere Reserve, on the west coast of Vancouver Island. There, a resurgence of the once extirpated sea otter, combined with a regional decline in fisheries, had created an atmosphere

[65] Group-level models are sometimes referred to as 'cultural models' (Kronenfeld 2008). However, for the purposes of this paper, we prefer the term 'aggregate' mental model, in that we mean our term to refer more specifically to a collection of individual mental models that may or may not feature a high degree of agreement amongst them, but nonetheless collectively represent the cumulative system of beliefs of a given group of individuals that have been identified or selected *a priori* to constitute a single unit. Such groups may emerge by institutional arrangement (e.g., political circumstance creating 'strange bedfellows' or alliances of dissimilar individuals that nonetheless go on to work together as a single actor, guided by their cumulative set of beliefs), by research logic (as in the case of this paper), or otherwise.

of tension amongst locals and government officials over how to best manage marine resources in rapid flux. Our results demonstrated crucial differences in the relative salience of kelp bed dynamics, sea otter predation and humans' role in the system, amongst six overlapping demographic groups of actors within the system.

We begin by providing a more detailed description of the social-ecological context of Clayoquot Sound. Then, because the particular synthesis of methods we chose is (to our knowledge) new and thus somewhat heterodox, we provide a relatively in-depth account of the techniques we used, including the logic behind our identification of the various demographic groups upon which we chose to focus our analyses. We then present and discuss our first round of results. This is followed by a description of how we used the software platform Gephi (2014) to treat those first results as a new set of data, ultimately creating a series of six network visualizations of the local foodweb, each corresponding to the aggregate mental model of a different demographic group. We follow with an interpretative discussion of those visualizations, and end with a summary of the cumulative insights produced by our first attempt at employing this synthesized method in Clayoquot Sound.

6.2 Context: voracious otters, disappearing invertebrates, elusive finfish, and acrimony in Clayoquot Sound

Clayoquot Sound is a visually stunning region on the west coast of Vancouver Island, British Columbia, Canada. Despite its beauty, however, the area has a history of heated resource conflicts amongst local First Nations, successive settler colonial governments, industry, environmental groups, and a diversity of other local actors. Intense negotiations and carefully assembled multistakeholder management frameworks have been crucial to calming some of the bitter intergroup antagonisms that have historically characterized the region (Lertzman and Vredenburg 2005, West Coast Aquatic 2014). However, given the crucial importance of natural resources to local livelihoods, these processes and decision-making structures are still tenuous, and multistakeholder relationships remain charged with social, political and economic tension (Okerlund 2007, Uu-a-thluk 2014). As such, Clayoquot Sound is an ideal candidate for the sorts of insights that can be gained from eliciting and comparing stakeholders' aggregate mental models of the social-ecological system.

Apart from a long history of forestry and fishery disputes in the region, in recent years, acrimony has begun to surface over a relatively new phenomenon: the perceived ecological effects of the unassuming but voracious sea otter (*Enhydra lutris*). A reintroduction and recent boom in the once decimated sea otter population is having substantial and rapidly cascading effects on the local nearshore ecosystem. As sea otters continue to multiply and, with the protection of Canada's *Species at Risk Act* (Fisheries and Oceans Canada 2013), spread unimpeded, the mammal has been coming into direct competition with humans for edible shellfish and other marine invertebrates. This has proven particularly troubling for First Nations in the remote northern region of the west coast of Vancouver Island (WCVI), where otters were first reintroduced. There, many locals perceive the animal's resurgence to have severely reduced their access to prized traditional foods, hence harming their food security, their sense of cultural continuity and arguably their health.

This tension is compounded by the fact that many (though certainly not all) non-First Nations residents view the otters much more positively than do their First Nations neighbours (see Chapter 5). For many of the more otter-enamoured locals, a booming sea otter population seems to suggest a “return” to a more “balanced” relationship between people and nature in the region. Ecological researchers and government managers, for their part, have vaunted the potential positive impacts of sea otters on the regrowth of kelp beds, and hence on the diversity and volume of biota that take shelter in such habitat (Markel 2011, Espinosa-Romero, et al. 2011, Gregr 2014). Finally, government managers, ecologists and some non-First Nations small-business owners alike, have all expressed hope that otters will provide a boost to the local economy through increased ecotourism (Fisheries and Oceans Canada 2004).

In addition to the question of otter resurgence, the past decades have also seen intense acrimony in Clayoquot Sound and the wider WCVI over the presumed state of local finfish populations (e.g., salmonids, herring, and rockfish) (Cameron 2014, Hume 2012, Rice 2002). Early 20th century logging practices are deemed to have largely decimated many local salmon runs (Harris 2001). In more recent years, overfishing and controversial aquaculture techniques have been blamed by various parties for massive seasonal fluctuations in remaining runs, as well as for precipitating an apparent drop in other economically and calorically crucial species (Page 2007).

As a result, the Canadian Department of Fisheries and Oceans (DFO) has, over the course of decades, drastically altered the licensing system for all salmonids and ground fish on the west coast of British Columbia. A significant consolidation of fishery access has followed, including a much-reduced number of license holders (Pinkerton and Edwards 2009). Fishery openings have also become far more restrictive than in the past, ostensibly with the aim of allowing stocks to recover. However, many locals, including First Nations and non-First Nations alike, cast serious doubt on the accuracy, and even on the integrity, of "government science" (Corbin 2002). Alternate theories about what causes stocks to fluctuate, when, and by how much, abound. Given that locals' livelihoods, ways of life, and sense of food security are all quite literally at stake, emotions run high.

It was in this charged and relatively cacophonous atmosphere that in 2009 we began conducting semi-structured interviews in communities in and around Clayoquot Sound and the wider WCVI. Our initial aim was to better understand the values and priorities at stake for various parties in the face of such rapid, contested changes to the marine environment (see Chapter 5). Over the course of our efforts, we realized that different participants from different demographic and economic sectors appeared to hold a range of contrasting, sometimes contradictory, beliefs about the nature of ecological dynamics in the marine environment (e.g., see Chapter 5, Section 5.4.6).

Left unaddressed, such contrasting beliefs can have potential ramifications for multistakeholder negotiations (see Section 6.1). Thus, we decided to specifically elicit these differences and similarities in underlying beliefs, so as to enable their clean, methodical analysis. To do so, in the spring of 2012, we launched into a final round of in-depth, structured interviews with 67 local residents, and four government managers. We focused a portion of our protocol explicitly on participants' mental models of the social-ecological system. In so doing, we paid particular attention to participants' beliefs about trophic interactions, or the marine 'foodweb,' innovating what is to our knowledge a new technique for eliciting and representing such data (see Section 6.3).

Given that it appears no one has yet attempted to combine the specific statistical methods we use here for this purpose, our efforts constitute merely a first and somewhat rudimentary iteration. In the interest of prioritizing an exploration of the kinds of potential insights our synthesized technique can reveal, we make a key simplifying assumption about group coherence (see Section 6.4) that can be more fully addressed in future iterations or applications of the approach. The aggregate mental models we ultimately present in Section 6.7 should thus be considered with that caveat in mind. Nonetheless, we deem the methodological synthesis we employed for this paper potential useful, and hope that by outlining it in some detail in Section 6.3, below, others will be able to subsequently refine and improve upon it.

6.3 Methods

Our methods consisted of three phases: (1) in-depth structured interviews in which freelisting and related tasks were used to elicit participants' individual mental models of the local marine foodweb; (2) salience analyses of the freelist data at the level of pre-determined demographic subgroups (see Section 6.4), using the software package ANTHROPAC (Borgatti 1996); and finally (3) network analyses of the group-level salience data using the software package Gephi (2014). Ultimately, these results were rendered visually, as quantitative-data rich networks of species, depicting various demographic subgroups' aggregate mental models of the local marine foodweb (see Figures 6.5 to 6.10). We describe each of these steps in more detail, below.

6.3.1 Interviews

In the spring of 2012, the primary author took up residence in the Clayoquot Sound region, and over the course of several months completed in-depth structured interviews with 67 local residents, as well as with four government resource managers responsible for conservation prerogatives in the region. To achieve as broad and diverse a sampling of the resident population as possible, the primary author recruited local interviewees by several means: advertisements on local poster boards, word of mouth, placement of information cards with contact information in stores around the local towns of Tofino and Ucluelet and, in the case of interviews within First Nations communities themselves, personal introductions by the relevant tribal authorities.

The interviews consisted of a relatively lengthy structured protocol, conducted at a place of the participants' choosing. These sites ranged from personal residences, to public cafes, to local NGO offices. The first of aim of the protocol was to elicit participants' basic demographic self-perceptions. As such, participants were first asked to state their name, where they were from, how long they had lived in the Clayoquot region and, if they were comfortable sharing, their year of birth, their legal First Nations ("Indian") status, and their occupation(s). Next, to prompt participants to think about the Clayoquot Sound region itself, the primary author then asked them to describe to him the things they most liked and disliked about living and working in the area. Once this was done, the protocol aimed to ascertain an initial sense of how each participant thought about the Clayoquot Sound region spatially. To do this, all participants were provided with an identical set of coloured pens, and a notepad. The primary author then asked the participants to visually depict "where [it was they] live and/or work." The drawings were then photographed and digitally stored for later analysis.

Subsequent to the drawing task, the primary author began eliciting participants' mental models of the social-ecological system, with a particular focus on the marine foodweb. To do this, he began with a freelisting task, wherein he asked participants to verbally list "as many species and/or resources you can think of on the west coast of Vancouver Island." As participants did so, the primary author requested that they write the name of each species or resource down on small individual cards in the order that they came to mind. [66] This ordering ultimately gave us a measurement of species' relative cognitive accessibility to participants and, by inference, a sense of which species feature most prominently in participants' mental models. We later conducted a sailence analysis (Smith and Borgatti 1997) on this ordering data to explore species' relative accessibility at the group level, which we report on in Section 6.5.

Subsequent to the first freelisting task, the protocol aimed to elicit participants' beliefs specifically regarding trophic interactions amongst species. To do this, we devised a task wherein the researcher provided participants with a box full of a large volume of wooden

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[66] After the order had been recorded, we then asked participants to engage in a number of tasks that involved ranking the species according to different subjective value criteria. The results of those tasks are reported in another paper (see Chapter 5).

popsicle sticks. On each popsicle stick we had written the word “eats” with a long arrow pointing in one of two directions. The primary author then requested that participants begin to connect the pieces of paper on which they had written species’ names by using the popsicle sticks to show him “what eats what” in the local ecosystem. Participants were asked to verbalize their thinking as much as possible during this task, so we could clearly understand their reasoning. As they did this, the primary author recorded the order in which the participants thought of, and represented, the various trophic interactions. The participants’ task ended once they had connected as many species, one to the other, as possible. For each given participant, the end result was thus a visually tangible depiction of his or her mental model of the local foodweb, which was then photographed (see Figure 6.1).

In total, we interviewed 71 individuals. Four of these participants were government resource managers, who for the purposes of this paper we regard as a separate group. This leaves a total of 67 ‘civilian’ interviewees, ranging from the ages of 20 to 80. Within this group, there were 29 females, and 38 males. 41 participants self-identified as non-First Nations, while the remaining 26 were self-identified First Nations, primarily from the Ahousaht and Toquaht nations, with a few participants from the Tla-oh-qui-aht and Yuułuʔiłʔath nations. Participants from the latter two bands granted interviews outside of their communities, in Tofino and Ucluelet proper, while interviews with the former were conducted on tribally-administered lands. All participants were offered financial compensation for their time at a rate of CAD$15 per hour.

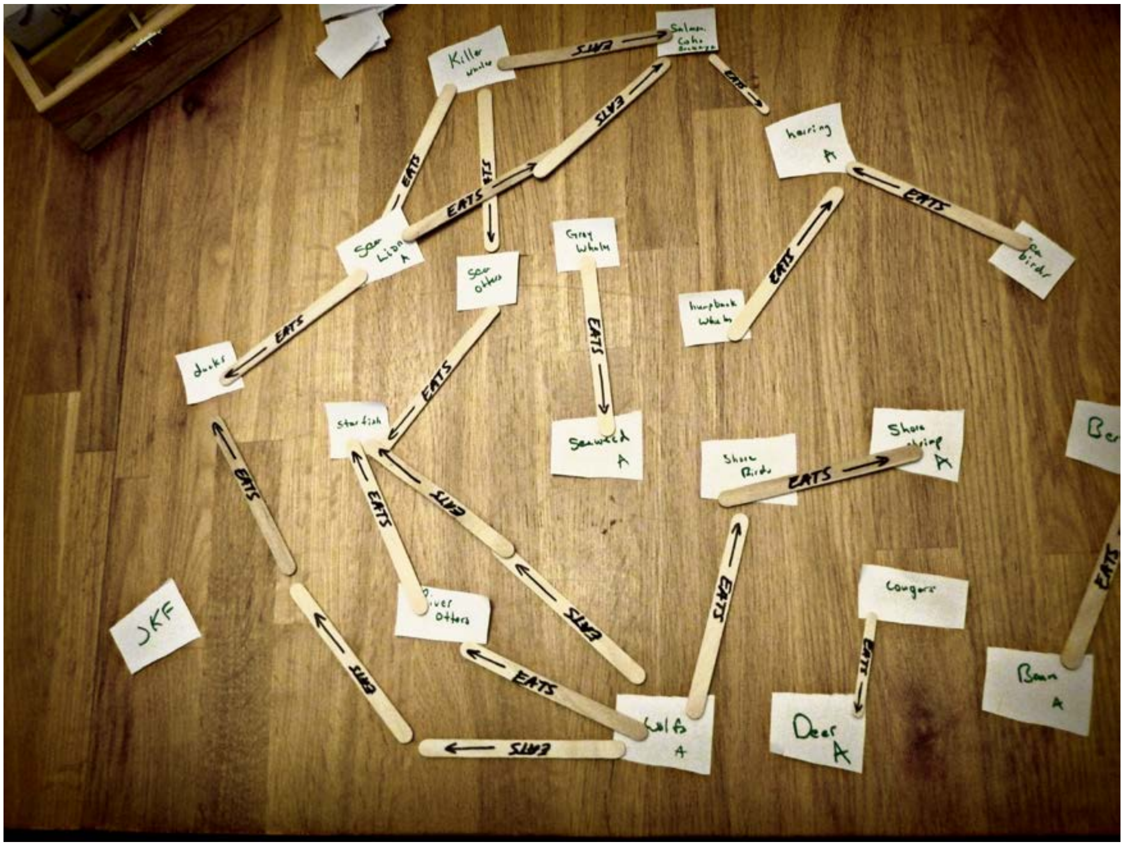

Figure 6.1 Sample output of a completed trophic connection task

This image is one example of the final output of the freelisting and trophic connection tasks put to participants in the course of the interview protocol. Participants were first asked to list as many local species as possible, as they were able to think of them. The order of each participant's listing was recorded for later salience analysis. Participants were then prompted to depict what they believed to be those listed species' trophic interactions with other species, using a large number of popsicle sticks with the word "Eats→" that we subsequently provided to them. The order in which each participant connected each species one to another was also then recorded for later salience analysis.

6.3.2 Salience analysis

Once all the species orderings and trophic web data had been collected, we began to analyze it at the level of predetermined demographic subgroups. Understanding this shift from eliciting data at the individual level, to analyzing it at the group level, is crucial. For simplicity's sake during this, the first iteration of the technique, we assumed the existence of several demographic subgroups *a priori*, based on a series of observations made during the interviews themselves. We elaborate on the logic of identifying and assuming the relevance of these subgroups in the following Section (6.4).[67]

With these *a priori* subgroups in mind, we first analyzed the freelisted species data using the salience analysis function of ANTHROPAC (Borgatti 1996). This parsing helped us approximate which species were most readily recalled by which kinds of people, and hence identified which species tend to feature most prominently in each predetermined demographic group's aggregate mental model of the ecosystem.

To do this, we used ANTHROPAC to calculate a *Smith's salience index* (Smith and Borgatti 1997)—or simply 'salience score'—for each species mentioned by participants. Calculating salience indices is a cognitive anthropological technique for analyzing interviewee-generated lists of terms, which has since been adopted across multiple disciplines (Smith and Borgatti 1997, Gravlee, et al. 2013, de Morais 2009, Dongre and Deshmukh 2012, Pradhan and Ram 2010, Sutrop 2001, Barg, et al. 2006, Thompson and Juan 2006, Ghorbani, et al. 2011,

[67] Future iterations of this technique could include an innovative use of multivariate analysis to determine if such groups emerge from the freelist data itself.

Malan and Neuba 2011). A given term's Smith's salience index (*S*) amongst a group of participants is a function of both the *frequency* with which the term is mentioned during a freelisting exercise—i.e., the number of participants who include a given term on their respective lists—as well as a function of the term's average *position* on participants' lists. Words that are mentioned most frequently and are positioned *highest* on people's lists obtain the highest saliency scores, and vice versa (Barg, et al. 2006). Scores range from 1 (highest) to 0 (lowest).[68]

We report on the results of this first round of salience analysis in Section 6.5. We then proceeded with what to our knowledge is a methodological innovation, in which we took participants' ordered lists of trophic interactions, treated these orderings as freelists in and of themselves, and conducted group-level salience analyses on them as well. This provided a general sense of which interspecies relationships were, on average, relatively prominent amongst which predetermined demographic subgroups' aggregate mental models of the ecosystem. In other words, for each demographic subgroup, the salience analysis produced a list of "what eats what," indicating by salience index which trophic relationships (e.g., otters eating urchins, or killer whales eating salmon) were most readily recalled by people. The results of this analysis provided intriguing insights into peoples' aggregate mental models, which we

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[68] "This is based on the formula:

$S=((\Sigma(L - R_j + 1))/L)/N$

where *S* is the average rank of an item across all lists in the sample, weighted by the lengths of the lists in which the item actually occurs; *L* = the length of (number of items in) a list; R_j = the rank of an item in the list (first = 1); and *N* = the number of lists in the sample" (Smith and Borgatti, 208-209).

report on in Section 6.6. However, because this data specifically characterized perceived relationships *between species,* it could also then be further analyzed as a *network of species connected by trophic relationships*, each connection weighted by salience index (see Section 6.3.3 directly below). This second innovation is what ultimately enabled us to produce uniquely data-rich visualizations of groups' aggregate mental models of the Clayoquot foodweb (see Figures 6.5 to 6.10)

6.3.3 Network analysis

Having used ANTHROPAC's salience analysis function to produce lists of trophic relationships with salience indices (see Section 6.3.2 above), we then took that data and entered it into the free network analysis software package 'Gephi' (2014). To do this, we converted each instance of our trophic data (e.g., otters eat urchins) into network data, as follows. We treated each species in every trophic pair (e.g., *otter* and *urchin*) as a node, and incorporated the particular trophic relationship as a directional connection in a network of these nodes. Each of those connections, in turn, was weighted with the salience score derived from the second ANTHROPAC analysis. This weighting represented a trophic connection's relative prominence (cognitive accessibility) in the resulting network. Once this data had been entered into Gephi, we were then able to proceed with a range of network analyses that calculated a range of centrality measures for each species. Ultimately, this enabled us to produce data-rich visualizations of groups' aggregate mental models (see Section 6.7 and Figures 6.5 to 6.10), depicting both which *connections* ("what eats what") appear to be most cognitively accessible to people, as well as which *species* feature as the most prominent predators, prey or ecological connectors. We elaborate on how to interpret these findings in Section 6.7.1.

6.4 Logic of group selection

As described at the end of Section 6.2, above, this paper constitutes a first iteration of a newly synthesized technique for analyzing, visualizing and comparing various groups' aggregate mental models of trophic webs. Given that it is a first iteration, we made a key simplifying assumption. Rather than parse the highly data-rich network analyses themselves for factors that could imply intergroup differences, we instead identified what appeared to be several meaningful demographic subgroups *a priori,* and proceeded to use those subgroups as examples of populations for which researchers can use the technique we present to construct insight-generating visualizations of aggregate mental models at the group level. This simplifying assumption obliges an important caveat. Namely, in our case—with the exception of government managers, who we treat as an entirely separate group—any given individual participant will be a member of more than one subgroup, and the models we ultimately produce for each group are thus emphatically not fully independent from one another. Nonetheless, we feel this approach still has both instructive and hypothesis-generating value, and is worthy of presentation even at this first iteration.

6.4.1 Patterns of difference in participants' visual depictions of Clayoquot Sound

We arrived at our choice of *a priori* demographic subgroups as follows. Our first intimations of systematic differences amongst groups of participants arose with the initial drawing task (see Section 6.3.1.). Namely, as we conducted an increasing number of interviews, we began to observe that males, on average, appeared to depict "the area in which [they] work and/or live" specifically in the form of abstract, overhead maps. Females, on the other hand, tended to depict "the area in which [they] work and/or live" specifically as human-scale landscapes, composed of features such as mountains, water, beaches and trees. Moreover, most of these depictions were largely devoid of people—that is, except in the case of First Nations participants. First Nations' depictions seemed to include people interacting with the environment (e.g., collecting food) much more frequently than did their non-First Nations counterparts' (see Figures 6.2 to 6.4).

To test the hypothesis that these observations were indicative of a significant difference amongst these groups, we first coded each participant's visual depiction as a "map" or "scene", respectively, and also noted whether each depiction "contained people" or not. We then used this simple coding scheme to regress participants' visual depictions of their local environment on three demographic variables: gender, First Nations status and—in case we had missed a different underlying driver—also age.

As we hypothesized, males emerged as having much greater odds than women of visually representing their local social-ecological system in the form of an overhead, abstract map, specifically. This was true by a factor of nearly 7:1, OR=6.77 (CI 1.78-25.72), $p=0.005$. In addition to gender, there was also a sizable difference between First Nations and non-First Nations participants. First Nations emerged as having much greater odds than non-First Nations (more than 6:1) of including *people* in their visual depictions, OR=6.35 (CI 1.22-32.91), p=0.028.

To be clear, we emphatically are not arguing that these differences suggest biologically or genetically determined variations in cognition. Rather, while we realize highlighting such differences may be provocative, our point is that—regardless of the underlying reason—if and when different "habits of mind" (Medin and Atran 2004) do appear to exist across groups, paying attention to them can serve as a first clue in better revealing and understanding potentially consequential variation in in the way multiple stakeholders are conceptualizing their shared social-ecological system, wittingly or otherwise.

In this case, we suspect that the gender- and cultural differences noted above are largely driven by the different kinds of activities that males versus females, and First Nations versus non-First Nations, tend to engage in most frequently in the Clayoquot Sound region. Commercial and subsistence fishing, which involve coastal navigation, often over large distances, are largely male-dominated activities on the west coast of Vancouver Island (WCVI). Thus, men's depictions of their environment may well reflect the habits of mind they form by virtue of repetition during their extended periods of time on the water.

Women in Clayoquot Sound, on the other hand, seem to spend relatively less time navigating long distances in boats. Rather, amongst our female participants, more commonly cited activities involved jobs in the land-based services industry or in near-shore areas. Similarly, while many men listed recreational fishing as a pastime, women participants' preferred recreational activities likewise tended to centre on near-shore or inland areas (e.g., surfing, hiking, beachcombing).

First Nations participants of both genders appear to engage in more subsistence food collection than do their non-First Nations neighbours. Locally harvested salmon and halibut are especially important foods in the diets and cultural economy of regional Nuu-Chah-Nulth First Nations, but so are herring, herring roe (which is collected off kelp or cedar branches lowered into spawning areas), and a wide range of rocky shore invertebrates. Amongst First Nations, it is largely men who traditionally harvest salmon and halibut, while it is women who have historically spent proportionally more time harvesting near-shore shellfish.

Such habits, however, may not entirely account for First Nations' participants' relative penchant for descriptive scenes over maps, nor their significantly greater inclusion of humans in their depictions. There may also be ontological or epistemological differences involved (Ross, Medin and Cox 2007): for example, a tendency amongst First Nations to think of humans as more directly involved in, or part of, the local social-ecological system, relative to non-First Nations who in the course of our interviews seemed to have more distinct notions of 'nature' as separate from human activity. Regardless of the underlying cause, these significant differences in cognitive style are thought provoking and, we argue, worthy of further consideration in the context of actual multistakeholder consultation or negotiation over shared marine resources in the region.

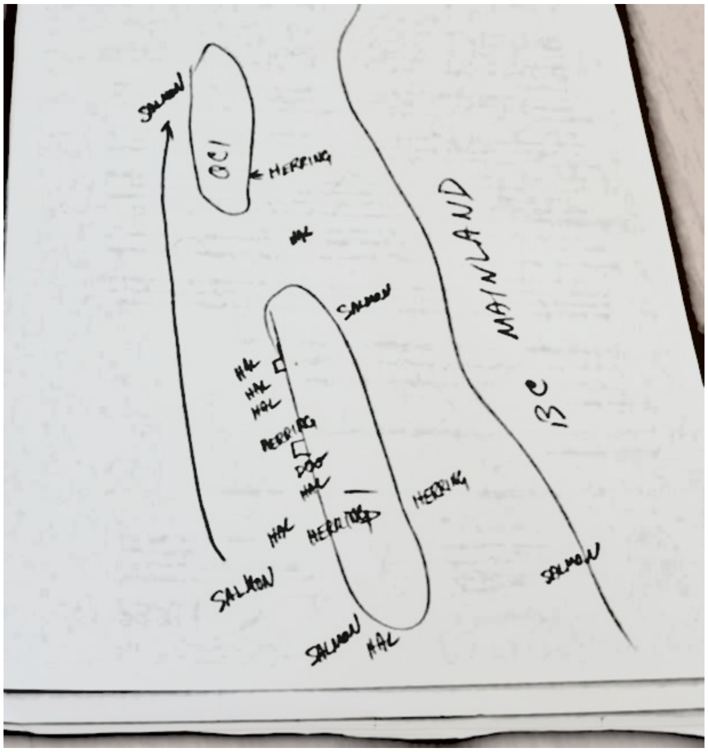

Figure 6.2 Sample depiction of local ambit: non-First Nations male

This image is an example of one non-First Nation male participant's response to the instruction "please depict the area in which you work and/or live." Note that this participant chose an overhead map-style depiction, at a fairly large scale, with an emphasis on fishing activities. Men exhibited, on average, nearly seven (6.77) times greater odds of intuitively choosing this map-based style of depiction than did women (p=0.005).

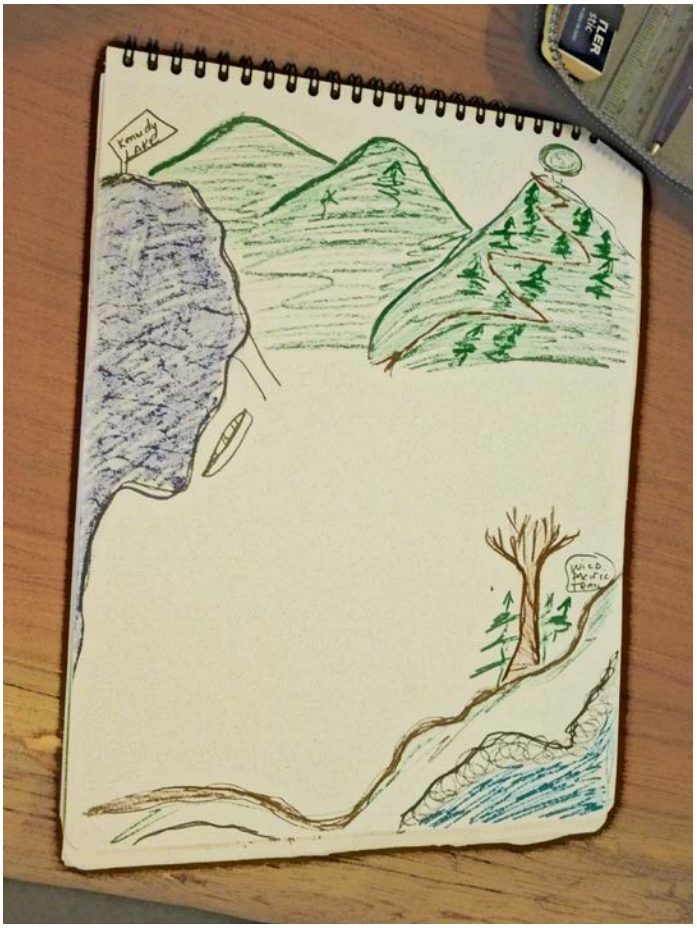

Figure 6.3 Sample depiction of local ambit: non-First Nations female

This image is an example of one non-First Nation female participant's response to the instruction "please depict the area in which you work and/or live." Note that this participant chose a natural scene, at a relatively high-resolution scale, depicting both land and coastline, with no humans in the image. Women exhibited, on average, nearly seven (6.77) times greater odds of intuitively choosing a scene-based style of depiction (such as this, above) than did men (p=0.005).

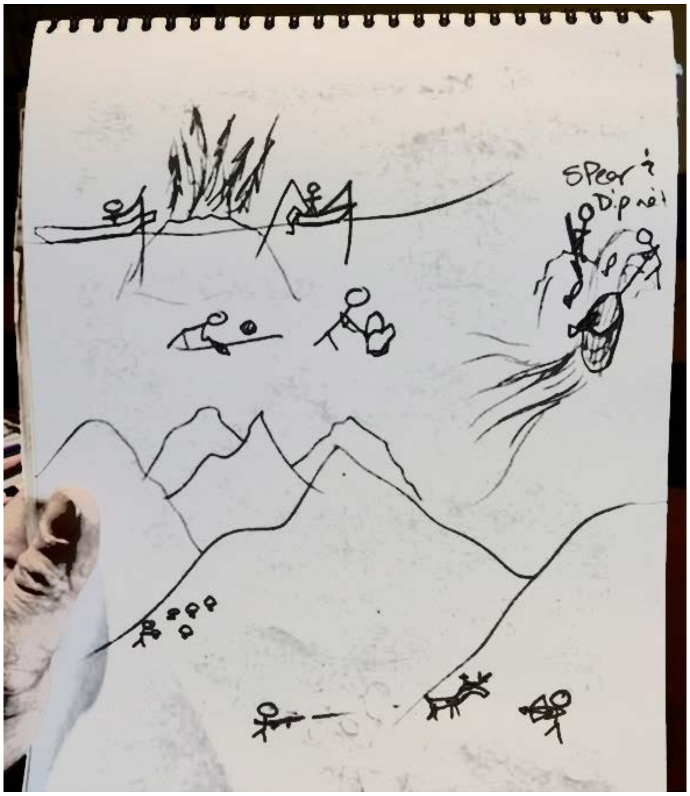

Figure 6.4 Sample depiction of local ambit: First Nations male

This image is an example of one First Nations male participant's response to the instruction "please depict the area in which you work and/or live." Note that this participant chose a series of outdoors scene, at a relatively high-resolution scale, depicting both land and water, with many humans in the image, each of which is conducting a different form of wild food collection. First Nations participants had, on average, over six (6.35) times higher odds of intuitively including humans in their depiction than did non-First Nations (p=0.028).

6.5 Species accessibility: you think plants, I think animals

Comparing the results of the salience analyses we conducted on different groups' freelists of local species yields revealing contrasts between government-employed resource managers, and the remainder of our sample, which for terminological consistency we refer to from this point forward as "civilian locals" or simply "civilians". As a whole, the following five species emerged as most accessible for our sample of civilian locals (listed in descending order by salience index): *bear*; *halibut*; *cougar*; *wolf*; and *eagle*. The next five most accessible species were: *sea otter*; *salmon*; *clam*; *sea lion*; and *grey whale* (see Table 6.1, below).

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Bear	1	0.480
Halibut	2	0.444
Cougar	3	0.401
Wolf	4	0.394
Eagle	5	0.377
Sea otter	6	0.367
Salmon	7	0.366
Clam	8	0.309
Sea lion	9	0.291
Grey whale	10	0.285

Table 6.1 Most cognitively accessible species: civilian locals (top 10)

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Giant kelp	1	0.712
Sea otter	2	0.624
Bull kelp	3	0.619
Chinook salmon	4	0.480
Sockeye salmon	5	0.459
Coho salmon	6	0.448
Chum salmon	7	0.432
Sea lettuce	8	0.411
Abalone	9	0.406
Humpback whale	10	0.404

Table 6.2 Most cognitively accessible species: government managers (top 10)

Remarkably, this ordering contrasts starkly with that of our four government manager participants (see Table 6.2, above). Managers appeared to intuitively think of quite different species relative to civilians, as well as think at a consistently higher phylogenetic resolution relative to the civilian population. Civilian participants, inversely, often conflated 'species' with broader phylogenetic categories in their own mental categorization schemes, more frequently invoking generic terms such as *salmon* and *clam*, rather than individual species thereof.

For managers, the following five species emerged as most accessible: *giant kelp*; *sea otter*; *bull kelp*; *chinook salmon*; and *sockeye salmon*. The next five most salient species for managers were: *coho salmon*; *chum salmon*; *sea lettuce*; *abalone*; and *humpback whale*. Note how two of five of the most salient species for managers are varieties of *kelp*, whereas *kelp* of any sort did not even feature in the local population's top 10 list. In fact, *kelp* ranked only 70th in the latters' list at S = 0.069, and even then only in the generic form, below many discrete species such as *yelloweye rockfish* (0.124), *littleneck clam* (0.071) or, simply, *moss* (0.077), none of which was listed by any of the four managers.

The fact that such stark, consistent differences were easily elicited using extremely simple methods suggests to us that it is no surprise that relations between government fisheries managers and local citizenry on the west coast of Vancouver Island are often so contentious. Even these very cursory results suggest that the two groups may well be inhabiting deeply divergent mental worlds with respect to their internal representations of the very same social-ecological system. While local citizens' mental representations appear to be dominated largely by iconic megafauna, as well as by key broad-level edible species groups such as salmon, halibut and clams, managers appear highly focused on habitat-forming marine plants, as well as specific individual salmonids. This suggests not only an entirely different set of concerns, but also a different set, and resolution, of salient mental-model components. Regardless of the drivers of these differences, the mere fact they appear with such clear contrast suggests they should be taken into serious consideration in the context of any resource management consultations in the region.

There were also noteworthy differences in response patterns amongst the predetermined demographic groups we identified earlier in our analysis (see Section 6.4). While not as stark as those shown above, as well as being more confounded by virtue of the fact that each individual civilian participant was by default a member of two different overlapping subgroups (gender and First Nations status), the results are nonetheless intriguing at the hypothesis generating level.

To begin with gender (see Tables 6.3 and 6.4), males' top five most salient species included, in descending order: *halibut* (0.558); *salmon* (0.429); *bear* (0.398); *lingcod* (0.369); and *sea otter* (0.325). Females' top five, while not altogether dissimilar, constituted a much more terrestrial focus, with a different ordering: *bear* (0.587); *cougar* (0.575); *wolf* (0.572); *eagle* (0.449); and *sea otter* (0.422). Notably, near-shore edible invertebrates were more salient for women than they were for men. Urchins were the seventh most salient species for women (0.367), whereas they only featured 20th on men's list (0.212). While mentioned often by both genders, clams and oysters were also more salient for women (at S = 0.364, and eighth and ninth place for each, respectively) than for men (at S = 0.267 and 0.206, and at ninth and

23rd place for each, respectively). Meanwhile, men appeared to think of fish species more readily and at higher resolution than did their female counterparts.

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Bear	1	0.587
Cougar	2	0.575
Wolf	3	0.572
Eagle	4	0.449
Sea otter	5	0.422
Grey whale	6	0.371
Urchin	7	0.367
Clam	8	0.364
Oyster	8	0.364
Sea lion	9	0.345
Crow	10	0.345
Gull	11	0.323
Killer whale	12	0.302
Crab	13	0.301
Halibut	14	0.294
Steller's jay	15	0.293
Salmon	16	0.284
Humpback whale	16	0.284
Whale	17	0.272
Deer	18	0.254

Table 6.3 Most cognitively accessible species: females (top 20)

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Halibut	1	0.558
Salmon	2	0.429
Bear	3	0.398
Lingcod	4	0.369
Sea otter	5	0.325
Eagle	6	0.322
Coho salmon	7	0.289
Sockeye salmon	8	0.283
Clam	9	0.267
Cougar	9	0.267
Wolf	10	0.258
Killer whale	11	0.255
Sea lion	12	0.250
Deer	13	0.242
Rockfish	14	0.239
Crab	15	0.237
Herring	16	0.225
Grey whale	17	0.219
Yelloweye rockfish	17	0.219
Urchin	18	0.212

Table 6.4 Most cognitively accessible species: males (top 20)

For instance, the generic term '*salmon*', while the second-most salient for men at S = 0.429, only ranked 16th for women, at S = 0.284. More specifically, *coho salmon* and *sockeye salmon* ranked as the seventh and eighth most salient species for men respectively (0.289 and 0.283), while they only featured 43rd and 38th on the women's collective list (at S = 0.121 and 0.130, respectively). *Halibut* also emerged as far less salient for women (0.294, in 14th place) than for men (0.558, in first place), while *rockfish* of any kind only emerged in 92nd place for women (0.054), while men listed both the category of *rockfish* itself (0.239), as well as a range of individual rockfish species, far more readily, and more often.

We suspect these differences once again point to genuine cognitive effects of the relatively gendered division of labour in Clayoquot Sound, as described in Section 6.4.1. In a marine management climate often numerically dominated by men, these data seem to suggest that greater inclusion of local female voices could have meaningful impacts on the focus and tenor of negotiations.

The differences that emerge between First Nations and non-First Nations salience rankings are also remarkable (see Tables 6.5 and 6.6, below). While six species (*bear, halibut, wolf, cougar, eagle* and *sea otter*) were common across both First Nations' and non-First Nations' top 10 lists of accessibility (albeit in a slightly different order from one another), the former cited specific edible near-shore invertebrates, as well as individual salmon species, much more readily than did the latter.

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Halibut	1	0.467
Bear	2	0.432
Wolf	3	0.418
Urchin	4	0.406
Cougar	5	0.405
Sockeye salmon	6	0.397
Deer	7	0.395
Clam	8	0.361
Eagle	9	0.333
Sea otter	10	0.264
Killer whale	11	0.241
Oyster	12	0.237
Salmon	13	0.231
Chiton	14	0.229
Coho salmon	15	0.226
Crab	16	0.224
Spring salmon	17	0.221
Crow	18	0.206
Herring	19	0.186
Cod	19	0.186

Table 6.5 Most cognitively accessible species: First Nations (top 20)

SPECIES	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Bear	1	0.510
Salmon	2	0.452
Sea otter	3	0.432
Halibut	4	0.429
Eagle	5	0.405
Cougar	6	0.398
Wolf	7	0.379
Sea lion	8	0.375
Grey whale	9	0.357
Gull	10	0.324
Oyster	11	0.297
Killer whale	11	0.297
Crab	12	0.290
Humpback whale	13	0.281
Clam	14	0.276
Lingcod	15	0.269
Crow	16	0.265
Whale	17	0.254
Red cedar	18	0.230
Hemlock	20	0.229

Table 6.6 Most cognitively accessible species: non-First Nations (top 20)

For instance, while oysters ranked as relatively salient for both groups alike, First Nations recalled clams, both as a taxonomic group, and as individual species (e.g., *manila, littleneck, butter*) much more readily than did non-First Nations. Even more starkly, urchins emerged as the fourth most accessible species for First Nations (0.406), while they appeared only 25th on the collective non-First Nations' list (0.199). Chitons were the 14th-most accessible species for First Nations (0.229), while they only ranked 137th for non-First Nations (0.038). Tellingly, *sockeye salmon*, specifically, ranked as the sixth-most accessible species amongst First Nations (0.397), followed *coho salmon* (0.226) and *spring salmon* (0.221) in 15th and 17th place respectively. In contrast, *sockeye salmon* as a distinct species (as opposed to simply '*salmon*' as a generic mental category) ranked a mere 56th (0.103) in accessibility amongst non-First Nations. *Coho* ranked higher, at 22nd place (0.210), but *spring salmon,* too, only emerged as the 54th-most accessible species for non-First Nations, at S = 0.104. Below, we show how these findings can be leveraged for further insight by eliciting and analyzing stakeholders' beliefs regarding trophic interactions in the ecosystem.

6.6 Imagined foodwebs: representing aggregate mental models with salience analysis

As outlined in Section 6.3.2, after performing the initial salience analysis (see Section 6.5, above), we also innovated a technique whereby we ran the same analysis on the chronologically-listed trophic-pair data that was produced by participants' engagement in the 'foodweb' task. This granted us an insight into which trophic relationships between species were most cognitively accessible to which of our *a priori* demographic groups. The results revealed a number of remarkable patterns.

Beginning at a broad demographic resolution (see Tables 6.7 and 6.8), our 67 local civilian participants as a whole most readily cited the following five trophic relationships, in descending order of accessibility ('→' indicates the direction of trophic consumption): *bear→salmon; wolf→deer*; *sea otter→urchin*; *cougar→deer*; and *killer whale→salmon*. These were followed by: *killer whale→sea lion*; *sea otter→clam*; *sea lion→fish*; *eagle→salmon*; and, finally, *bear→berries.*

PREDATOR→PREY RELATIONSHIP	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Bear→Salmon	1	0.230
Wolf→Deer	2	0.219
Sea otter→Urchin	3	0.191
Cougar→Deer	4	0.185
Killer whale→Salmon	5	0.175
Killer whale→Sea lion	6	0.147
Sea otter→Clam	7	0.133
Sea lion→Fish	8	0.109
Eagle→Salmon	8	0.109
Bear→Berries	9	0.107
Killer whale→Seal	10	0.103
Sea otter→Crab	11	0.090
Bear→Fish	12	0.088
Eagle→Fish	13	0.086
Cougar→Raccoon	14	0.082

Table 6.7 Most cognitively accessible trophic relationships: civilian locals (top 15)

PREDATOR→PREY RELATIONSHIP	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Human→Chinook salmon	1	0.250
Sea otter→crab	1	0.250
Sea otter→Sea cucumber	1	0.250
Bear→Berries	1	0.250
Sea otter→Mussel	2	0.242
Bear→Leaves	2	0. 242
Human→Chum salmon	3	0.240
Sea otter→Swm. Scallop	4	0.239
Abalone→Kelp	5	0.234
Sea otter→Gnk. Barnacle	5	0.234
Human→Sockeye salmon	6	0.231
Sea otter→Butter clam	7	0.227
Red urchin→Kelp	7	0.227
Sea otter→Chiton	7	0.227
Human→Coho salmon	8	0.221

Table 6.8 Most cognitively accessible trophic relationships: government managers (top 15)

The degree of contrast between the trophic relationships most salient to the general public, versus those highlighted by our four government manager participants is particularly stark. This is likely at least partially due to substantial differences in sample size (four managers, versus 67 local civilians). That said, it is remarkable that not one single trophic relationship was mentioned in common amongst the civilian sample's collective top 10 list, and that of our government manager participants (see Tables 6.7 and 6.8). The following trophic relationships were identified by one manager each, respectively, as the most accessible interaction in the ecosystem: *human→chinook salmon*; *sea otter→crab*; *sea otter→sea cucumber*; and *bear→berries*. These were followed by: *sea otter→mussels*; *bear→leaves*; *human→chum salmon*; and *sea otter→swimming scallop*. Third-ranking trophic relationships for the four managers included: *abalone→kelp*; *sea otter→gooseneck barnacle*; *human→sockeye salmon*; and *sea otter→butter clam.*

Insofar as these results are indeed indicative of the trophic relationships most cognitively accessible, on average, to civilian locals and government managers, respectively, this suggests that there may in fact be a consequential gap in focus, and possibly understanding, between how the general public one on hand, and government officials on the other, tend to think about the local social-ecological system. Specifically, civilian locals appear, on average, to much more easily imagine the predatory habits of charismatic megafauna than they do the trophic habits that constitute kelp forest dynamics. The inverse appears true for managers. Similarly, managers appear far more sensitized to the role of humans as predators on specific species of finfish than do their civilian counterparts. Addressing these contrasts in accessibility explicitly in the context of consultative or managerial processes between government and civilian stakeholders may well improve outcomes by making it clear which gaps in understanding have to be addressed in order to construct a mutually recognizable shared mental model of the social-ecological system (Van den Bossche, et al. 2011).

Gender differences were also evident in this first round of food-web data analysis (see Tables 6.9 and 6.10). For males, the top five most accessible trophic relationships were: *killer whale*→*salmon*; *bear*→*salmon*; *wolf*→*deer*; *cougar*→*deer*; and *killer whale*→*sea lion*. In other words, the predator-prey relationships amongst the largest local megafauna were by far the most readily recalled trophic interactions amongst men. Women, on the other hand, seemed much more focused on the specific role of both sea otters and humans in the system. While women, too, readily recalled the predator-prey relationships amongst the largest regional megafauna, the first two most salient trophic relationships for women were in fact: *sea otter*→*urchin* and *sea otter*→*clam*. These relationships ranked only sixth (0.134) and 20th (0.060) in saliency on the men's list, respectively.

Furthermore, seven of the 20 most salient trophic interactions for female participants included humans: *human*→*halibut*; *human*→*salmon*; *human*→*prawn*; *human*→*clam*; *human*→*bear*; *human*→*oyster*; and *human*→*dogfish*. Remarkably, in contrast, men hardly mentioned humans at all. They first appear on males' collective list only in 41st place, and only then in a very general sense: *human*→*everything* (0.046). These data suggest quite significant differences in how men and women in the Clayoquot Sound region intuitively think about trophic relationships in the local environment—and humans' inclusion therein. This lends even more credence to the argument that gender balance may have a major effect on the focus, tenor and outcome of multistakeholder negotiation over resources in the region and is thus worthy of further consideration.

PREDATOR→PREY RELATIONSHIP	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Sea otter→Urchin	1	0.264
Sea otter→Clam	2	0.224
Wolf→Deer	3	0.198
Bear→Salmon	4	0.184
Cougar→Deer	5	0.180
Bear→Berries	6	0.163
Killer whale→Sea lion	7	0.159
Bear→Fish	7	0.159
Human→Halibut	8	0.145
Sea lion→Fish	9	0.132
Human→Salmon	10	0.128
Human→Prawn	10	0.128
Eagle→Fish	11	0.127
Human→Clam	12	0.123
Human→Bear	13	0.111
Human→Oyster	13	0.111
Whale→Sea lion	14	0.107
Human→Dogfish	15	0.104
Eagle→Salmon	16	0.103
Seal→Fish	17	0.101

Table 6.9 Most cognitively accessible trophic relationships: females (top 20)

PREDATOR→PREY RELATIONSHIP	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Killer whale→Salmon	1	0.270
Bear→Salmon	2	0.267
Wolf→Deer	3	0.236
Cougar→Deer	4	0.189
Killer whale→Sea lion	5	0.138
Sea otter→Urchin	6	0.134
Eagle→Salmon	7	0.114
Killer whale→Seal	8	0.109
Sea otter→Crab	9	0.104
Sea lion→Fish	10	0.091
Cougar→Raccoon	11	0.090
Bird→Berries	12	0.085
Whale→Plankton	13	0.079
Grey whale→Plankton	13	0.079
Wolf→Bear	14	0.078
Salmon→Herring	15	0.072
Seal→Salmon	16	0.067
Wolf→Raccoon	17	0.065
Bear→Berries	18	0.062
Sea otter→Clam	19	0.060

Table 6.10 Most cognitively accessible trophic relationships: males (top 20)

Intriguingly, First Nations status appeared to have relatively little effect on how readily participants considered humans' role as trophic actors in the system. However, consistent with their apparent accentuated awareness of sea otters, First Nations were on average indeed more likely than non-First Nations to focus on sea otters' role in the ecosystem: sea otters' eating habits accounted for seven percent of the trophic relationships cited by First Nations, but only three percent of those cited by non-First Nations. Similarly, citations of *sea otter* predation had an average salience of $S = 0.062$ amongst First Nations, but only $S = 0.035$ amongst non-First Nations. Finally, sea otters appeared as predators eight times (26%) amongst the top 30-most salient trophic relationships for First Nations, compared to only three times (10%) amongst non-First Nations' 30 most salient trophic relationships (see Tables 6.11 and 6.12). This corroborates the observation that sea otters—and their prey—appear to feature more prominently in Clayoquot Sound First Nations' cognition of the local ecosystem than they do in non-First Nations'. Given the intense debate over how or whether at all to manage sea otters in the region (Okerlund 2007, Fisheries and Oceans Canada 2004), this apparent systematic difference in accessibility and focus is, once again, likely worth making explicit in the context of multistakeholder dialogue on the issue.

PREDATOR→PREY RELATIONSHIP	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Wolf→Deer	1	0.295
Sea otter→Urchin	2	0.255
Bear→Salmon	3	0.237
Cougar→Deer	4	0.229
Sea otter→Clam	5	0.206
Killer whale→Salmon	6	0.168
Sea otter→Crab	7	0.127
Bear→Fish	7	0.120
Killer whale→Seal	8	0.116
Eagle→Salmon	9	0.115
Eagle→Fish	10	0.101
Sea otter→Gnk. Barnacle	11	0.092
Salmon→Herring	12	0.080
Bear→Clam	13	0.078
Bear→Berries	14	0.075
Killer whale→Porpoise	14	0.075
Eagle→Sockeye salmon	15	0.073
Bear→Blackberry	16	0.070
Wolf→Dog	17	0.068
Human→Halibut	18	0.067
Bear→Sockeye salmon	19	0.065
Sea otter→Oyster	20	0.064
Human→Deer	21	0.063
Killer whale→Sea lion	22	0.062
Sea otter→Mussel	23	0.060
Sea otter→Abalone	24	0.059
Seal→Clam	25	0.055
Sea otter→Chiton	26	0.054
Cougar→Dog	27	0.053
Bear→Crab	27	0.053

Table 6.11 Most cognitively accessible trophic relationships: First Nations (top 30)

PREDATOR→PREY RELATIONSHIP	RANK BY *S*	SMITH'S SALIENCE INDEX (*S*)
Bear→Salmon	1	0.227
Killer whale→Sea lion	2	0.196
Killer whale→Salmon	3	0.179
Cougar→Deer	4	0.160
Sea otter→Urchin	5	0.155
Wolf→Deer	6	0.151
Sea lion→Fish	7	0.148
Cougar→Raccoon	8	0.128
Bear→Berries	9	0.125
Eagle→Salmon	10	0.106
Killer whale→Seal	11	0.095
Killer whale→Fish	12	0.092
Sea otter→Clam	13	0.091
Killer whale→Sea otter	14	0.082
Humpback whale→Herring	14	0.082
Starfish→Oyster	14	0.082
Whale→Plankton	15	0.080
Human→Halibut	17	0.078
Eagle→Fish	18	0.077
Human→Bear	18	0.077
Bear→Mussel	19	0.074
Whale→Sea lion	19	0.074
Bird→Berries	19	0.074
Human→Prawn	20	0.073
Human→Dogfish	21	0.072
Human→Shrimp	22	0.070
Bear→Fish	23	0.069
Bear→Oyster	23	0.069
Sea otter→Crab	23	0.069
Bear→Bird	24	0.068

Table 6.12 Most cognitively accessible trophic relationships: non-First Nations (top 30)

6.7 Imagined foodwebs: combining salience with network analysis

By conducing network analysis on the saliency-indexed trophic-pair data reported above, we were then able to generate a range of further insights into the similarities and differences amongst various groups' aggregate mental models of the regional marine foodweb. Because quantitative network data is also uniquely amenable to being represented spatially, this particular approach had the added benefit of enabling us generate inferentially meaningful, tangible visualizations of groups' aggregate mental models of the foodweb. We consider this a key contribution of the nascent method we present in this paper. In Section 6.7.1, below, we outline some of the most basic measures that network analysis allows us to calculate that are relevant to mental models of foodwebs. For clarity, we describe how these features are represented in our chosen visualization scheme. We then follow in Sections 6.7.2 to 6.7.4 with a presentation of the results of the network analyses themselves.

6.7.1 Network analysis of imagined foodweb data: measuring and visualizing centralities

For the purpose of most analyses, visualized network data consist of two components: nodes and edges. Nodes quite simply constitute 'things' that are somehow able to be connected one to the other. In the case our Clayoquot Sound foodweb data, these nodes are the plants and animals that participants mentioned during their trophic connection task (see Section 6.3.1). Edges are the connections between pairs of nodes. Edges can vary in a number of ways, including by their relative strength (in our case, their 'weighting,' as determined by salience index), and their directionality (or the lack thereof).

There is a plethora of ways to measure the importance of nodes to a network (which in our study equates to the importance of species to the wider foodweb). This suite of metrics are referred to in the network analysis literature as 'centrality measures'. Given that our present study comprises merely a first iteration of a new technique, for simplicity's sake, we have chosen to highlight only three of the most basic and seemingly relevant centrality measures in our visualizations: 'in-degree' centrality, 'out-degree' centrality and so-called 'betweenness' centrality. These are represented in our visualizations as follows.

6.7.1.1 Out-degree centrality: bigger text depicts a more voracious predator

We chose the *size of each species' name* to correspond to that species' relative *out-degree centrality*. In this case, out-degree centrality equates specifically to the number of other individually named plants or animals that participants believe a given species preys upon. Thus, the more individual prey a given species is believed to have, the larger its name appears in the network, and vice versa.

6.7.1.2 In-degree centrality: bigger circles depict more widely targeted prey

The *size of a species' circle*, inversely, was selected to represent that species' relative *in-degree centrality*. In our study, this equates specifically to the number of individually named predators that participants believe prey on the given species. Thus, the greater the number of specific predators a species is believed to have, the bigger its corresponding circle appears in the network.

6.7.1.3 Betweenness centrality: darker circles depict more crucial connectors

We chose the *darkness* of a given circle to correspond to that species' perceived *betweenness centrality* in the foodweb. Somewhat more involved than the two measures of centrality mentioned above, *betweenness centrality* is one of the most basic measures of how pivotal a node is as a connector amongst other nodes in a network.[70] Specifically, analyzing for this measure of centrality identifies which nodes in a network are most frequently located along the most direct path between all other pairs of nodes in the network. In the case of our foodweb data, this equates to how *directly* a given species functions as a connector in the energy transfer amongst all other species in the foodweb.

6.7.1.4 Edge weight: bigger arrows depict greater cognitive accessibility

Finally, because our networks represent not an actual foodweb, but rather participants' aggregate *cognitive representation* of that foodweb, we also included in our visualizations the relative *cognitive accessibility* of each trophic interaction. This greatly increases the inferential relevance of each visualized aggregate mental model, as it enables the viewer to immediately grasp which relationships between which species feature most prominently in peoples' minds. This in turn allows the viewer to infer which relationships amongst which species are likely to most actively structure people's thinking about the ecosystem. We chose to depict this relative

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[70] Our chosen software package, Gephi (Gephi 2014), calculates this measure based on an algorithm refined by Brandes (2001). For other sources on measuring node centralities, see, e.g., Opsahl, Agneessens and Skvoretz 2010; Borgatti, Carley and Krackhardt 2006.

cognitive accessibility of trophic relations using the size of the arrows that connect species in the network one to another. In other words, while the direction of each arrow represents the direction of predation, the *size* of each arrow represents the cognitive ‘weight’ of that trophic connection for participants, as calculated by salience index (see Section 6.6). Thus, the more cognitively salient a given trophic connection is amongst a group of participants, the larger the arrow connecting the two relevant species.

For simplicity’s sake, and for the ease of comparing participant groups of different sizes, we limited the number of trophic connections included in each visualization to 50. The metric we used as a threshold was once again the salience ranking we had calculated earlier using ANTHROPAC (see Section 6.6). Thus, only the 50 most salient trophic connections amongst species were included in this analysis for each of the demographic subgroups we studied. An added advantage of this innovation is it allows us to offset power dynamics by representing the aggregate mental models data of different sized, differentially powerful, groups as nonetheless entirely commensurate with one another. In broader terms, this approach has the potential to afford important but underrepresented groups an equal amount of consideration relative to more dominant actors in terms of understanding how each makes sense of their shared social-ecological system.

6.7.2 Government managers versus local civilians

Turning now to the network visualizations, one can see from Figure 6.5 that, for local civilians, the most central[71] *predators*, ranked in descending order by out-degree centrality (noted numerically in parentheses) include: *human* (10); *bear* (8); *killer whale* (6); *sea otter* (6); and *wolf* (4). For government managers, on the other hand (Figure 6.3), the most central predator is, by far, *sea otter* (10), suggesting a different locus of ecological attention amongst managers relative to the wider local population.

In the managers' network, *sea otter* is subsequently followed by the familiar *human* (7) and *bear* (7), suggesting at least some similarity amongst locals' and managers' respective aggregate mental models of the foodweb. However, in the managers' model, *human* and *bear* species are ultimately followed by *shark* (4), *sunflower starfish* (4), and *octopus* (4), none of which appear anywhere amongst the top 50 most salient trophic relationships for local civilians. This suggests that, while there appear to be a small number of points of overlap between the two groups' networks, the predators that government managers are most cognizant of do appear to in fact differ quite starkly from those that occur most readily to local civilians. To the degree this signals significant differences in how managers on one hand, and locals resident on the other, tend on average to imagine the salient dynamics of the same local ecosystem, this is a point that may well be worth considering openly in the course of any public government consultation over the management of marine resources in the region.

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[71] Central, here, meaning most diverse in their feeding habits, as described in Section 6.7.1.1.

Even more explicit are the differences amongst the central prey species in locals' versus government managers' aggregate models. For local citizens, the generic category *salmon* (6), and the even more vague, but quite commonly cited, category of *fish* (6), both share the position of being the most cognitively salient prey 'species' (in fact, species groups) to feature in locals' mental representations of the foodweb. These are followed in descending order of centrality by *oyster* (4), *deer* (3) and *plankton* (3).

Government managers, in contrast, display at least two key differences from the local civilian population with respect to their conceptions of prey (see Figure 6.6). One of these differences is, somewhat unsurprisingly, that managers appear to think at a higher phylogenic resolution than do locals. Note, for instance, the diversity of individual salmon species that emerge as salient in the managers' aggregate model, relative to local civilians'. The second difference is that the most central prey species for managers is *kelp* (6), followed by *urchin* (3) and the category *forage fish* (3). This alerts us to the fact that government managers appear acutely cognizant of a distinct ecological subsystem that is entirely absent from locals' aggregate model: kelp beds.

Thus, by comparing the central prey species in managers' versus local civilians' respective aggregate models, it quickly becomes clear that the two are characterized by a focus on largely different ecological subsystems and relationships. Namely, local civilians' aggregate mental model pivots largely around the consumption of fish species (particularly salmon) by a range of relatively easily observed, often charismatic megafauna. This model also demonstrates an awareness of the dynamics amongst terrestrial charismatic megafauna (wolves, cougars, deer, bears, and raccoons), as well as humans' and sea otters' role as fairly prolific predators in their own right. Locals also appear to make a somewhat inconsistent distinction between toothed and baleen whales, although the former feature much more prominently than the latter in their aggregate mental model of the system.

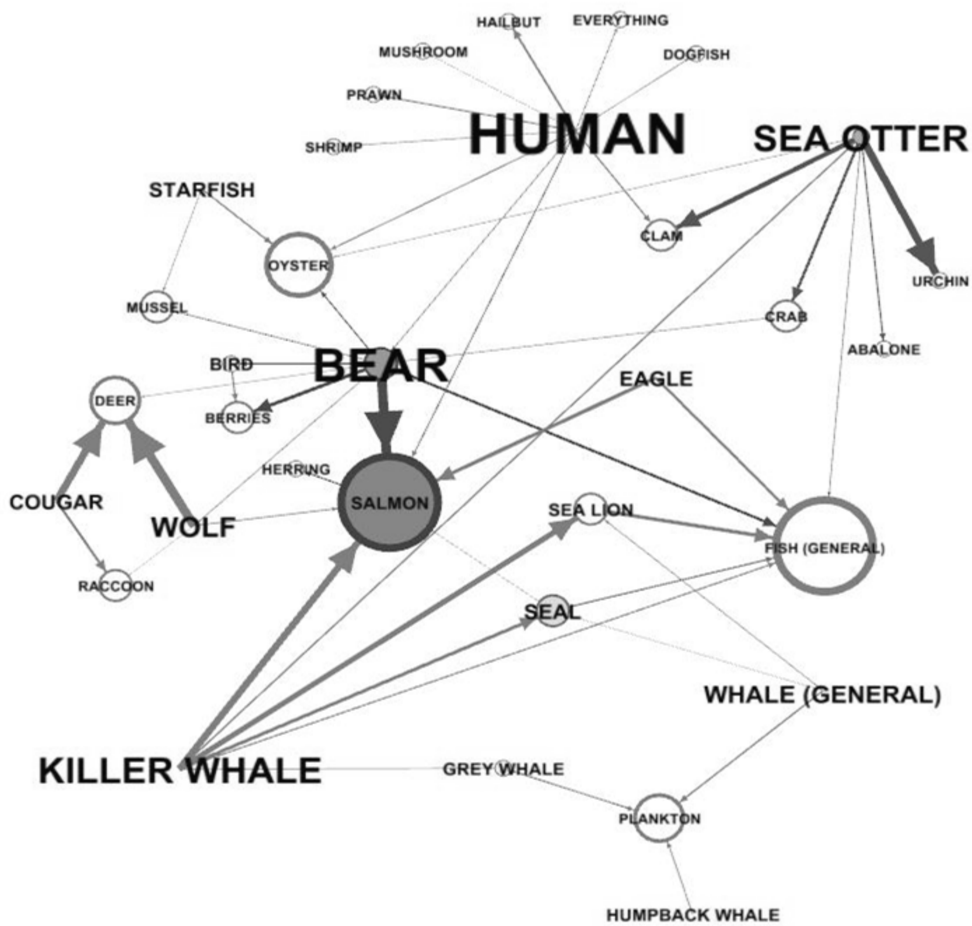

Figure 6.5 Aggregate mental model of the regional foodweb: local civilians

As described in Section 6.7.1, the size of a species' name in a given group's aggregate mental model corresponds to that species' out-degree centrality, the size of a species' circle *corresponds to its in-degree centrality, and the darkness of a species' circle corresponds to its betweenness centrality. Finally, the width of an arrow corresponds to that given trophic relationship's average cognitive accessibility. From this visualization, it thus appears that local civilians' average conception of the Clayoquot Sound foodweb revolves largely around the feeding habits of large charismatic megafauna (bears, killer whales, wolves, and cougars), as well as that of sea otters. Local civilians appear aware of humans' role as a prolific predator in the system, but this role is far less salient, or immediately apparent, to them than the behaviour of other predatory mammals. Salmon, as a taxonomic class, appears to occupy a uniquely central role in local civilians' conceptions of the social-ecological system, both as a crucial 'species' for energy transfer throughout the foodweb, as well as a 'species' that is fed on (along with 'fish' in general) by the widest diversity of predators.*

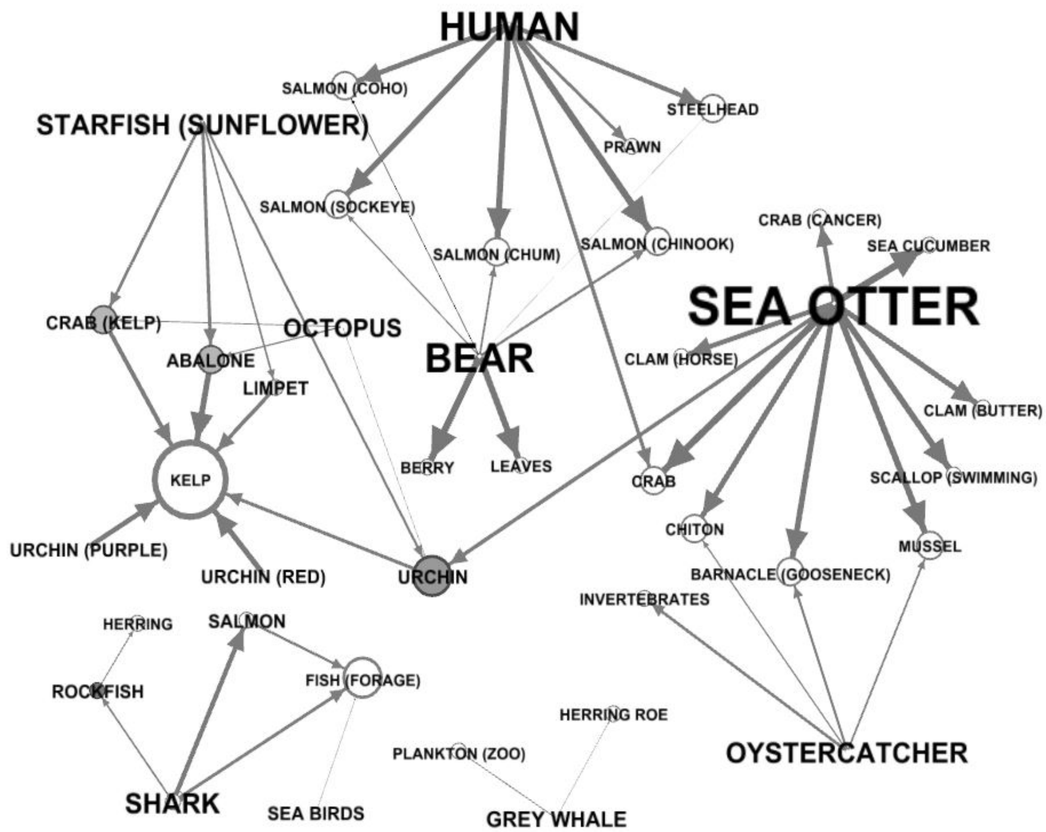

Figure 6.6 Aggregate mental model of the regional foodweb: government managers

The feeding habits of sea otters, humans and bears appear especially salient for government managers. Managers also appear to think of fish species and those species' respective trophic relationships at a much higher phylogenetic resolution than do civilians. Furthermore, unlike local civilians, above, managers appear particularly cognizant of the trophic relationships that constitute the kelp-and-urchin centered subsystem that is directly impacted by the trophic cascade of sea otter predation. Finally, the charismatic killer whale appears conspicuously absent from managers' cognitive representations of the marine ecosystem, while two other, less iconic predators—sharks and sunflower starfish—both serve important structural roles in managers' aggregate model.

Managers' aggregate mental model, conversely, appears to be characterized by an awareness of several distinct ecological subsystems, none of which surfaces with the same degree of detail amongst locals' aggregate model. The *human*→*salmonid*←*bear* subsystem, the *sea otter*→*invertebrate* subsystem and vague awareness of the *baleen whale*→*microscopic prey* subsystem do feature in both managers' and locals' models. However, the former's model also includes a *kelp*-centered subsystem, a *shark*-centered subsystem, and a keen awareness of the role of two relatively unassuming predators that receive little to no attention in the locals' model: *sunflower starfish* and a shorebird known as an *oystercatcher*. The single species that links any of these subsystems together in the managers' model is the *urchin*, which receives the highest *betweenness centrality* score (1.583) of any species in the model. Given this model's nature as an aggregate representation of the beliefs of four discrete participants, this suggests that managers reason about the ecosystem using quite specialized and intricate, but also somewhat myopic, mental models of one or more particular subsets of the system. Because these subsystems hinge on the trophic behaviours of many species that are not easily observed by humans (e.g., those of the sunflower starfish, of sharks, or of urchins), the importance of such systems may not be readily obvious at all to non-managers.

In contrast, local civilians' aggregate model appears to revolve around the centrality of bears (which have a *betweenness centrality* score of 12), salmon (7) and sea otters (5), with considerable attention also paid to killer whales. This suggests an awareness of the local ecosystem predicated on trophic relationships that are most immediately apparent to the unaided human senses (i.e., without diving equipment, microscopes or theoretical training in ecology). The higher degree of interconnectedness within local civilians' aggregate mental model suggests civilians may in fact tend to be less myopic in focus than their more specialized managerial counterparts. However, at the same time, locals seem to be far less aware of potentially important trophic relationships that occur largely out of human sight.

This difference in cognitive 'accessibility' of different features of the same shared ecosystem seems to us at least partly an artifact of the kinds of interactions and observational experiences that local civilians, as opposed to managers, tend to have with their environment and vice versa. In the context of the often fraught relationships between government resource managers and local residents in the Clayoquot Sound region, this difference in cognitive focus is a key point worthy of explicit consideration in resource management or consultation contexts (L. A. Liu 2004, Veltfort and Lee 1943).

6.7.3 Males versus females

Comparing the aggregate mental models of men versus women, respectively, also yields important insights. Note that the most central predators in male participants' aggregate model (Figure 6.7) are, in descending order: *bear* (7); *killer whale* (7); and *sea otter* (6); followed by the relatively generic category *salmon* (3); as well as *cougar* (3); *wolf* (3); and *halibut* (3). For women, however, the most centrally prolific predator to emerge by far is *human* (12). While men did note, with a relatively low degree of saliency, that humans tend to eat 'everything,' it is the women's attention to the variety and specificity of human-ecosystem trophic relations that dominates the latter group's aggregate mental model. For women, the central predator, *human*, is then followed by several key predators also highlighted in the men's model: *bear* (7); *sea otter* (6); and *killer whale* (5), with the addition of a relatively generic category *whale* (5), which, inferring from its trophic relationships, appears to be virtually a direct stand in amongst some respondents for what others identify specifically as *killer whale*. While women did identify *salmon* as the most central prey species in the ecosystem (with an in-degree centrality score of 6), unlike men, they did not identify salmon, nor halibut, nor any other fish species, as important predators (see Figure 6.8).

Other prey species that emerge as central in women's aggregate model include *oyster* (4), and the general category of *fish* (4). Men's imaginings of the ecosystem appear to differ from this somewhat. Apart from *salmon* (5), the most highly salient prey in the men's aggregate model are, in contrast, *herring* (4) and *clam* (4), followed by *deer* (3), *crab* (3), and ultimately—as with women—the general category *fish* (3).

While our data suggest there are certainly important similarities amongst men and women's mental models of the Clayoquot ecosystem, key differences in salience and content mean that for men, salmon emerge as far more central (with a *betweenness centrality* score of 22.5), while for women, it is sea otters (11), that take the relative, albeit considerably dimmer, spotlight. While both genders appear cognizant of the same general array of key relationships (e.g., *bear*→*salmon*, *sea otter*→*invertebrates*, *human*→*many species*, *wolf* and *cougar*→*deer*, etc.), there do appear to be important differences in the relative focus and resolution of men's ecological reasoning, versus women's. While men appear on average to be especially focused upon salmon predation, and uniquely aware of a relative diversity of fish species and said species' respective predators and prey, women seem relatively keenly aware of the central role of humans' prolific predation to the system, as well as sea otters' unique penchant for clams and, especially, urchins. Once again, these differences seem to reflect a relatively gendered division of labour in the region. Similarly, the tangible evidence of the cognitive implications of these differences, presented here, once again suggest the importance of acknowledging potential biases that could develop should either gender come to dominate consultative processes on marine resource management in the region.

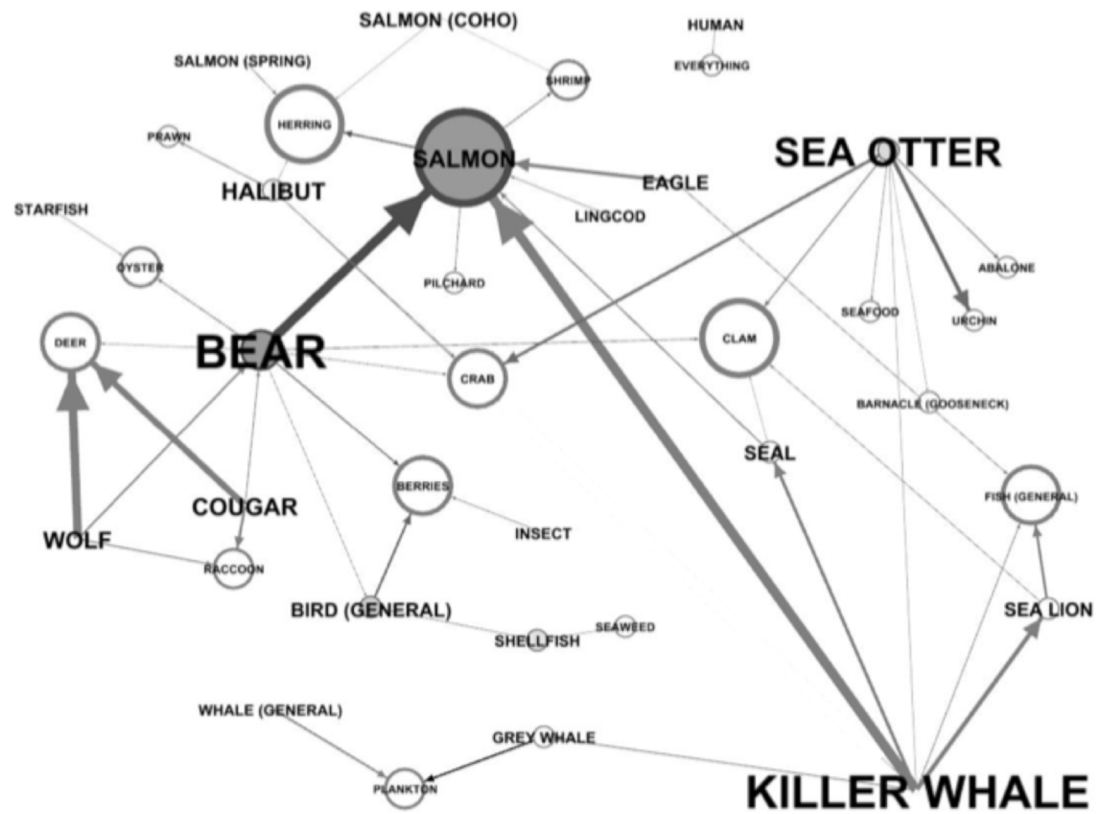

Figure 6.7 Aggregate mental model of the regional foodweb: males

The feeding habits of large charismatic megafauna (bears, killer whales, cougars and wolves) tend to dominate males' aggregate mental model in terms of cognitive accessibility. The prolific feeding habits of sea otters are also recognized but remain relatively less salient (with the slight exception of their consumption of urchins, and to a lesser extent crab). Salmon play the most central role in males' imagined trophic web: they are both the most important single prey species, as well as being most crucial to the transfer of energy throughout the foodweb. For men, other prey with particular importance to the wider foodweb include herring, and clams. Humans are recognized as prolific predators, but with very low salience.

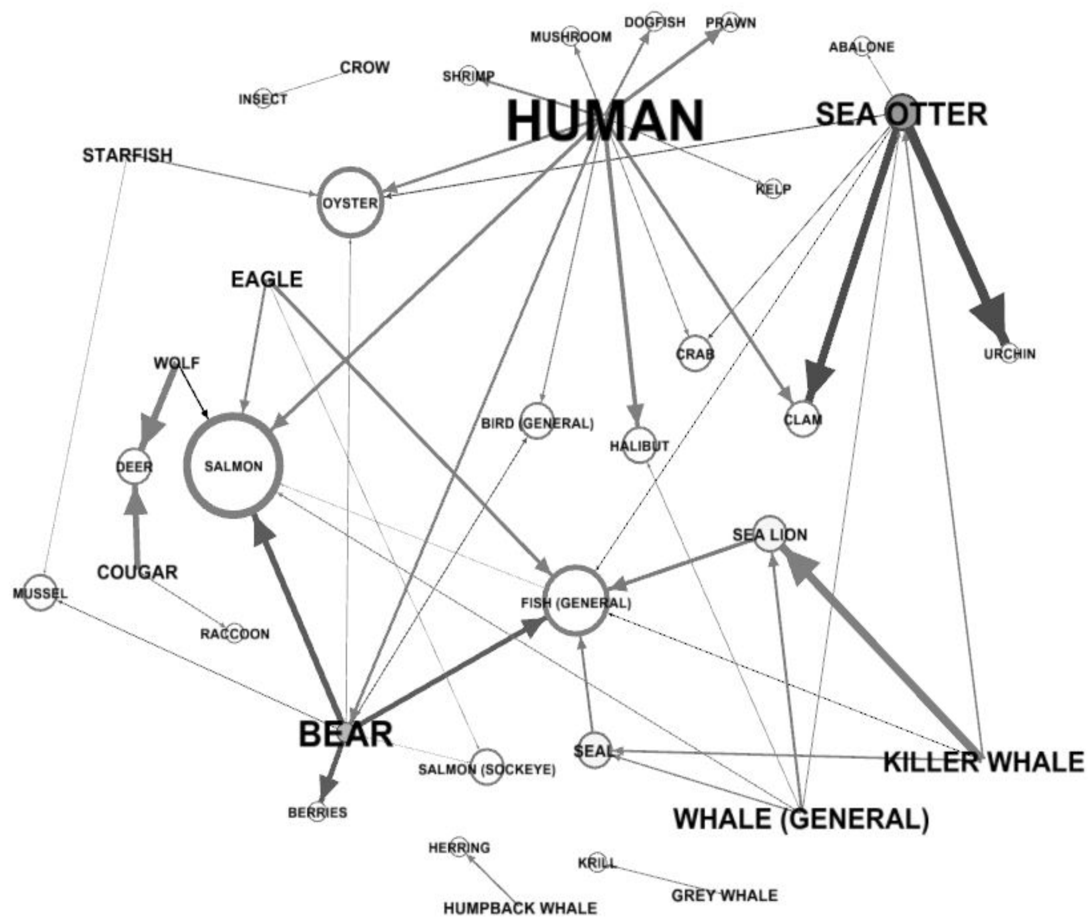

Figure 6.8 Aggregate mental model of the regional foodweb: females

Women's aggregate mental model is cognitively dominated by the feeding habits of sea otters. On average, women appear especially cognizant of otters' penchant for urchins and clams. Similarly salient for women are the feeding habits of large charismatic megafauna (bears, killer whales, cougars and wolves). The feeding habits of humans appear to be less cognitively accessible to women than those of other mammals. Nonetheless, the prolific nature of human predation plays a uniquely central structural role in women's aggregate mental model. In other words, while humans' eating habits are not necessarily immediately apparent to women in the context of imagining the local foodweb, once humans' role is indeed considered, it becomes *highly central to women's mental representation of the system. Central prey species in women's mental representations of the foodweb include salmon, oysters, and fish (the latter as a broad, but commonly cited, taxonomic category). Women also appear aware of several other parallel features of the foodweb, such as the importance of herring and krill to baleen whales. These subsystems nonetheless remain conceptually detached from the web as a whole.*

6.7.4 First Nations versus non-First Nations

Finally, a comparison of First Nations and non-First Nations participants' respective aggregate mental models reveals even starker contrasts. In First Nations' aggregate mental model of the foodweb (Figure 6.9), *sea otter* is by far the most central, prolific predator, represented as preying on eight different species of invertebrate, as well as on the general categories of *shellfish* and *everything*, for a total out-degree centrality score of 10. Otters' perceived tendency to predate on clams, and urchins, in particular, is especially salient for First Nations. In non-First Nations' aggregate model, however (Figure 6.10), humans are by far the more prolific (although not particularly salient) predator, boasting an out-degree centrality score of 12. *Sea otter*, in contrast, receives a relatively low out-degree centrality score of five amongst non-First Nations, while otters' trophic connections also appear considerably less salient for non-First Nations than they do for First Nations.

Bear and *killer whale* appear as relatively central predators in both demographic groups' models, as does the general category *salmon* emerge as a shared central prey 'species.' However, on average, First Nations appear to find *sockeye salmon,* in particular, quite central

(3), while non-First Nations appear less likely to think of salmonids at that high a resolution. For First Nations, *clam*, as a broad taxonomic group, is in fact the most central prey, with an in-degree centrality score of five. Non-First Nations, in contrast, find the general category *fish* (6), as well as *oyster* (3) and *plankton* (3), to be more central as prey species than they do *clam* (2).

Interestingly, while sea otters are clearly the most central predator in First Nations' aggregate model, because they are apparently not readily thought of by First Nations as prey, it is instead *salmon*, *seal,* and *sockeye salmon* which feature as the most salient 'connector' species for the foodweb as a whole, with *betweenness centrality* scores of 9.5, 5.5 and four, respectively. In non-First Nations' model, inversely, *sea otter* has a relatively high *betweenness centrality* (4), topped only by *bear* (8.5). Meanwhile *salmon*, while important, does not emerge as a particularly central connecting species in non-First Nations' model, partially because it is not readily regarded by non-First Nations as a predator. This latter point suggests that, on average, First Nations have much clearer, more salient beliefs about what salmon feed on than do non-First Nations.

In sum, while First Nations' and non-First Nations' models do have important areas of overlap (including the relative importance of humans, bears, sea otters, salmon and killer whales), non-First Nations appear to think of humans—once they do think of them—as the central source of predation in the system, while for First Nations it is sea otters that loom cognitively as the most significant marine predator. And while both groups appear to think readily about salmon as a key prey species, and killer whales as an important predator, First

Nations appear to think of the trophic interactions of both animals at a significantly higher phylogenetic resolution than do non-First Nations.

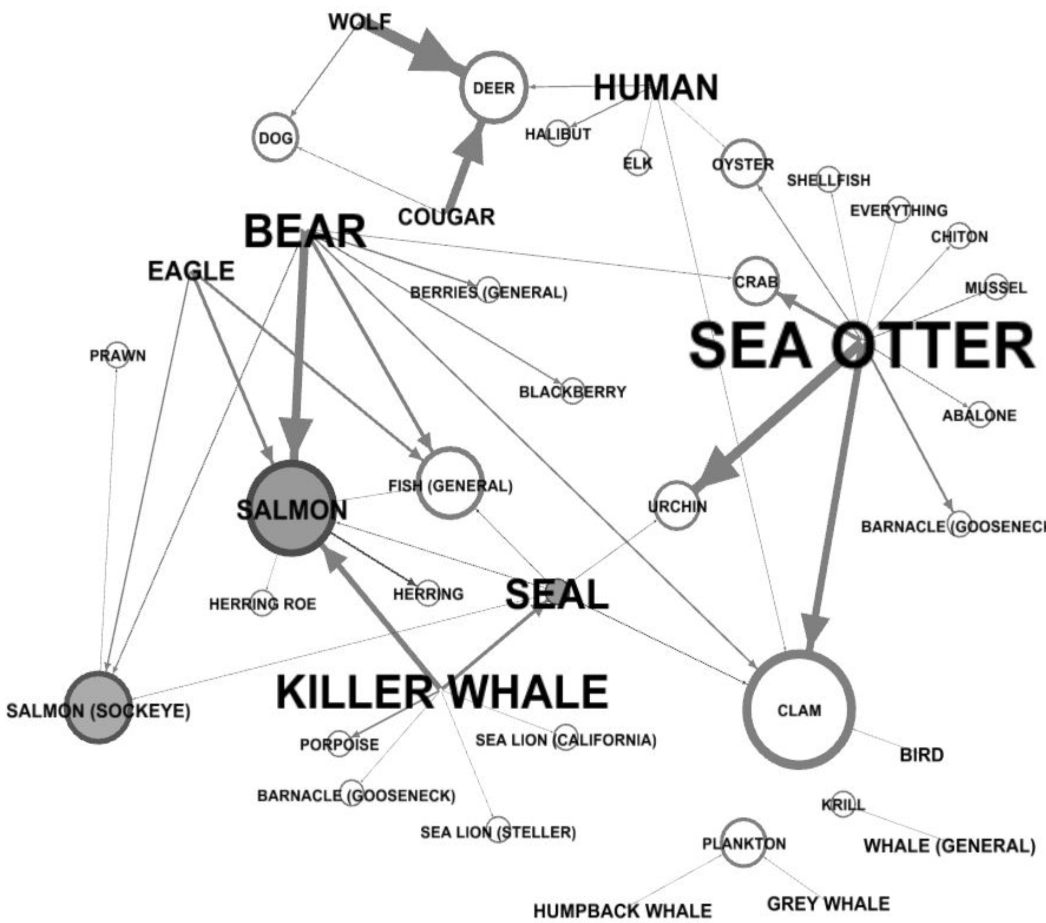

Figure 6.9 Aggregate mental model of the regional foodweb: First Nations

First Nations' aggregate model is cognitively dominated in terms of salience by the feeding habits of charismatic terrestrial predators (wolves, bears, cougars) as well as that of sea otters and, to a lesser extent, killer whales. Sea otters, in particular, emerge as especially central predators in First Nations' model, given the vast array of individual prey species otters are collectively believed to eat. Bears and killer whales are also regarded as relatively prolific *predators, but it is their penchant for salmon that emerges as an especially important feature of First Nations' model. Salmon, in turn, are regarded by First Nations both as a central prey species, but also as marine predators in and of themselves. As such, for First Nations, salmon constitute the most central species in the foodweb with regards to facilitating energy transfer throughout the ecosystem. Seals occupy a similar, but slightly less central, role in First Nations' collective model. Humans are acknowledged as somewhat prolific predators, but with a low degree of salience. Baleen whales are noted for their predation on plankton and krill, but these relationships remain conceptually detached from the wider foodweb. Amongst First Nations, it appears that after salmon it is clams, specifically, that are regarded as the most widely targeted prey species in the ecosystem.*

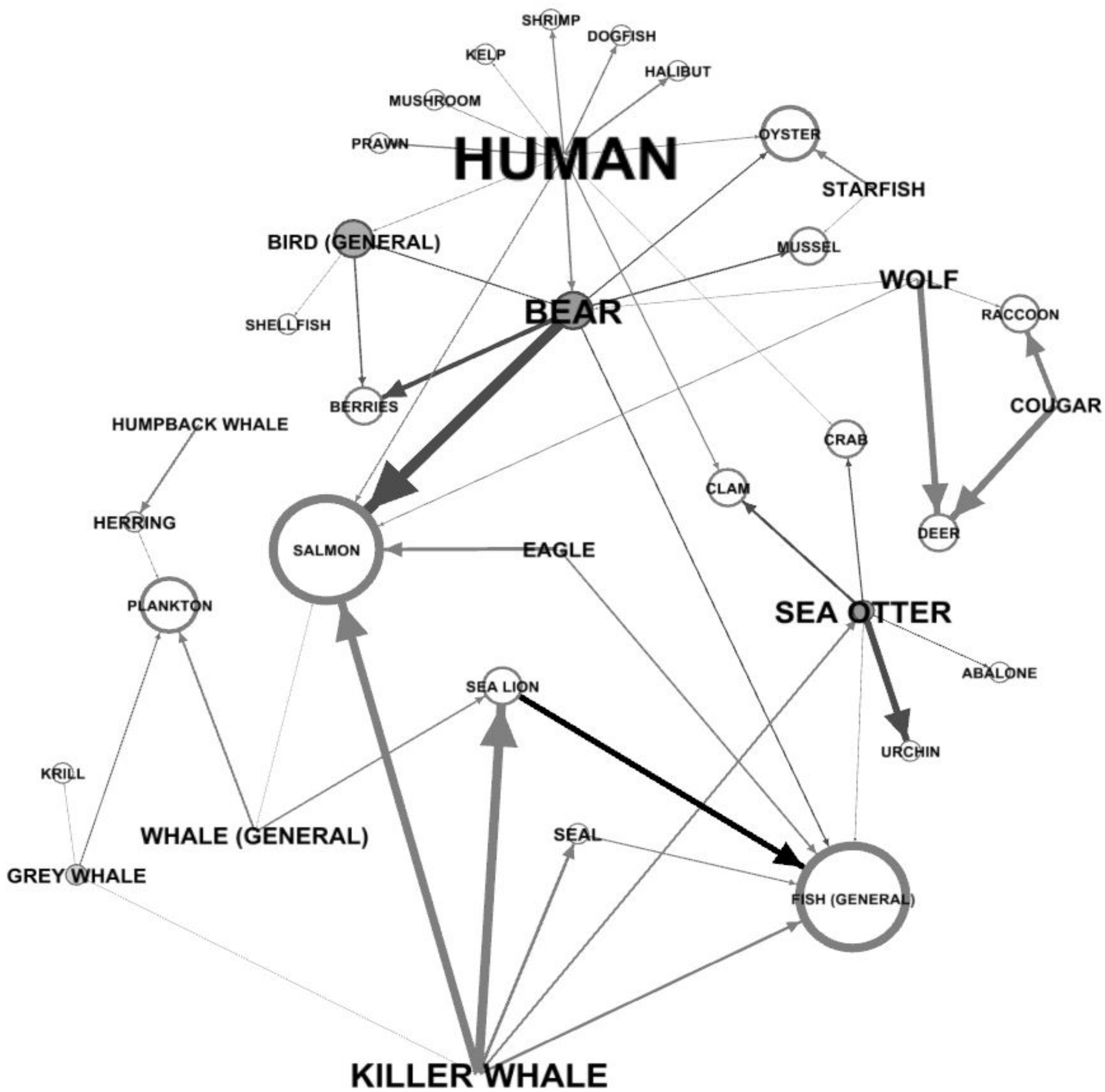

Figure 6.10 Aggregate mental model of the regional foodweb: non-First Nations

For non-First Nations, the most salient aspects of the foodweb appear to be the predation habits of bears, killer whales, wolves, and cougars, as well as those of sea otters and sea lions. Humans feature as uniquely prolific predators, but not as particularly salient ones. Salmon—and fish in general—are regarded by non-First Nations as the most widely targeted, and hence central, prey species. However, non-First Nations seem relatively agnostic with respect to what *those species in turn themselves eat. As such it is in fact bears, and birds, which emerge as the most central species to the foodweb in terms of energy transfer throughout the ecosystem. This is largely due to the fact that both are regarded as human prey, not true apex predators. Finally, non-First Nations appear somewhat uniquely cognizant of the feeding habits of baleen whales, with clear beliefs about how that whale-driven subsystem connects to rest of the foodweb through herring and killer whale predation.*

Together, these differences hint at a number of possibilities. One, First Nations' comparative discounting of humans as predators, but relative stress on sea otters as predators, suggests there may be a subtle epistemic difference in terms of how First Nations and non-First Nations each tend, on average, to frame nature and humans' relation to it. Such effects have been reported in other cognitive anthropological studies comparing the epistemic stance of indigenous and settler colonial peoples toward the environment or 'nature' (Ross, Medin and Cox 2007).

In the case of the Nuu-Chah-Nulth First Nations, a group whose cultural roots have been firmly planted in the local ecology of the Clayoquot region for millennia, they may be relatively more liable to see humans as one actor amongst many in the ecosystem, while non-First Nations may have a greater tendency to think of humans as either protectors, or consumptive defilers, of an otherwise more pristine and separate 'nature' (Ross, Medin and Cox 2007, Atran and Medin 2010). Under this rubric, sea otters would be more readily interpreted as a 'natural' presence by non-First Nations, who easily think of them in terms of their role in the ecosystem as both predator *and prey*. First Nations, on the other hand, may view the otter itself as a consumptive defiler, or intruder upon a mutual relationship amongst humans and the local ecosystem that had been functional for a long period of time prior to the otters' confounding, government-assisted resurgence.

A second possibility is that differences between First Nations and non-First Nations participants' models of the local ecosystem may well constitute reflections of different "habits of mind" (Atran 1998, Medin and Atran 2004) acquired by virtue of differences in the two groups' economic and subsistence activities in the area. For instance, while our interview data suggest that non-First Nations spend time outdoors in a largely touristic, industrial or recreational capacities, First Nations reported spending relatively more time devoted to subsistence food collection, which they are uniquely permitted to do by law.

This difference in habitual interaction with the ecosystem would help account both for the relatively higher phylogenetic resolution at which First Nations appear to think about key marine food species (e.g., sockeye salmon, nearshore edible invertebrates), as well a higher degree of concern and awareness of the various trophic interactions that support, or threaten, the particular food species themselves. Non-First Nations, conversely, would be more liable to focus on the trophic relationships most readily apparent to the eye, and to the imagination, of a visitor: e.g., the feeding habits of charismatic species such as killer whales, bears and wolves, without much need for attention to high resolution phylogenetic distinctions.

There is also a third alternative. Namely, neither of these two accounts is mutually exclusive. They may well reinforce one another to create the sorts of observable differences amongst First Nations' and non-First Nations' aggregate mental models that emerged from our analysis.

Irrespective of which explanation is most accurate, the results of this first iteration of our synthesized technique do indeed suggest meaningful differences exist. As such, in light of the relevant evidence from studies on the importance of shared mental models in negotiation processes (L. A. Liu 2004, Van den Bossche, et al. 2011), we argue these differences should not be swept under the figurative rug in the interest of finding common ground. Rather, marine resource management negotiations amongst First Nations and non-First Nations actors could well stand to gain from actively acknowledging and discussing precisely where people's unspoken mental models are likely to converge and diverge, and hence how such gaps may be addressed through information sharing or dialogue. We reflect on this further in the summary discussion, below.

6.8 Summary discussion

Mental models have begun to receive a growing amount of attention in the field of resource management (Lynam and Brown 2011, Lynam, et al. 2012, Jones, et al. 2011). However, their importance has yet to be fully integrated into the practice of multistakeholder management, perhaps owing to the relative incompatibility of a mental models approach with a default rational-actor approach to understanding the role of human cognition in decision-making. This lack of full integration is relevant, because empirical research (L. A. Liu 2004, Van den Bossche, et al. 2011, Brodt and Dietz 1999) suggests that it is actually the act of moving towards a convergent mental model itself that is most important in fostering good outcomes. This lies in contrast to the arguably more intuitive belief that success is ultimately borne from focusing directly on the details of resource allocation (L. A. Liu 2004).

A necessary first step towards usefully applying the insights of mental models research to the multistakeholder management of social-ecological systems is thus the development of tools that can be used to reliably elicit and represent groups' mental models in ways that are simultaneously meaningful, and accessible. A key challenge in doing so is to avoid devolving into excessively broad generalizations, or perceptions of stereotyping. Our experimentation with the methods outlined in this paper constitute one first attempt at doing so using two simple, accessible techniques that, to our knowledge, have not yet been combined in a resource management context.

To briefly review, we used a straightforward salience analysis (Borgatti 1996) of freelisting data to measure the cognitive accessibility of relevant species to participants. We then used a simple paper-and-popsicle-stick technique to generate a representation of participants' beliefs about the local foodweb. We ran another round of salience analysis on this latter data set. Then, we ultimately ran a basic network analysis on outputs of that second salience analysis, using the salience indices associated with each trophic pair as a network weights.

For clarity and simplicity's sake, in this paper, we reported only the very simplest measures of centrality that were relevant to the kind of weighted, directional data we were parsing: in-degree centrality, out-degree centrality and *betweenness centrality*. However, due to the burgeoning nature of the field, there are in fact many more centrality measures that could easily be determined from this sort of data, each of which would illuminate a slightly different aspect of the participants' mental models of ecosystem dynamics.

In addition, we limited ourselves to exploring similarities and differences amongst only six overlapping predetermined demographic subgroups: government managers versus the local civilian population, males versus females, and First Nations versus non-First Nations. Crucial for future iterations will be employing techniques whereby the aggregate freelist data can itself be parsed to test for factors that account for the greatest variation in participants' listing and ordering of species and trophic relationships.

Moreover, for each demographic subgroup that we did select *a priori*, we opted to include only 50 trophic linkages per network analysis. On a purely visual level, we found this to be an optimum number of data points to include, in order to reflect the richness of participants' responses, without creating figures that were unhelpfully cluttered. That said, this was an arbitrary cut-off point. Additional analyses could be done on more, or less, data, including or excluding salience weights. Doing so could well shift the results in interesting ways (imaginably, a higher cut-off point would exhibit more convergence, while a lower cut-off point would emphasize key differences in salience, although not necessarily differences in centrality). The usefulness of the inferences one could draw would hinge on remembering precisely what it is that is being represented both by *S*, and by the various measures of centrality that one can choose to calculate.

Specifically regarding Clayoquot Sound—our case study site of choice for this paper—one particularly important insight was that, amongst local civilians as a whole, relatively high *S* scores amongst a sample of over 60 diverse participants suggest there is a demonstrable level of agreement about the particular ecological subsystems, and key trophic relationships, that characterize the region. Local residents from all walks of life do appear to think most readily about the same key ecosystem components, such as salmon, bears, whales, cougars, wolves, sea otters, and each of those species' respective trophic relationships. Taken on its own, this sizable overlap appears to be 'good news' for multistakeholder management efforts.

That said, there were also important differences that emerged from our analysis which, because of their relatively subtle nature, may have otherwise remained doggedly implicit rather than explicit, and hence risked frustrating efforts at mutual understanding and agreement in a relatively clandestine fashion. Namely, the differences that did emerge appear to be artifacts of the divergent cognitive accessibility of certain species to different demographic groups, *not* drastically different beliefs about 'what eats what.'

To briefly recap, our results suggest that male Clayoquot Sound residents seem particularly focused on marine trophic webs involving finfish, while they appear relatively unfocused of the role of humans and sea otters in the system. For women, precisely the inverse appears to be the case. Similarly, First Nations seem especially cognizant of particular individual species of fish, such as *sockeye salmon* and *halibut*, as well as a uniquely varied range of edible invertebrates, and the immediate predators and prey of each of those species. Humans, however, occupy a relatively deemphasized place as predators in First Nations' model.

Moreover, what all four of these subgroups appear to have in common with each other, but not with government managers, is a conspicuous unawareness of the role of *kelp* in the system. For managers, inversely, *kelp* has particularly high centrality. In the context of any consultative process involving diverse and representative local stakeholders, we thus predict that it is precisely the differences in relative awareness described here that will emerge as key drivers of disagreement or misunderstanding.

As such, because Clayoquot stakeholders appear not to hold glaringly contradictory beliefs one from the other, the danger is that the more subtle effects of this differential awareness of various ecosystem components and dynamics may go under-recognized. In other words, because stakeholders' beliefs may appear similar to one another 'on the surface,' this risks leaving actual, deeper, structural differences ignored. This is relevant because psychology suggests that how, exactly, we perceive and reason about a given scenario is highly dependent, not only on our beliefs, but just as importantly on what we regard as salient. Merely by paying attention to different components of a system even we are liable to come to dramatically different conclusions with regard to action (Peterson 1999, Peterson and Flanders 2002). In the Clayoquot context, managers' inherent, relatively acute awareness of kelp bed dynamics may thereby lead them to decisions that confound otherwise apparently like-minded locals. Explicit cognitive transparency could help bridge such gaps in misunderstanding generated by opaque differences in relative salience.

At a more general level, while immediate power sharing and resource allocation concerns are of course centrally important factors in the direction and results of multistakeholder negotiations, we argue that unspoken differences in underlying mental models—such as those identified here—may be playing a much more central determining role in the success or failure of such negotiations than has heretofore been acknowledged. This is particularly true in the case of highly complex, opaque domains such as coastal social-ecological systems. Thus, eliciting and discussing such differences in a methodical, explicit and deliberate way, using increasingly refined applications of the kinds of cognitive anthropological and analytical techniques employed in this paper, may offer a key tool for problem-solving amongst multiple stakeholders in a shared resource management context.

Chapter 7: Conclusion

7.1 From inconvenience to insight

At the outset of this dissertation, I asserted that the notoriously "inconvenient" truth (Gore 2005) of looming ecological state-shift is in fact even less convenient than many of us may think. This is not for a lack of data, nor even, would I argue, is it for a lack of collective willpower. No—this truth is especially inconvenient, I submit, because of how science suggests we actually function at a cognitive level.

As discussed briefly in Chapter 2, psychology informs us that the particular affordances we perceive in the environment—such as seeing a goat as something to kill and eat, or a sea otter as something to defend—are not somehow magically inherent in the world itself (Peterson 1999, Peterson and Flanders 2002). In fact, even the existence of the hypothetical goat, or sea otter, as discrete entities distinct from the rest of the environment, is not an *a priori* given. Rather, the way in which we parse reality into component parts, and then interpret what those parts mean with respect to action, is the cumulative upshot of ancient evolutionary pressures, moment-to-moment *in situ* goals, and culturally-mediated habits of mind (Peterson and Flanders 2002, Medin and Atran 2004, G. Rees 2008). Crucially, all of these things are changeable to varying degrees over varying periods of time. If we are to truly take this to heart, the potentially unsettling implication is that things are not what they appear to us to be. They are, in fact, infinitely more; the world around us (and within us) is more usefully described as a field of goal-determined possible interactions amongst matter, than it is a place full of objects that are already discrete or singularly meaningful independent of our cognition (Sun 2012, Peterson 1999, B. Smith 1995).

The reason this makes environmentalism's already "inconvenient" truth doubly inconvenient, therefore, is that the perceived 'reality' of ecological 'crisis' can, in the view of science itself, be legitimately interpreted in a hugely voluminous number of ways. The implication here is that even if sustainability scientists feel that an interpretation of a given social-ecological system is wrong—or does not, for instance, correspond to Western scientific ontology—it cannot, strictly speaking, by the logic of science itself, be meaningfully argued to be wrong in the absolute sense; only more or less effective for achieving one's *a priori* aims (Westphal 2014, J. Peterson 2014, Schulkin 1996, Munz 1993, Barsalou 1993, Peterson and Flanders 2002, Peterson 1999).

What this means practically is that the adage "one man's trash is another man's treasure" is not only accurate, but goes far deeper than trash, and in fact may be as close to an elegant scientific maxim about human cognition and epistemology as we can achieve. What one person may perceive as a depressing ecological catastrophe in the making, another may perceive as an exciting new entrepreneurial opportunity. What one group might perceive as a decimated landscape in need of ecological renewal, another might perceive as ideal grazing land.[72] Disturbingly, the epistemic legitimacy of each of those perceptions is in fact *not* a matter of 'objective' truth-in-the-world (regardless of whether such truth 'exists' beyond

[72] While this may sound like a variety of argument for *moral* relativism, it is anything but. Moral relativism is itself a normative claim about metaphysical categories of 'good' and 'bad' or 'right' and 'wrong'. What I am drawing our attention to here is expressly *a*moral—it is, rather, a purely descriptive account of how cognitive science suggests we ought to think about how humans function.

perception), but is rather to be measured solely by how well they produce one's desired aims, or not (Westphal 2014, J. Peterson 2014, Schulkin 1996, Munz 1993, Barsalou 1993, Peterson and Flanders 2002, Peterson 1999). And people's aims regularly differ.

This particular view of 'truth-perception' as radically mediated by internal cognitive and motivational context (see Chapter 2), while I argue is the most robust conclusion to draw from the evidence we have (Westphal 2014, J. Peterson 2014, Schulkin 1996, Munz 1993, Barsalou 1993, Peterson and Flanders 2002, Peterson 1999), can nonetheless feel deeply counterintuitive on a naïve phenomenological level. As such, as sustainability scientists, environmentalists or other concerned citizens, we are still liable to interpret the data that is salient to us in the world as 'real' evidence of a 'real' so-called looming catastrophe. But that common sense view in fact contrasts starkly with what cognitive science suggests: that ours is one narrow interpretation of a small subset of all possible data and that the interpretation may or may not prove useful for the goals of a particular subset of humanity—no more and no less.

This poses a problem. Namely, for those of us urgently concerned with humanity's future on this planet, knowing that our interpretations of the ecological data cannot be proved as objectively 'true' in a naïve classical sense, yet feeling compelled to present them and even to believe in them as such, leads us inevitably to a state of cognitive dissonance, increasingly detectible hypocrisy and, ultimately, to a lack of credibility. Rather, what I argue, and have endeavoured to advance throughout this dissertation, is that those of us at the nexus of this academic-normative drive towards sustainability do precisely the opposite. By this I mean there are numerous, under-explored and yet-unknown benefits to be gained by embracing this counterintuitive, but empirically supported (Westphal 2014, J. Peterson 2014, Schulkin 1996, Munz 1993, Barsalou 1993, Peterson and Flanders 2002, Peterson 1999), view of truth-perception, and to use it as the theoretical foundation for a sustainability science that sincerely integrates the social—and hence the cognitive—with the ecological.

It is with this in mind that I first synthesized and presented the Efficient Complexity Manager (ECM) model in Chapter 2. Because it is so hard to figuratively wrap our heads around the implications of multiple insights about human cognition that have and continue to emerge from multiple disciplinary corners, I felt synthesizing such information into one internally consistent, widely accessible model was an obligatory first contribution. The result, I believe, is an accessible set of foundational assumptions (see Section 2.3) that is a much more empirically-honest reflection of human thinking than the hyper-rationalist view of 'man'[73] that has characterized and indelibly shaped the western intellectual tradition since the early Enlightenment (Damasio 1994).

In contrast to this earlier rationalist model, and even in contrast to popular interpretations of a more contemporary 'bounded rationality' model (Kahneman 2003), the ECM model distinctly emphasizes that people make their way through the world *continually* using intuitive heuristics and mental models to reduce the complexity of their environments into quickly actionable, emotionally satisfying behaviour that is most often—though unfortunately not always (see Chapters 3 and 4)—adaptive. It is not that we as people do this merely when cutting corners. It is, conversely, our standard modus operandi. This distinction is

[73] I.e., 'man,' as originally contrasted with non-rational, emotion-driven 'woman' (Prokhovnik 1999).

arguably subtle, and can be challenging to grasp, but is nonetheless central to understanding what cognitive science offers social-ecological science in way of foundational theory. What cognitive science informs is that the potential objects of our attention are literally, constantly infinite. Thus, making our way in the world requires a perpetual process of sensory, goal-oriented myopia that reduces very minute bandwidths of the field of matter that comprises our environment into perceived stable objects that have useful motivational significance. Of course, this process means that at any one time, we are each individually savvy to only a miniscule fraction of the near endless possibilities afforded by our social-ecological surroundings. We can work to overcome the gigantic blind spots that this adaptive myopia creates, through scientific method, through technology and through communication. However, insofar as we remain human, to do so is tantamount to leveraging our specific set of cognitive-perceptual abilities to the maximum, not magically transcending them (Slingerland 2008, Lakoff and Johnson 1999).

To the extent this really does seem inconvenient to the practice or dissemination of sustainability-oriented science (if not disturbing to the very foundations of our naïve phenomenological experience), rest assured that there is, as first mentioned in Chapter 1, a proverbial silver lining. Despite the heightened awareness of our innate constraints that cognitive science invokes, there are nonetheless a suite of highly useful methodological tools from cognitive-oriented disciplines that can be adapted, recombined and iteratively refined to help us better understand and more usefully characterize how it is people shape and interact with their social-ecological systems. Such tools can both reveal the unspoken beliefs and assumptions that fundamentally structure peoples' behaviour in these systems, as well as demonstrate similarities and differences in those beliefs amongst multiple stakeholders. Empirical work in organizational behaviour (L. A. Liu 2004, Van den Bossche, et al. 2011, Brodt and Dietz 1999) suggests that this in turn can potentially facilitate greater mutual understanding amongst actors, improved dialogue, and ultimately more effective management.

In Chapters 3 to 6 of this dissertation, I drew from original field work in two different case study sites to present four diverse examples of precisely this. In Chapter 3, I employed two iterative rounds of interviews focused on eliciting on participants' mental models of a land-use crisis in Mt. Carmel Biosphere Reserve to better understand the local dynamics that have heretofore prevented a sustainable solution from taking hold. In so doing, I reveal that there is actually a crucial contradiction between locals' commonly stated beliefs *about each other*, and a curiously silent preference for high-density housing options shared by a large segment of the community. I explain how this contradictory perception is likely rooted in a very simple cognitive bias: people's tendency to overgeneralize about the fixity of the community's preferences based on their mental representations of a hyper-salient minority of the population. My local collaborators and I felt these cumulative insights could significantly alter the current impasse in land-use conflict on Mt. Carmel. Namely, by showing that a clear, transparent, systematic methodology suggests there is actually a far greater interest in high-density housing on Mt. Carmel than people appear to assume, this opens up a range of discursive possibilities amongst the community, the state authorities, and potential investors alike for collaborative initiatives to shift towards a more sustainable town-and-park plan. Our results were thus delivered directly to the local community in February of 2012, and we have now been requested to present them to the relevant government authorities in coming months.

In Chapter 4 I took the same foundational theory developed in Chapter 2 and applied in Chapter 3, but adapted a different methodological approach in order to gain insight into another aspect of the same social-ecological system: the massive 2010 Carmel fire. By looking specifically at how various groups simplified the complexity inherent in the Mt. Carmel social-ecological system over time, with my colleagues I was able to reveal how public history of disaster is forged, not only by the powerful, but also by the powerful's *most accessible heuristics* and *a priori* cultural worldviews. In this instance, our approach also revealed what was missing, specifically, from the public discourse that could prevent similar future catastrophes and hence increase societal resilience. Namely, we were able to explain how the nature of debate that ensued in the wake of the fire fixated on blaming individual human actors and ethnic 'others,' while entirely missing the decades-long ideological debates about idealized 'nature' that underpinned the slow change, and questionable management, of the Carmel landscape. In other words, a crucial opportunity for public education about resilience and social-ecological feedback loops lost out to political point scoring and ethnic division. This, I argue, constitutes a primary example how resilience fails to build. For-profit mass media interests are inherently shaped by very specific financial constraints. As such, journalists, editors and the public along with them are often led to fall back on the easiest, most immediately satisfying objects of analysis—e.g., contemptible 'others.' Rather than spend resources to examine and convey the underlying, less tantalizing factors that can feed back over time to create disaster-invoking conditions, most mass media are either unable or unwilling to frame sensational events such as the 2010 Carmel fire as anything other than a mono-causal mistake of an identifiable culprit (Nayar 2012). Unless specifically educated otherwise, the wider population is liable to make exactly the same mistake, simply by virtue of human cognitive habit (see Chapter 2). This, I submit, is where the academe can play a key public educational role by filling in such gaps left by profit-driven media and self-interested leaderships. As such, in addition to submitting Chapter 4 for publication in a refereed journal, my argument regarding the cognitive and ecological factors underlying the 2010 disaster will also be disseminated in popular format through a local Israeli web portal with which I have working relations.

In Chapter 5, I move on from Mt. Carmel and shift focus to another contested biosphere reserve, this time in a Canadian context: Clayoquot Sound. By devising a simple freelisting and sorting task, and by paying explicit attention to statistically significant intergroup differences, with my colleagues I was able to reveal important variation in how several demographic groups are likely to perceive the immanent resurgence of the regional sea otter population. Using salience analysis (Smith and Borgatti 1997), this in turn allowed us to bring into direct relief the asymmetric nature of benefits that various groups are likely to perceive under the coming ecological regime shift. Employing very straightforward field methods and analysis, we were able to tackle directly a challenge that has been lamented in the conservation literature as sorely lacking for some time (Daw, et al. 2011, Chan, Satterfield and Goldstein 2012): capturing the inherently *disaggregate* and *multidimensional* nature of the various benefits that various groups of people derive from their local ecosystems. In so doing, we make the social justice element of ecosystem change in Clayoquot quantitatively palpable, and mutually comparable amongst groups, thus moving this crucial but under-quantified field from the rhetorical and political into the tangibly measurable for decision-making purposes. With regard to specific, immediately actionable insights, one contrast in particular emerged as central to the axes of difference we observed in participants' responses: normative ideas about kelp. A key gap appears to exist between a small handful of local residents—mostly First Nations—on one hand, and government managers, along with some other locals, on the other, with respect to normative appraisals and basic beliefs surrounding kelp beds. While the former group appears to feel negatively towards kelp, not least because it is a nuisance for boating, but also because of beliefs that it can 'smother' sea-life (I suspect the causal directionality between belief and appraisal may well be inverse, here, but that would have to be tested), the latter group are especially focused on kelp growth as an innately positive phenomenon that is believed to bring with it a whole suite of ecologically beneficial knock-on effects. It seems to me crucial that this stark gap in both belief and appraisal be explored and directly addressed in the context of any consultative or collaborative management process involving both groups in the region. The particular kelp-related beliefs I was able to elicit through the course of my field work could well serve directly as talking points for multistakeholder dialogue on the issue.

Finally, in Chapter 6, by combining two techniques not heretofore combined—salience analysis and network analysis –my colleagues and I were able to visually represent the differential *cognitive accessibility* of various components of the social-ecological system to various stakeholders who are often at loggerheads. This use of cognitive anthropology techniques enabled us to link research in organizational behaviour with social-ecological systems theory, showing openly and visually where the challenges lie in terms of constructing a *shared* mental model of the system key to improved management (L. A. Liu 2004, Van den Bossche, et al. 2011, Brodt and Dietz 1999). Moreover, this combined technique—focused specifically on foodweb data—visualizes interconnections between species that are not necessarily immediately apparent to the participants themselves, allowing us to bring directly to the fore people's tacit, implicit, knowledge. The similarities and differences amongst different demographics' tacit knowledge can subsequently be shared openly in multistakeholder management contexts, ultimately affording improvements in collaborative management.

7.2 From insight to action

Above, I have detailed the specific findings from each chapter, highlighting the potentially actionable, management-relevant implications of the respective insights that emerged in each case. However, before moving on to closing remarks, it is important to note two additional dimensions relating to the relevance and future dissemination of my findings.

7.2.1 Gender

At several points in my research—particularly in the findings to emerge from Clayoquot Sound—gender arose as a relevant object of analysis. This appears to be largely an artifact of relatively stable divisions of labour between the sexes, most notably accented within the Nuu-Chah-Nulth First Nations population. Simply put, women tend to be more terrestrially bound, and in the case of First Nations, more focused on nearshore edible invertebrates, while men tend to spend more time on the water, fishing for income, sustenance, or (especially amongst non-First Nations) for recreation. My findings (see Chapters 5 and 6) suggest this division of labour may have consequential effects on which species, and which trophic interactions amongst species, are most salient for men, versus women. Interestingly, it appears this division of labour may also systematically affect the normative preferences that men and women, respectively, tend to exhibit with respect to many of those same species (see Chapter 5). Given that women, and particularly First Nations women, appear to be the least likely group to perceive immediate benefits from the enforced conservation and hence imminent spread of sea otters along the entire west coast of Vancouver Island (see Chapter 5), it will be crucial both in future research, and in research dissemination efforts, to consider the power structures in place, both local and regional, that have led to this outcome, and may perpetuate or deepen the concomitant social injustices over time.

I argue that the insights gained from this active disaggregation of gender data highlight and support a key argument put forth by Agrawal and Gibson (2002). Namely, despite romanticized or stereotyped images of local communities being coherent, homogenous entities that can optimize conservation outcomes when sufficiently empowered, local communities are, in fact, often consequentially heterogeneous on axes of gender and political interest, and that these axes of heterogeneity can impact and complicate conservation efforts, their successes, and how the benefits of those success are distributed. However, while Agrawal and Gibson (2002) highlight the multiplicity and heterogeneity of actors' interests, specifically, I believe my research can help enrich this view considerably by brining to the fore the diversity and heterogeneity of implicit *cognitive landscapes* within a community, and how the figurative topography of those landscapes may be predictably determined by gender-roles. Such *cognitive* implications of gender-role heterogeneity within social-ecological systems (e.g., gender-mediated differences in the relative salience of system components such as species or trophic relationships, or the diversity in the conceptual or normative associations people of different genders have with respect to those objects of attention) are a factor that I argue may be missed even by a thorough analysis of intra-community and inter-institution power dynamics, in the style of Agrawal and Gibson (2002).

Harrison and Watson (2012) note that, despite rhetoric to the contrary, there is still a lamentable disconnect between the importance of gender considerations as presented by social scientists, and the degree to which those implications are taken up by natural scientists in resource management and related contexts. I suspect that an integration of the kinds of findings produced by the theoretical foundation I employed in this dissertation may help redress that concern. By highlighting the observable *cognitive* effects of gendered differences in how locals habitually interact with their surrounding social-ecological system, such efforts may ultimately make the relevance of considering gender issues clearer and more salient for natural scientists and policy makers.

I argue exploring and presenting the degree to which gender serves as a marker of potentially consequential cognitive differences in how people conceptualize and relate to their social-ecological system helps explain, and further reinforces, the now voluminous findings on how more equitably integrating women into decision-making processes can help deliver more rounded, successful natural resource management strategies (Agarwal 2009). This phenomenon has been attested to with statistical robustness in terrestrial systems management (Agarwal 2009). In light of such work, I argue my own findings suggest it is also worth investigating the degree to which this may or may not hold in nearshore or other marine systems such as Clayoquot Sound.

That said, with specific reference to Clayoquot Sound, it is important that we do not blindly fall into familiar cultural tropes that may not map directly onto the system as it currently functions. Namely, others' work (e.g., Espinosa 2010) has suggested that women's role in diversifying family income and food sources can reduce male-mediated pressure on ecologically-important wildlife (e.g., large game, or other high-trophic level species targeted mainly by men for food or income). However, in the case of Clayoquot Sound, there is a fundamental inversion of this dynamic. Rather than women mitigating pressure on game species of ecological concern through resourceful collection of secondary food sources, in this case, the relevant species of conservation concern—the sea otter—is actually a direct competitor for the shellfish and other wild foods collected by (mainly First Nations) women to supplement local diets. On that front, it is crucial to note that Clayoquot Sound women's apparent heightened awareness and attachment to a diversity of nearshore invertebrates is not, in fact, a reflection of women's often-stereotyped greater concern for 'conservation' as a concept or outcome (Cornwall, Harrison and Whitehead 2007). Rather, their apparent relative interest in these diverse species is testament to people's attachment to very specific ecological states—not a predilection for restoring or conserving what it deemed to be objectively 'natural.' This reflects the work of Cornwall, Harrison and Whitehead (2007), who argue incisively that cultural tropes about women's implied innate propensity towards conservation and environmental protection are in fact as much a part of an expedient motivating myth as they are a stable reality. Rather, like Cornwall, Harrison and Whitehead (2007), our own findings support a view of social-ecological systems in which the complex interplay amongst gender issues and natural resource management can vary heterogeneously from community to community. Importantly, in such a view, who prefers what to be conserved or sustained, and why, is by no means an *a priori* given.

7.2.2 Communicating relevance

A core argument of this thesis is that conservation and sustainability objectives are not *a priori* facts about how 'nature' can be saved, but rather that they are subjective human opinions, observably mediated, if not wholly determined, by predictable cognitive and cultural factors. Without a sufficient appreciation of the implicit philosophical assumptions this argument refutes, and why (see Section 7.3), it is easy to misinterpret this position as a claim of paralyzing relativism or, worse, an underlying nihilism that subverts the very normative foundation of a sustainability ethic before it has a chance to succeed. Such an interpretation is understandable, but results from mistaking an empirically-informed pragmatism (Schulkin 1996, Minteer 2011) for a figurative evil twin of metaphysically-committed objectivism (i.e., a metaphysically-committed *anti*-objectivism). People's liability to make this identification error has crucial implications for how cognition and culture research can be best understood and disseminated.

To be clear, here I wish to make a brief but crucial point regarding how I view the implicative value of the insights described and discussed throughout this dissertation. Entirely irrespective of metaphysical concerns regarding the (non-)existence of a measurable, objective truth, or of the 'truthfulness' of particular sustainability or conservation aims, it is my assertion that culture and cognition research can be valuable for managers and sustainability scientists alike in two important ways. One, as I have endeavoured to do in this dissertation, research efforts informed by the synthetic approach outlined in Chapter 2 can bring to our collective attention *implicit* cognitive and cultural dynamics that may be clandestinely contributing to, driving, or precluding, certain resource management outcomes. What a dissemination of cognition and culture research can do is therefore increase the awareness, salience and ultimately the cognitive accessibility of such information, to help enrich the information landscape that managers, local actors, and fellow researchers alike have available to them to reason about their system.

One could argue that, this is all well and good, but if there is no 'objective' truth that such information is helping us approximate, all is for naught. Such a reaction is arguably understandable, particularly for those who hold strong objectivist assumptions and thus find it difficult to humour a coherent epistemology independent of such commitments. However, I disagree with such a dismissal. Rather, the second and crucial point I would like to make about the implicative value of cognition and culture research is that the proof, if you will, is in the figurative pudding. Specifically, the value of a given set of cognition and culture research is a function of precisely the following: to what degree the knowledge it produces helps us accomplish our *goals* (meaning, here, our plethora of individual and collective aims as managers, as citizens or as researchers, alike). Thus, cognition and culture research on social-ecological systems is explicitly not a question of delivering clearer prescriptions for action. Rather, it is about helping actors refine their conceptual models of the systems in question to help them more usefully navigate those systems, and thus better accomplish their *a priori* aims, whatever those may be. In so doing, there will likely be feedback loops whereby the results of people employing and iteratively refining working models of a given social-ecological system reflexively (re-)shapes their goals over time. Nonetheless, to appreciate the potential value of cognition and culture research for the study and management of social-ecological systems, it is key to put aside any preoccupations with specific prescriptive outcomes, and focus instead on this pragmatic, goal-oriented dimension, whereby new information is assessed purely on its ability help us formulate more pragmatically useful analogical representations of the systems in question. As such, in the course of disseminating my own particular findings to the communities and decision-makers in question, my focus has and will continue to be presenting the insights articulated earlier in this dissertation in such a way that increases their salience and accessibility for the audience, and in such a way that I hopes enables them to more usefully understand both their surrounding ecology, and also each other. How that can or should affect policy, and thereby ultimately the social-ecological system under study, is of course fascinating to ponder but, strictly speaking, lies outside of the purview of the research itself.

7.3 Closing thoughts

Given this is a papers based dissertation, the significance of the findings is multifaceted rather than leading to one cumulative insight. My key theoretical contribution is a synthesis of empirical findings from disparate cognition-literate disciplines on how people genuinely do appear to make sense of and navigate through complex systems and situations (see Chapter 2). This is significant in that, without such an accessible synthesis, researchers and authors in various sustainability-related fields appear liable to fall back on convenient earlier models and assumptions about hyper-rationality (Adamowicz 2004, Ariely, Loewenstein and Prelec 2003, Kahneman and Knetsch 1992, Desvousges, Mathews and Train 2012, Gomez-Baggethun, et al. 2010) that have nonetheless been shown to be unsatisfactory in a range of contexts (Henrich, et al. 2001). The publication of this new synthesis of cumulative insights is thus a crucial contribution that can help researchers ask ever-more relevant and pragmatic questions, knowing that the basic assumptions they invoke are rooted in empirical science, not early-modern pre-empirical theory (Persky 1995).

Each of my data chapters constitutes distinct contributions insofar as each is a clear, straightforward example of how the theoretical model I propose in Chapter 2 can be used to structure immediately management-relevant research agendas in real-world social-ecological systems. Of particular significance are Chapters 4 and 6, which use the theory presented in Chapter 1 to synthesize two new methods for examining and articulating actors' comparative *in situ* methods of complexity reduction: measuring causal conflation within a discourse over time, and salience-and-network analysis, respectively.

The results to emerge from Chapters 3 and 5, respectively, are perhaps the most directly applicable to social aspects of contemporary management issues in the biosphere reserves in question. As detailed above in Section 7.1.1, in the case of Chapter 3, our data reveal a heretofore silent majority opinion which, if expressed in the right context, could help rapidly speed the resolution of a growing land-use crisis that also threatens interethnic relations in the area. In the case of Chapter 5, by examining environmental preferences and associated beliefs at a disaggregate level, we demonstrate that there are clear and immediate social justice concerns that are likely to emerge in the wake of the ongoing trophic cascade reshaping the nearshore ecology of the west coast of Vancouver Island. Presenting academically sound evidence on this issue to relevant decision makers and community members will hopefully have direct positive impacts on the tenor and focus of local decision-making surrounding how to manage the changing ecosystem and locals' access thereunto.

The cumulative research presented in this dissertation derives its strength specifically from these two factors: one, the integrative and innovative synthesis of both theory and of methods from diverse disciplines that study cognition and culture; and, two, the immediate relevance of the results derived from applying those syntheses to ongoing, *in situ* management crises. That said, this dissertation was constrained in a number of consequential ways. First, my research efforts were spread across two sites, and thus I spent less time in each place than perhaps I otherwise would have, precluding, for instance, a more in-depth round of follow-up data gathering.

Second, as dynamic real-world social systems experiencing rapid change, the sites themselves did not lend themselves to clear hypothesis testing and experimental design. Thus the approaches I adopted in each location were more exploratory and pragmatically-focused than scientific in a strict positivist sense. The site-specific outputs thus took the form of practical and hypothesis-generating insights with relevance to local decision-making, but with a relative lack of widely *generalizable* results.

Third, because of the papers-based structure of the dissertation, I had limited space to explore the full suite of analytic options for each of the respective datasets. Thus, for instance, much more could be explored in terms of additional measures of centrality in the Chapter 6 data. I could also have analyzed and reported on a range of additional questions asked during the interview protocol in Clayoquot Sound, that, in the interest of length, I instead chose to set aside for future work. These other sets of questions pertained largely to participants' perceptions of the explicitly social dimension of the social-ecological system. Finally, each of the papers in my dissertation used relatively simple methods of analysis. This has its own suite of benefits—including transparency and accessibility, particularly for relevant decision-makers—but, with a larger data set from one or both of the sites, and more time and funding, I could have experimented with a number of more involved analytical methods, including Consensus Analysis (Smith and Borgatti 1997). This would have enabled me to derive a much richer, more involved picture of the cognitive landscape, particularly of the Clayoquot social-ecological system.

In sum, what this dissertation presents is a series of practical examples of what can be innovated and applied when research is rooted in an updated, synthetic model of human thought and action. Future research could, and I sincerely hope will, include an application of the ECM model to a range of other social-ecological contexts, particularly where the behaviour of multiple remote actors influences a common system. For instance, the study of watersheds, food systems, agroecosystems, and other situations in which economic, subsistence or management behaviours vary across groups could stand to benefit greatly from insights derived from an approach rooted in contemporary advances in cognitive theory. The same could be true of higher-level, international negotiations over planetary commons. It would indeed be fascinating to attempt an adaptation of the approach presented in this dissertation to higher-level scales, and larger nested networks of social-ecological systems. Regardless of the scale, however, what is most urgently needed is a spirit of openness to building a new, cogent foundation for the social dimension of sustainability science on firm, empirical and, crucially, cognitively-literate grounding. As described in Section 7.1, the implications for our notion of truth—and of our own unique access to that truth—may be unsettling. Yet, I submit that if the intellectual history of our species demonstrates one thing, it is that inconvenient truths are only inconvenient so long we remain fearfully attached to the illusions of prior paradigms.

Works Cited

Al Jazeera. "Mukhatat istitani be silwan wa hadam qariya bi al-naqab [Settlement construction in Silwan and the demolition of villages in the Negev]." *Al Jazeera.* November 11, 2013. http://www.aljazeera.net/news/pages/432f1245-4433-4fd7-9943-ffcb21e55d09 (accessed December 4, 2013).

Ableson, R. P., and A. Levi. *Decision making and decision theory.* Vol. 1, in *The Handbook of Social Psychology*, edited by G. Lindzey, & E. Aronson, 231-309. New York: Random House, 1985.

Adamowicz, W.L. "What's it worth? An examination of historical trends and future directions in environmental valuation ." *Australian Journal of Agricultural and Resource Economics* 48, no. 3 (2004): 419-443.

Adams, William H., and Jon Hutton. "People, Parks and Poverty: Political Ecology and Biodiversity Conservation." *Conservation and Society* 5, no. 2 (2007): 147-183.

Adar, Kalil (Director of Forest Department, KKL Northern Region). (January 2012).

Adger, W. Neil. "Social and ecological resilience: are they related?" *Progress in Human Geography* 24, no. 3 (2000): 347-364.

Agarwal, Bina. "Gender and forest conservation: The impact of women's participation in community forest governance." *Ecological Economics* 68, no. 11 (2009): 2785-2799.

Agrawal, A. and C. C. Gibson (eds). *Communities and the Environment: Ethnicity, Gender, and the State in Community-Based Conservation.* Piscataway, NJ: Rutgers University Press, 2001.

Anderies, J. M., et al. "The challenge of understanding decisions in experimental studies of common pool resource governance." *Ecological Economics* 70, no. 9 (2011): 1571-1579.

Andersson, K., and A. Agrawal. "Inequalities, institutions, and forest commons." *Global Environmental Change* 21 (2011): 866-875.

Arana, J. E., and C. J. Leon. "Do emotions matter? Coherent preferences under anchoring and emotional effects." *Ecological Economics* 66, no. 4 (2008): 700-711.

—. "Understanding the use of non-compensatory decision rules in discrete choice experiments." *Ecological Economics* 68, no. 8-9 (2009): 2316-2326.

Araujo, Rita M., Inka Bartsch, Trine Bekkby, Karim Erzini, and Isbel Sousa-Pinto. "What is the impact of kelp forest density and/or area on fisheries?" *Environmental Evidence* 2 (July 2013): 15.

Ariely, D, G. Loewenstein, and D. Prelec. ""Coherent arbitrariness": stable demand curves without stable preferences." *The Quarterly Journal of Economics* 118, no. 1 (2003): 73-106.

Arrow, K. J. *Social choice and individual values.* New York: John Wiley & Sons, 1963.

Atran, Scott. "Folk biology and the anthropology of science: Cognitive universals and cultural particulars ." *Behavioural and Brain Sciences* 21, no. 4 (August 1998): 547-569.

Atran, Scott, and Douglas Medin. *The Native Mind and the Cultural Construction of Nature.* Cambridge, Massachusetts: The MIT Press, 2010.

Atran, Scott, and Robert Axelrod. "Reframing Sacred Values." *Negotiation Journal* 24, no. 3 (July 2008): 221-246.

Atran, Scott, et al. "Folkecology and Commons Management in the Maya Lowlands." *PNAS* 96, no. 13 (June 1999): 7598-7603.

Attfield, Robin. *Biocentrism.* Vol. 1, in *Encyclopedia of Environmental Ethics and Philosophy*, by J. Baird Callicott, & Robert Frodeman, 97-100. New York: Macmillan Reference USA, 2009.

Bang, M., D. L. Medin, and S. Atran. "Cultural mosaics and mental models of nature." *PNAS* 104, no. 35 (2007): 13868-13874.

Bar, M. "The proactive brain: memory for predictions." *Phil. Trans. R. Soc. B* 364, no. 1521 (2009): 1235-1243.

Barg, Frances K., Rebecca Huss-Ashmore, Marsha N. Wittink, Genevra F. Murray, Hillary R. Bogner, and Joseph J. Gallo. "A Mixed-Method Approach to Understanding Lonliness and Depression in Older Adults." *Journals of Gerontology B: Psychological Sciences*, November 2006: S329-S339.

Barsalou, Lawrence W. "Challenging Assumptions About Concepts ." *Cognitive Development* 8 (1993): 169-180.

Bar-Tal, Daniel. "Why Does Fear Override Hope in Societies Engulfed by Intractible Conflict, as It Does in the Israeli Society?" *Political Psychology* 22, no. 3 (2001): 601-627.

Becker, C. "The human actor in ecological economics: philosophical approach and reserach perspectives." *Ecological Economics* 60, no. 1 (2006): 17-23.

Beckerman, Wilfred. "'Sustainable Development': Is it a Useful Concept?" *Environmental Values* 3, no. 3 (August 1994): 191-209.

Benet-Martinez, V., J. Leu, F. Lee, and M. Morris. "Negotiating biculturalism: cultural frame switching in biculturals with oppositional versus compatible cultural identities." *Journal of Cross-Cultural Psychology* 33, no. 5 (2002): 492-516.

Berkes, Fikret, Johan Colding, and Carl (Eds.) Folke. *Navigating Social-Ecological Systems: Buildling Resilience for Complexity and Change.* Cambridge: Cambridge University Press, 2003.

Bierbaum, Rosina M., and Robert B. Zoellick. "Development and Climate Change ." *Science* 326, no. 5954 (November 2009): 771.

Biger, Nili Liphschitz and Gideon. *Green Dress for a Country.* Jerusalem: Ariel Publishing House, 2004.

Biggs, Adam T., and Bradley S. Gibson. "Visual salience can co-exist with dilution during visual selection." *Journal of Experimental Psychology: Human Perception and Performance* 40, no. 1 (February 2014): 7-14.

Bina, O., and S. G. Vaz. "Humans, environment and economies: from vicious relationships to virtuous responsibility." *Ecological Economics* 72 (2011): 170-178.

Blood, Donald A. "Sea Otter." *Wildlife at Risk in British Columbia.* Victoria, BC: Wildlife Branch--BC Environment, October 1993.

Blum, Jason, N. "Retrieving Phenomenology of Religion as a Method for Religious Studies." *Journal of the American Academy of Religion* 80, no. 4 (December 2012): 1025-1048.

Bodoff, David. "When learning meets salience." *Theory and Decision* 74, no. 2 (February 2013): 241-266.

Boiral, Olivier. "Tacit Knowledge and Environmental Management." *Long Range Planning* 35, no. 3 (June 2002): 291-317.

Boneh, Omri. (Director, KKL-Northern Wing) Personal communication (January 2012).

Boonstra, Wiebren J., and Florianne W. de Boer. "The Historical Dynamics of Social–Ecological Traps." *Ambio* 43, no. 3 (2014): 260-274.

Borgatti, SP. "ANTHROPAC 4.0 [Computer Software]." Natick, MA: Analytic Technologies, 1996.

Borgatti, S.P., Carley, K. M., and D. Krackhardt. "On the robustness of centrality measures under conditions of imperfect data." *Social Networks* 28, no. 2 (2006): 124-136.

Borgida, E., and R. E. Nisbett. "The differential impact of abstract vs. concrete information on decision." *Journal of Applied Social Psychology* 7, no. 3 (1977): 258-271.

Bower, G. H. "Mood and memory." *American Psychologist* 36, no. 2 (1981): 129-148.

Bowles, S., and H. Gintis. "The revenge of homo economicus: contested exchange and the revival of political economy." *The Journal of Economic Perspectives* 7, no. 1 (1993): 83-102.

Boyer, P. "Evolutionary economics of mental time travel?" *Trends in Cognitive Sciences* 12, no. 6 (2008): 219-224.

Brandes, Ulrik. "A faster algorithm for betweenness centrality ." *The Journal of Mathematical Sociology* 25, no. 2 (2001): 163-177.

Branscombe, Nyla R., and Daniel L. Wann. "Collective self-esteem consequences of outgroup derogation when a valued social identity is on trial." *European Journal of Social Psychology* 24, no. 6 (1994): 641-657.

Briggs, Charles L. "Theorizing modernity conspiratorially: Science, scale, and the political economy of public discourse in explanations of a cholera epidemic." *American Ethnologist* 31, no. 2 (2004): 164-187.

Broadbent, D. E., P. Fitzgerald, and M. H. Broadbent. "Implicit and explicit knowledge in the control of complex systems." *British Journal of Psychology* 77 (1986): 35-50.

Brodt, Susan E., and Leah E. Dietz. *Shared information and information sharing: Understanding negotiation as collective construal.* Vol. 7, in *Research in negotiation in organizations*, edited by Robert J. Bies, Roy J. Lewicki, & Blair H. Sheppard, 263-283. Elsevier Science/JAI Press, 1999.

Brown, Katrina. "Three challenges for a real people-centred conservation." *Global Ecology and Biogeography* 12, no. 2 (March 2003): 89-92.

Buck, R. "Prime theory: an integrated view of motivation and emotion." *Psychological Review* 92, no. 3 (1985): 389-413.

Bulkeley, Harriet, and Arthur P.J. Mol. "Participation and Environmental Governance: Consensus, Ambivalence and Debate." *Environmental Values* 12, no. 2 (May 2003): 143-154.

Bull, Hedley. *The Anarchical Society: A Study of Order in World Politics, 3rd ed.* New York: Columbia University Press, 2002.

Burger, Jerry M. "Motivational Biases in the Attribution of Responsibility for an Accident: A Meta-Analysis of the Defensive-Attribution Hypothesis." *Psychological Bulletin* 90, no. 3 (1981): 496-512.

Burns, Sarah E. "Thinking about fairness & achieving balance in mediation ." *Fordham Urban Law Journal* 35, no. 1 (January 2008): 39.

Bute, E. H., Lipper L., R. Stringer, and D. ZIlberman. "Payments for ecosystem services and poverty reduction: concepts, issues and empirical perspectives." *Environment and Development Economics* 13 (2008): 245-254.

Callander, Steven. "Political Motivations." *Review of Economic Studies* 75, no. 3 (July 2008): 671-697.

Camerer, C., G. Loewenstein, and D. Prelec. "Neuroeconomics: how neuroscience can inform economics." *Journal of Economic Literature* 53 (2005): 9-64.

Cameron, Neil. "First Nations say conflicts could occur if fishery is allowed on recovering herring stocks." *Courier-Islander.* February 7, 2014. http://www.courierislander.com/news/local/first-nations-say-conflicts-could-occur-if-fishery-is-allowed-on-recovering-herring-stocks-1.842943 (accessed July 24, 2014).

Campbell, W. Keith, and Constantine Sedikides. "Self-threat magnifies the self-serving bias: A meta-analytic integration." *Review of General Psychology* 3, no. 1 (March 1999): 23-43.

Canada. *Species Profile (Sea Otter).* May 29, 2014. http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=149 (accessed July 8, 2014).

Carvalho, Anabela. "Ideological cultures and media discourses on scientific knowledge: re-reading news on climate change." *Public Understanding of Science* 16, no. 2 (2007): 223-243.

Caselli, Francesco, and Massimo Morelli. "Bad politicians." *Journal of Public Economics* 88, no. 3-4 (2004): 759-782.

CBC. "Sea otter hunt planned by Vancouver Island First Nations." *CBC News British Columbia.* May 20, 2009. http://www.cbc.ca/news/canada/british-columbia/sea-otter-hunt-planned-by-vancouver-island-first-nations-1.849941 (accessed July 8, 2014).

Cederman, Lars-Erik, Nils B. Weidmann, and Kristian Skrede Gleditsch. "Horizontal Inequalities and Ethnonationalist Civil War: A Global Comparison." *American Political Science Review* 105, no. 03 (2011): 478-495.

Chan, Kai M. A., et al. "Where are 'cultural' and 'social' in ecosystem services: A framework for constructive engagement." *BioScience* 6, no. 8 (2012): 744-756.

Chan, Kai M. A., Terre Satterfield, and Joshua Goldstein. "Rethinking ecosystem services to better address and navigate cultural values." *Ecological Economics* 74 (February 2012): 8-18.

Clark, Dav, and Michael Andrew Ranney. "Known knowns and unknown knowns: multiple memory routes to improved numerical estimation." *ICLS '10 Proceedings of the 9th International Conference of the Learning Sciences* 1 (2010): 460-467.

Clark, William C., and Nancy M. Dickson. "Sustainability science: The emerging research program." *PNAS* 100, no. 14 (2003): 8059–8061.

Claxton, G. *Hare brain, tortoise mind: how intelligence increases when you think less.* New York: HarperCollins, 1999.

Cohen, D., R. E. Nisbett, B. F. Bowdle, and N. Schwarz. "Insult, aggression and the southern culture of honor: an experimental ethnography." *Journal of Personality and Social Psychology* 70, no. 5 (1996): 945-960.

Constanza, Robert. "Ecosystem services: Multiple classification systems are needed ." *Biological Conservation* 141, no. 2 (February 2008): 350-352.

Cook, Curtis (Former Manager, Clayoquot Sound Biosphere Trust). Tofino, BC, (July 21, 2009).

Corbera, Esteve, and Unai Pascual. "Ecosystem Services: Heed Social Goals." *Science (letters)* 335 (February 2012).

Corbett, Julia B., and Jussica L. Durfee. "Testing Public (Un)Certainty fo Science." *Science Communication* 26, no. 2 (December 2004): 129-151.

Corbin, Carol. "Silences and lies: how the industrial fishery constrained voices of ecological conservation." *Canadian Journal of Communication* 27, no. 1 (2002): 7-32.

Corcoran, K., and T. Mussweiler. "The cognitive miser's perspective: Social comparison as a heuristic in self-judgements." *European Review of Social Psychology* 21, no. 1 (2010): 78-113.

Cornwall, A., Harrison, E., and A. Whitehead. "Gender Myths and Feminist Fables: The Struggle for Interpretive Power in Gender and Development." *Development and Change* 38, no. 1 (2007): 1-20.

Cosmides, L., and J. Tooby. "Better than rational: evolutionary psychology and the invisible hand." *American Economic Review* 84, no. 2 (1994): 327-332.

Costanza, Robert, et al. "The value of the world’s ecosystem services and natural capital." *Nature* 387 (May 1997): 253-260.

Curry, Patrick. "Re-Thinking Nature: Towards an Eco-Pluralism." *Environmental Values* 12, no. 3 (2003): 337-360.

Daily, Gretchen. *Nature's Services: Societal Dependence on Natural Ecosystems.* Washington, DC: Island Press, 1997.

Daily, Gretchen, and Katherine Ellison. *The New Economy of Nature: The Quest To Make Conservation Profitable.* Washington, D.C.: Island Press, 2003.

Dalisay, Francis, Jay D. Hmielowski, Mathew J. Kushin, and Masahiro Yamamoto. "Social Capital and the Sprial of Silence." *International Journal of Public Opinion Research* 24, no. 3 (2012): 325-345.

Damasio, A. R. *Descartes' error: emotion, reason and the human brain.* New York: HarperCollins, 1994.

—. *The feeling of what happens: body and emotion in the making of consciousness.* Boston: Houghton Mifflin Harcourt, 2000.

—. "The somatic marker hypothesis and the possible functions of the prefrontal cortex." *Phil. Trans. R. Soc. Lond. B* 351 (1996): 1413-1420.

Dana, Nissim. *The Druze in the Middle East .* Brighton: Sussex Academic Press, 2003.

D'Andrade, Roy G. *The Development of Cognitive Anthropology.* Cambridge: Cambridge University Press, 1995.

Daw, Tim, Katrina Brown, Sergio Rosendo, and Robert Pomeroy. "Applying the ecosystem services concept to poverty alleviation: the need to disaggregate human well-being." *Environmental Conservation* 38, no. 4 (2011): 370-379.

De Mantaras, R. L., et al. "Retreival, reuse, revision and retention in case-based reasoning." *The Knowledge Engineering Review* 20, no. 3 (2005): 215-240.

de Morais, Fernando Ferreira. "Traditional ecological knowledge about plants cultivated by fishermen at Community Estirão Comprido, Pantanal matogrossense, Brazil." *Boletim do Museu Paraense Emílio Goeldi--Ciências humanas* 4, no. 2 (2009): 277-294.

Dessai, Suraje, and Mike Hulme. "Does climate adaptation policy need probabilities? ." *Climate Policy* 4, no. 2 (2004): 107-128.

Desvousges, W., K. Mathews, and K. Train. "Adequate responsiveness to scope in contingent valuation." *Ecological Economics* 84 (2012): 121-128.

Deur, Douglas, Nancy J. Turner, Adam Dick (Kwaxsistalla), Daisy Sewid-Smith (Mayanilth), and Kim Recalma-Clutesi (Oqwilowgwa). "Subsistence and Resistence on the British Columbia Coast: Kingcome Village's Estuarine Gardens as Contested Space." *BC Studies* 179 (2013): 13-37,255-256.

Dijksterhuis, A., and L. F. Nordgren. "A theory of unconscious thought." *Perspectives on Psychological Science* 1, no. 2 (2006): 95-109.

Dobes, L. *Adaptation to climate change: Formulation policy under uncertainty.* CCEP Working Paper 1201, Centre for Climate Economics & Policy, Canberra: Crawford School of Economics and Government, The Australian National University, 2012.

Dongre, Amol R., and Pradeep R. Deshmukh. "Farmers' suicides in the Vidarbha region of Maharashtra, India: a qualitative exploration of their causes." *J Inj Violence Res* 4, no. 1 (2012): 2-6.

Doucouliagos, C. "A note on the evolution of homo economicus." *Journal of Economic Issues* 28, no. 3 (1994): 877-883.

Douglas, Richard McNeill. "The Green Backlash: Scepticism or Scientism?" *Social Epistemology* 23, no. 2 (2009): 145-163.

Dowd, E. Thomas, and Angela N. Roberts Miller. "Tacit Knowledge Structures in the Negotiation Process." In *Psychological and Political Strategies for Peace Negotiation: A Cognitive Approach* , by Francesco Aquilar, & Mauro (Editors Galluccio, 75-86. New York: Springer, 2011.

Drabeck, Thomas E., and Enrico L. Quarantelli. "Scapegoats, Villains and Disasters." *Trans-Action* 4, no. 4 (March 1967): 12-17.

Du Pisani, Jacobus A. "Sustainable development – historical roots of the concept." *Environmental Sciences* 3, no. 2 (2006): 83-96.

Duggins, D. O., J. E. Eckman, and A. T. Sewell. "Ecology of understory kelp environments II: effects of kelps on recruitment of benthic invertebrates." *Journal of Experimental Marine Biology and Ecology* 143 (1990): 27-45.

Eccleston, Charles H. "Domestic versus International Perspectives." *Environmental Practice*, no. 4 (December 2004): 276-277.

Eclles, J. S., and A. Wigfield. "Motivational beliefs, values and goals." *Annual Review of Psychology* 53 (2002): 109-132.

Edayat, Fadi. "Suspected arson sparks flames in same area Carmel fire began." *Haaretz.* December 22, 2010. http://www.haaretz.com/news/national/suspected-arson-sparks-flames-in-same-area-carmel-fire-began-1.332273 (accessed January 6, 2014).

El-Eini, Roza I.M. *Mandated Landscape: British Imperial Rule in Palestine, 1929-1948.* New York: Routledge, 2006.

Engel, S., S. Pagiola, and S. Wunder. "Designing payments for environmental services in theory and practice: an overview of the issues." *Ecological Economics* 65, no. 4 (2008): 663-674.

Escobar, Arturo. "After Nature: Steps to an Antiessentialist Political Ecology." *Current Anthropology* 40, no. 1 (February 1999): 1-30.

Espinosa-Romero, Maria J., Edward J. Gregr, Carl Walters, Villy Christensen, and Kai M. A. Chan. "Representing mediating effects and species reintroductions in Ecopath with Ecosim." *Ecological Modelling* 222, no. 9 (May 2011): 1569-1579.

Ettinger, Yair. "Yishai: I'm being lynched because I am ultra-Orthodox, right-wing and Mizrahi." *Haaretz.* December 6, 2010. http://www.haaretz.com/print-edition/news/yishai-i-m-being-lynched-because-i-am-ultra-orthodox-right-wing-and-mizrahi-1.329065 (accessed January 6, 2014).

Eubanks, P. "The story of conceptual metaphor: what motivates metaphoric mappings?" *Poetics Today* 20, no. 3 (1999): 419-442.

Evans, Jonathan St. B. T. "Dual-Processing Accounts of Reasoning, Judgment, and Social Cognition." *Annual Review of Psychology* 59 (January 2008): 255-278.

Faber, M., T. Petersen, and J. Schiller. "Homo oeconomicus and homo politicus in ecological economics." *Ecological Economics* 40, no. 3 (2002): 323-333.

Falah, Ghazi. "How Israel Controls the Bedouin in Israel." *Journal of Palestine Studies* 14, no. 2 (1985): 35-51.

Falah, Salman. *The Druze in the Middle East.* Druze Research & Publications Institute , 2002.

Fauconnier, G., and M. Turner. *The way we think: conceptual blending and the mind's hidden complexities.* New York: Basic Books, 2002.

Fehr, E., and S. Gachter. "Fairness and retaliation: the economics of reciprocity." *Journal of Economi Perspectives* 14, no. 3 (2000): 159-181.

Fein, Steven, and Steven J. Spencer. "Prejudice as self-image maintenance: Affirming the self through derogating others." *Journal of Personality and Social Psychology* 73, no. 1 (July 1997): 31-44.

Finucane, M. L., A. Alhakami, P. Slovic, and S. M. Johnson. "The affect heuristic in judgments of risks and benefits." *J. Behav. Dec. Making* 13 (2000): 1-17.

Firro, Kais M. *The Druzes in the Jewish State.* Leiden: Brill, 1999.

Fischer, Carolyn, and Thomas Sterner. "Climate Policy, Uncertainty, and the Role of Technological Innovation." *Journal of Public Economic Theory* 14, no. 2 (March 2012): 285-309.

Fischer, Joern, et al. "Human behavior and sustainability." *Frontiers in Ecology and the Environment* 10, no. 3 (2012): 153-160.

Fisher, B., K. Kulindwa, I. Mwanyoka, R. Kerry Turner, and N. D. Burgess. "Common pool resource management and PES: Lessons and constraints for water PES in Tanzania." *Ecological Economics* 69, no. 6 (2010): 1253-1261.

Fisher, Brendan, and R. Kerry Turner. "Ecosystem services: Classification for valuation ." *Biological Conservation* 141, no. 5 (May 2008): 1167-1169.

Fisher, Edna M. "Habits of the Southern Sea Otter." *American Society of Mammalogists* 20, no. 1 (February 1939): 21-36.

Fisheries and Oceans Canada. "Input from the Community Workshops on the Draft Sea Otter Recovery Action Plan." *Fisheries and Oceans Canada.* Dovetail Consulting. March 2004. http://www.dfo-mpo.gc.ca/Library/284342.pdf (accessed July 8, 2014).

—. *Sea Otters.* April 22, 2013. http://www.dfo-mpo.gc.ca/science/publications/article/2010/11-25-10-eng.html (accessed July 8, 2014).

Folke, Carl. "Resilience: The emergence of a perspective for social–ecological systems analyses." *Global Environmental Change* 16, no. 3 (August 2006): 253–267.

Folke, Carl, Steve Carpenter, Thomas Elmqvist, Lance Gunderson, C.S. Holling, and Brian Walker. "Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations." *Ambio* 31, no. 5 (2002): 437-440.

Fong, C. "Social preferences, self-interest, and the demand for redistribution ." *Journal of Public Economics* 82, no. 2 (2001): 225-246.

Forgas, J., ed. *Feeling and thinking: the role of affect in social cognition.* Cambridge: Cambridge University Press, 2000.

Forsyth, Tim. "Political ecology and the epistemology of social justice." *Geoforum* 39, no. 2 (March 2008): 756-764.

Frank, R.H. "If Homo economicus could choose his own utility function, would he want one with a conscience?" *American Economic Review* 77, no. 4 (1987): 593-604.

Frankenberg, Eliezer (Deputy Chief Scientist, Israel Nature and Parks Authority). Personal communication (September 29, 2009).

Frey, B. "How intrinsic motivation is crowded out and in." *Rationality and Society* 6, no. 3 (1994): 334-352.

Fu, Wai-Tat, and Wayne D. Gray. "Suboptimal tradeoffs in information seeking." *Cognitive Psychology* 52, no. 3 (May 2006): 195-242.

Fuster, J. M. *Memory in the cerebral cortex: an empirical approach to neural networks in the human and nonhuman primate.* Cambridge, MA: MIT Press, 1999.

Garmestani, Ahjond S., and Melinda Harm Benson. "A Framework for Resilience-based Governance of Social-Ecological Systems." *Ecology and Society* 18, no. 1 (2013): 9.

Gausel, Nicolay, and Colin Wayne Leach. "Concern for self-image and social image in the management of moral failure: Rethinking shame." *European Journal of Social Psychology* 41, no. 4 (June 2011): 468-478.

Gentner, D., and D.R. Gentner. "Flowing waters or teeming clouds: mental models of electricity." In *Mental Models*, edited by D. Gentner, & A. L. Steven, 99-190. New Jersey: Lawrence Erlbaum Associates, 1983.

Gentner, Dedre, and Albert L. Stevens, . *Mental Models.* Florence, KY: Taylor & Francis Group, 1983.

Gephi. 2014. https://gephi.org (accessed February 2014).

Ghorbani, Abdolbaset, Gerhard Langenberger, Liu Feng, and Joachim Sauerborn. "Ethnobotanical study of medicinal plants utilised by Hani ethnicity in Naban River Watershed National Nature Reserve, Yunnan, China." *Journal of Ethnopharmacology* 134, no. 3 (April 2011): 651-667.

Giere, Ronald N., and Barton Moffat. "Distributed Cognition: Where the Cognitive and the Social Merge ." *Social Studies of Science* 33, no. 2 (April 2003): 301-310.

Gigerenzer, G., and D. Goldstein. "Reasoning the fast and frugal way: models of bounded rationality." *Psychological Review* 103, no. 4 (1996): 650-669.

Gigerenzer, Gerd. "Why Heuristics Work." *Perspectives on Psychological Science* 3, no. 1 (January 2008): 19-29.

Gilovitch, T., D. Griffin, and D. Kahneman, . *Heuristics and biases: the psychology of intuitive judgment.* New York: Cambridge University Press, 2002.

Gintis, Herbert. "Beyond Homo economicus: evidence from experimental economics." *Ecological Economics* 35, no. 3 (2000): 311-322.

Girard, Rene. *Things Hidden Since the Foundation of the World.* Stanford: Stanford University Press, 1978.

Godfray, H. Charles J., et al. "Food Security: The Challenge of Feeding 9 Billion People." *Science* 327, no. 5967 (February 2010): 812-818.

Goldstein, N. J., R. B. Cialdini, and V. Griskevicius. "A room with a viewpoint: using social norms to motivate environmental conservation in hotels." *Journal of Consumer Research* 35, no. 3 (2008): 472-482.

Gómez-Baggethun, E., R. de Groot, P. Lomas, and C. Montes. "The history of ecosystem services in economic theory and practice: from early notons to markets and payment schemes." *Ecological Economics* 69, no. 6 (2010): 1209-1218.

An Inconvenient Truth. Film. Directed by Davis Guggenheim. Produced by Paramount Classics, Participant Productions. Performed by Al Gore. 2005.

Gravlee, Clarence C., H. Russell Bernard, Chad R. Maxwell, and Aryeh Jacobsohn. "Mode Effects in Free-list Elicitation: Comparing Oral, Written, and Web-based Data Collection." *Social Science Computer Review* 31, no. 1 (February 2013): 119-192.

Greene, J., and J. Haidt. "How (and where) does moral judgment work?" *Trends in Cognitive Sciences* 6, no. 12 (2002): 517-523.

Gregr, Edward (Principal, SciTech Environmental Consulting). Personal communication (June 4, 2014).

Griggs, David, et al. "Policy: Sustainable development goals for people and planet." *Nature* 495, no. 7441 (March 2013): 305-307.

Haaretz. "In wake of Carmel fire, Eli Yishai must resign." *Haaretz.* December 6, 2010. http://www.haaretz.com/print-edition/opinion/in-wake-of-carmel-fire-eli-yishai-must-resign-1.329094 (accessed January 7, 2014).

—. "World's biggest fire-fighting plane joins fight to contain Carmel blaze." *Haaretz (English).* December 5, 2010. http://www.haaretz.com/news/national/world-s-biggest-fire-fighting-plane-joins-fight-to-contain-carmel-blaze-1.328957 (accessed July 10, 2014).

Haidt, J. *The Happiness Hypothesis.* New York: Basic Books, 2006.

—. "The Emotional Dog and its Rational Tail: A Social Intuitionist Approach to Moral Judgment." *Psychological Review* 108 (2001): 814-834.

Haque, C. Emdad, and David Etkin. "People and community as constituent parts of hazards: the significance of societal dimensions in hazards analysis." *Natural Hazards* 41, no. 2 (2007): 271-282.

Harris, Douglas C. *Fish, Law, and Colonialism: The Legal Capture of Salmon in British Columbia.* Toronto: University of Toronto Press, 2001.

—. *Landing Native Fisheries: Indian Reserves and Fishing Rights in British Columbia, 1849-1925 .* Vancouver: UBC Press, 2008.

Harrison, E. A. and E. E. Watson. "Mind the Gap: Disciplinary Dissonance, Gender, and the Environment." *Society & Natural Resources: An International Journal* 25, no. 9 (2012): 933-944.

Hart, S. J., S. R. Green, M. Casp, and A. Belger. "Emotional priming effects during Stroop task performance." *NeuroImage* 49, no. 3 (2010): 2662-2670.

Haslam, Nick, Louis Rothschild, and Donald Erns. "Essentialist beliefs about social categories." *British Journal of Social Psychology* 39 (2000): 113-127.

Heine, Steven J. *Cultural Psychology.* 2nd. New York: W.W. Norton, 2012.

Helmholtz UFZ. "Scientists: The fire in Israel is a typical example of climate change effects in the Mediterranean." *Helmholtz Center for Envrionmental Research - UFZ.* December 8, 2010. http://www.ufz.de/index.php?en=20837 (accessed January 7, 2014).

Henrich, J, et al. "In search of homo economicus: behavioural experiments in 15 small-scale societies." *American Economic Review* 91, no. 2 (2001): 73-78.

Henrich, Joe, Steven J. Heine, and Ara Norenzayan. "The weirdest people in the world?" *Behavioral and Brain Sciences* 33, no. 2-3 (June 2010): 61-83.

Hickey, D. T., and M. A. McCaslin. "A comparative, sociocultural analysis of context and motivation." In *Motivation in learning contexts: theoretical advances and methodological implications*, edited by S. Volet, & S. Jarvela, 33-56. Oxford: Elsevier Science Ltd., 2001.

Hillerbrand, Rafaela, and Michael Ghil. "Anthropogenic climate change: Scientific uncertainties and moral dilemmas." *Physica D: Nonlinear Phenomena* 237, no. 14-17 (August 2008): 2132-2138.

Hoffman, Andrew J. "Shades of Green." *Stanford Social Innovation Review* 7, no. 2 (2009): 40-49.

Hopwood, Bill, Mary Mellor, and Geoff O'Brien. "Sustainable development: mapping different approaches." *Sustainable Development* 13, no. 1 (2005): 38-52.

Hovel, Revital. "Carmel fire victims' families plan High Court petition to fire Steinitz, Yishai." *Haaretz.* June 22, 2012. http://www.haaretz.com/news/national/carmel-fire-victims-families-plan-high-court-petition-to-fire-steinitz-yishai-1.440312 (accessed January 6, 2012).

—. "Case against teens suspected of starting the Carmel fire is closed ." *Haaretz.* November 24, 2011. http://www.haaretz.co.il/news/science/1.1575172 (accessed January 6, 2014).

Howitt, Richard, and Sandra Suchet-Pearson. "Rethinking the Building Blocks: Ontological Pluralism and the Idea of 'Management'." *Geografiska Annaler. Series B, Human Geography* 88, no. 3 (2006): 323-335.

Hudson, D., R. Karina Gallardo, and Terill R. Hanson. "A Comparison of Choice Experiments and Actual Grocery Store Behaviour: An Emprical Applicatino to Seafood Products." *Journal of Agricultural and Applied Economics* 44, no. 1 (2012): 49-62.

Hume, Mark. "Fisheries stakeholders searching for answers on eve of Cohen report's release ." *The Globe and Mail.* October 29, 2012. http://www.theglobeandmail.com/news/british-columbia/fisheries-stakeholders-searching-for-answers-on-eve-of-cohen-reports-release/article4747889/ (accessed July 24, 2014).

Hurrell, Andrew. *On Global Order: Power, Values, and the Constitution of International Society.* Oxford: Oxford University Press, 2008.

Icaza, Rosalba, and Rolando Vázquez. "Social Struggles as Epistemic Struggles." *Development & Change* 44, no. 3 (May 2013): 683-704.

Ingebrigsten, S., and O. Jakobsen. "Moral development of the economic actor." *Ecological Economics* 68, no. 11 (2009): 2777-2784.

INPA. "The History of Man's Influence on Natural Factors on the Carmel (Hebrew)." Internal report. 2012.

Israel Central Bureau of Statistics. *Settlements and Other Geographical Regions.* 2012. http://www1.cbs.gov.il/reader/?MIval=cw_usr_view_SHTML&ID=807 (accessed November 25, 2013).

Jabareen, Yosef. "A New Conceptual Framework for Sustainable Development." *Environment, Development and Sustainability* 10, no. 2 (April 2008): 179-192.

Jackson, T. "Evolutionary psycjology in ecological economics: consilience, consumption and contentment." *Ecological Economics* 41 (2002): 289-303.

Jaeger, Tilman. *New Prospects for the MAB Programme and Biosphere Reserves.* Division of Ecological Sciences, UNESCO, Paris: UNESCO (South-South Cooperation Program), 2005.

Jager, W., M. A. Janssen, H. J. M. De Vries, J. De Greef, and Vlek C. A. J. "Behaviour in commons dilemmas: homo economicus and homo psychologius in an ecological-economic model." *Ecological Economics* 35, no. 3 (2000): 357-379.

Jay, Stephen, Carys Jones, Paul Slinn, and Christopher Wood. "Environmental impact assessment: Retrospect and prospect." *Environmental Impact Assessment Review* 27, no. 4 (May 2007): 287-300.

Jenkins, Martin. "Prospects for Biodiversity." *Science* 302, no. 5648 (November 2003): 1175-1177.

Jessup, David A., et al. "Southern Sea Otter as a Sentinel of Marine Ecosystem Health." *EcoHealth* 1 (2004): 239–245.

Johansen, Anders, and Didier Sornette. "Finite-time singularity in the dynamics of the world population, economic and financial indices." *Physica A* 294, no. 3-4 (May 2001): 465-502.

Johnson, Fred A., B. Ken Williams, and James D. Nichols. "Resilience Thinking and a Decision-Analytic Approach to Conservation: Strange Bedfellows or Essential Partners?" *Ecology and Society* 18, no. 2 (2013): 27.

Johnson-Laird, Philip N. "Mental models and deduction." *Trends in Cognitive Sciences* 5, no. 10 (October 2001): 434-442.

Jollands, N. "Concepts of efficiency in ecologial economics: Sisyphus and the decision maker." *Ecological Economics* 56, no. 3 (2006): 359-372.

Jones, Natalie A., Helen Ross, Timothy Lynam, Pascal Perez, and Anne Leitch. "Mental Models: An Interdisciplinary Synthesis of Theory and Methods." *Ecology and Society* 16, no. 1 (2011): 46.

JPost. "MK Michaeli: Carmel arsonists should be tried for treason." *The Jerusalem Post.* December 5, 2010. http://www.jpost.com/Breaking-News/MK-Michaeli-Carmel-arsonists-should-be-tried-for-treason (accessed January 7, 2014).

Kahneman, D., and J. Knetsch. "Valuing public goods: the purchase of moral satisfaction." *Journal of Environmental Economics and Management* 22, no. 1 (1992): 57-70.

Kahneman, D., and S. Frederick. "Representativeness revisited: Attribute substitution in intuitive judgment." In *Heuristics and Biases*, edited by T. Gilovich, D. Griffin, & D. Kahneman, 49-81. New York: Cambridge University Press, 2002.

Kahneman, Daniel. "A perspective on judgment and choice: mapping bounded rationality." *American Psychologist* 58, no. 9 (2003): 697-720.

Kahneman, Daniel, Paul Slovic, and Amos Tversky. *Judgment under Uncertainty: Heuristics and Biases.* Cambridge: Cambridge University Press, 1982.

Karez, Claudia (Programme Director, MAB MERCOSUR). Montevideo, (April 10, 2010).

Keller, Carmen, Michael Siegrist, and Heinz Gutscher. "The Role of the Affect and Availability Heuristics in Risk Communication." *Risk Analysis* 26, no. 3 (2006): 631-639.

Kemp-Benedict, Eric. "Inequality and Trust: Testing a Mediating Relationship for Environmental Sustainability." *Sustainability* 5, no. 2 (2013): 779-788.

Keren, Gideon, and Leonie E.M. Gerritsen. "On the robustness and possible accounts of ambiguity aversion." *Acta Psychologica* 103, no. 1 (November 1999): 149-172.

Kerwin, Ann. "None Too Solid: Medical Ignorance." *Science Communication* 15, no. 2 (1993): 166-185.

Kissinger, G., C. Patterson, and G. Neufeldt. *Payments for ecosystem services schemes: project-level insights on benefits for ecosystem and the rural poor.* Working Paper, Nairobi: World Agroforestry Centre, 2013.

Kleinberg, Katja B., and Benjamin O. Fordham. "The Domestic Politics of Trade and Conflict." *International Studies Quarterly* 57, no. 3 (2013): 605-619.

Klockner, C. A., E. Matthies, and M. Hunecke. "Problems of operationalizing habits and integrating habits in normative decision-making models." *Journal of Applied Social Psychology* 33, no. 2 (2003): 396-417.

Knesset. "Argana Commission." *The Knesset.* 2008. http://www.knesset.gov.il/lexicon/eng/agranat_eng.htm (accessed January 8, 2014).

Knight, Trevor. "Electoral justice for aboriginal people in Canada." *McGill Law Journal* 46, no. 4 (2001): 1063.

Kokinov, B.N., and A.A. Petrov. "Integrating memory and reasoning in analogy-making: the AMBR model." In *The analogical mind: perspectives from cognitive science*, edited by D. Genter, K. J. Holyoak, & B. N. Kokinov, 59-124. Cambridge, MA: MIT Press, 2001.

Kolodner, J. "An introduction to case-based reasoning." *Artificial Intelligence Review* 6 (1992): 3-34.

Kriegler, Elmar, Jim W. Hall, Hermann Held, Richard Dawson, and Hans Joachim Schellnhuber. "Imprecise probability assessment of tipping points in the climate system." *PNAS* 106, no. 13 (March 2009).

Kronenfeld, David. "Cultural models." *Intercultural pragmatics* 5, no. 1 (2008): 67-74.

Kuhn, Rachel A., Hermann Ansorge, Szymon Godynycki, and Wilfried Meye. "Hair density in the Eurasian otter Lutra lutra and the Sea otter Enhydra lutris." *Acta Theriologica* 55, no. 3 (September 2010): 211-222.

Kuper, Adam. "The Return of the Native." *Current Anthropology* 44, no. 3 (June 2003): 389-402.

Kuran, Timur, and Cass R. Sunstein. "Availability Cascades and Risk Regulation." *Stanford Law Review* 51, no. 4 (April 1999): 683-768.

Kusev, P., P. van Schaik, and S. Aldrovandi. "Preferences induced by availability: evidence from priming." *Journal of Neuroscience, Psychology and Economics* 5, no. 4 (2012): 250-258.

Lakoff, G. "Cognitive models and prototype theory." In *The cognitive linguistics reader*, edited by V. Evans, B. Bergen, & J. Zinken, 130-167. London: Equinox, 2007.

—. "The contemporary theory of metaphor." In *Metaphor and thought*, edited by A. Ortony, 202-252. Cambridge: Cambridge University Press, 1993.

Lakoff, G., and M. Johnson. *Philosophy in the flesh: the embodied mind and its challenge to western thought.* New York: Basic Books, 1999.

Langenohl, Andreas. "History between Politics and Public: Historiography, Collective Memory, and the "Archival Revolution" in Russia." *Kritika* 1, no. 3 (2000): 559-569.

Langhelle, Oluf. "Sustainable Development and Social Justice: Expanding the Rawlsian Framework of Global Justice." *Environmental Values* 9, no. 3 (2000): 295-323.

Lau, RIchard R., and David P. Redlawsk. "Advantages and Disadvantages of Cognitive Heuristics in Political Decision Making." *American Journal of Political Science* 45, no. 4 (October 2001): 951-971.

Lavine, H. "On the primacy of affect in the determination of attitudes and behaviour: the moderating role of affective-cognitive ambivalence." *Journal of Experimental Social Psychology* 34, no. 4 (1998): 398-421.

Lee, Olivia A., Paul Olivier, Ryan Wolt, and Randall W. Davis. "Aggregations of Sea Otters (Enhydra lutris kenyoni) Feeding on Fish Eggs and Kelp in Prince William Sound, Alaska." *American Midland Naturalist* 161, no. 2 (2009): 401-405.

Leiserowitz, A. "Climate change risk perception and policy preferences: the role of affect, imagery and values." *Climatic Change* 77, no. 1-2 (2006): 45-72.

Lempert, Robert, Nebojsa Nakicenovic, Daniel Sarewitz, and Michael Schlesinger. "Characterizing Climate-Change Uncertainties for Decision-Makers." *Climatic Change* 65, no. 1-2 (2004): 1-9.

Lertzman, David A., and Harrie Vredenburg. "Indigenous Peoples, Resource Extraction and Sustainable Development: An Ethical Approach." *Journal of Business Ethics* 56 (2005): 239-254.

Lewicki, P, H. Hoffman, and M. Czyzewska. "Unconscious acquisition of complex procedural knowledge." *Journal of Experimental Psychology* 13, no. 4 (1987): 523-530.

Lichtenstein, S., and P. Slovic, . *The construction of preference.* New York: Cambridge University Press, 2006.

Lillard, Charles. "Writers for Clayoquot." *Manoa* 25, no. 1 (2013): 141-143.

Liphschitz, Nili, and Gideon Biger. *Green Dress for a Country.* Jerusalem: Ariel Publishing House, 2004.

Lis, Jonathan. "'Loyalty-citizenship' laws." *Haaretz.* November 17, 2011. http://www.haaretz.com/black-flag-over-israel-s-democracy/black-flag-facts-and-figures/loyalty-citizenship-laws-1.396117 (accessed July 10, 2014).

Liu, Jianguo, et al. "Complexity of Coupled Human and Natural Systems." *Science* 317, no. 5844 (2007): 1513-1516.

Liu, Leigh Anne. "Shared Mental Models in Negotiation." Nashville, TN: Graduate School of Vanderbilt University, August 2004.

Loomis, John. "Estimating Recreation and Existence Values of Sea Otter Expansion in California Using Benefit Transfer." *Coastal Management* 34, no. 4 (October 2006): 387-404.

Lowenstein, G. F., C. K. Hsee, E. U. Weber, and N. Welch. "Risk as feelings." *Psychological Bulletin* 127, no. 2 (2001): 267-286.

Lynam, T., et al. "Waypoints on a Journey of Discovery: Mental Models in Human-Environment Interactions." *Ecology and Society* 17, no. 3 (2012): 23.

Lynam, Timothy, and Katrina Brown. "Mental Models in Human–Environment Interactions: Theory, Policy Implications, and Methodological Explorations ." *Ecology and Society* 17, no. 3 (2011): 24.

MacDonald, David B., and Graham Hudson. "The Genocide Question and Indian Residential Schools in Canada." *Canadian Journal of Political Science* 45, no. 2 (June 2012): 427-449.

Macnaghten, P., and M. Jacobs. "Public identification with sustainable development: investigating cultural barriers to participation." *Global Environmental Change* 7, no. 1 (1997): 5-24.

Macrae, C. Neil, Alan B. Milne, and Galen V. Bodenhausen. "Stereotypes as energy-saving devices: A peek inside the cognitive toolbox." *Journal of Personality and Social Psychology* 66, no. 1 (1994): 37-47.

Maertens, Annemie. "Social Norms and Aspirations: Age of Marriage and Education in India." *World Development* 47 (July 2013): 1-15.

Magnani, L., and N. J. Nersessian, . *Model-based reasoning: science, technology, values.* New York: Springer, 2002.

Malan, Djah F., and Danho F.R. Neuba. "Traditional Practices and Medicinal Plants Use during Pregnancy by Anyi-Ndenye Women." *African Journal of Reproductive Health* 15, no. 1 (March 2011): 85-93.

Markel, Russel Wayne. *Rockfish recruitment and trophic dynamics on the west coast of Vancouver Island: fishing, ocean climate and sea otters.* Vancouver, BC, August 2011.

Markus, H., and S. Kitayama. "Culture and the self: implications for cognition, emotion and motivation." *Psychological Review* 98, no. 2 (1991): 224-253.

Mati, Evan, and Hugo de Boer. "Ethnobotany and trade of medicinal plants in the Qaysari Market, Kurdish." *Journal of Ethnopharmacology* 133 (2011): 490-510.

McDaniels, T., R. Gregory, J. Arvai, and R. Chuenpagdee. "Decision structuring to alleviate embedding in environmental evaluation." *Ecological Economics* 46, no. 1 (2003): 33-46.

McKechnie, Iain. "Investigating the complexities of sustainable fishing at a prehistoric village on western Vancouver Island, British Columbia, Canada." *Journal for Nature Conservation* 15, no. 3 (October 2007): 208-222.

McMilan, Alan D. *Since the Time of the Transformers: the Ancient Heritage of the Nuu-chah-nulth, Ditidaht and Makah.* Vancouver: UBC Press, 1999.

Mebratu, Desta. "Sustainability and sustainable development: Historical and conceptual review." *Environmental Impact Assessment Review* 18, no. 6 (November 1998): 493-520.

Medin, Douglas, and Scott Atran. *Folkbiology.* Cambridge, Massachusetts: The MIT Press, 1999.

—. "The native mind: Biological categorization and reasoning in development and across cultures." *Psychological Review* 111, no. 4 (2004): 960-983.

Medin, Douglas, Norbert Ross, Douglas Cox, and Scott Atran. "Why Folkbiology Matters: Resource Conflict Despite Shared Goals and Knowledge." *Human Ecology* 35 (2007): 315-329.

Menzel, Susanne, and Jack Teng. "Ecosystem Services as a Stakeholder-Driven Concept for Conservation Science." *Conservation Biology* 24, no. 3 (2009): 909.

Millennium Ecosystem Assessment. *Ecosystems and Human Well-being: Synthesis.* Washington, DC: Island Press, 2005.

Miloslavljevic, M., V. Navalpakkam, C. Koch, and A. Rangel. "Relative visual saliency differences induce sizable bias in consumer choice." *Journal of Consumer Psychology* 22 (2012): 64-74.

Minteer, Ben A. *Refounding Environmental Ethics: Pragmatism, Principle, and Practice*. Philadelphia, PA: Temple University Press, 2011.

Mischel, Walter. "From Personality and Assessment (1968) to Personality Science, 2009." *Journal of Research in Personality* 43 (2009): 282-290.

Mitcham, Carl. "The concept of sustainable development: its origins and ambivalence." *Technology and Society* 17, no. 3 (1995): 311-326.

Monroe, Kristen Renwick, and Kristen Hill Maher. "Psychology and Rational Actor Theory." *Political Psychology* 16, no. 1 (March 1995): 1-21.

Munz, Peter. *Philosophical Darwinism.* London: Taylor & Francis, 1993.

Murphy, S., and R. B. Zajonc. "Affect, cognition and awareness: affective priming with optimal annd suboptimal stimulus exposures." *Journal of Personality and Social Psychology* 64, no. 5 (1993): 723-739.

Nachshoni, Kobi. "Rabbi Ovadia hints the fire was caused by desecration of the Sabbath." *Ynet.* December 4, 2010. http://www.ynet.co.il/articles/0,7340,L-3994273,00.html (accessed July 11, 2014).

Nana10 News. "Special Knesset Report on the Carmel Disaster: "The Writing [was] on the Wall" (Hebrew)." *Nana10.* Deecmber 6, 2010. http://news.nana10.co.il/Article/?ArticleID=764051&TypeID=0 (accessed January 7, 2014).

Natter, Wolfgang, and Wolfgang Zierhofer. "Political ecology, territoriality and scale." *GeoJournal* 58 (2002): 225-231.

Nature. "Climate costs." *Nature* 461, no. 7261 (September 2009): 150.

Naveh, Zev. "Ancient man's impact on the Mediterranean landscape in Israel--Ecological and evolutionary perspectives." In *Man'r Role in the Shaping of the Eastern Mediterranean Landscape*, by Sytze Bottema, Gertie Entjes-Nieborg, & Willem van Zeist, 43-52. Rotterdam: A.A. Balkema, 1990.

Nayar, Pramod K. "Disaster Communications: Media, Crisis and Representation." *Journal of Creative Communications* 7, no. 1 (2012): 1-3.

Nekola, Jeffrey C,, et al. "The Malthusian–Darwinian dynamic and the trajectory of civilization." *Trends in Ecology & Evolution* 28, no. 3 (March 2013): 127-130.

Nissan, Mordechai. "The Druze in Israel: Questions of Identity, Citizenship and Patriotism." *The Middle East Journal* 64, no. 4 (2010): 575-596.

Noelle-Neumann, Elizabeth. *The spiral of silence: public opinion, our social skin.* Chicago: University of Chicago Press, 1993.

Norton, B,, and D. S. Noonan. "Ecology and valuation: big changes needed." *Ecological Economics* 64, no. 3 (2007): 644-675.

Oguamanam, Chidi. "Tension on the Farm Fields: The Death of Traditional Agriculture?" *Bulletin of Science, Technology & Society* 27, no. 4 (2007): 260-273.

Ohman, A. "Emotion drives attention: detecting the snake in the grass." *Journal of Experimental Psychology* 130, no. 3 (2001): 466-478.

Okerlund, Lana. "Taking Aim at Otters." *The Tyee.* October 5, 2007. http://thetyee.ca/News/2007/10/05/Otters2/ (accessed July 17, 2014).

Opsahl, T., Agneessens, F. and J. Skvoretz. "Node centrality in weighted networks: generalizing degree and shortest paths." *Social Networks* 32, no. 3 (2010): 245-251

Oster, Marcy. "After Israel's deadly fire, mourning, vows to rebuild and finger pointing ." *JTA.* December 6, 2010. http://www.jta.org/2010/12/06/news-opinion/israel-middle-east/after-israels-deadly-fire-mourning-vows-to-rebuild-and-finger-pointing (accessed November 25, 2013).

Ostrom, Elinor. "A Behavioural Approach to the Rational Choice Theory of Collective Action." *American Political Science Review* 92, no. 1 (March 1998): 1-21.

—. "A General Framework for Analyzing Sustainability of Social-Ecological Systems." *Science* 325, no. 419 (2009): 419-422.

Ostrom, Elinor, and Marco A. Janssen. "Multi-Level Governance and Resilience of Social-Ecological Systems." In *Globalization, Poverty and Conflict*, edited by Max Spoor, 239-259. Kluwer Academic Publishers, 2004.

Otters holding hands. February 2007. http://www.youtube.com/watch?v=epUk3T2Kfno (accessed February 20, 2014).

Oxford Poverty and Human Development Initiative. "Global MPI 2014: Key findings." *OPHI.* June 2014. http://www.ophi.org.uk/multidimensional-poverty-index/mpi-2014/ (accessed July 3, 2041).

Page, Justin. "Salmon Farming in First Nations' Territories: A Case of Environmental Injustice on Canada's West Coast." *Local Environment* 12, no. 6 (December 2007): 613-626.

Parks, Bradley C., and J. Timmons Robers. "Globalization, Vulnerability to Climate Change, and Perceived Injustice." *Society & Natural Resources* 19, no. 4 (2006): 337-355.

Parsons, Laila. *The Druze between Palestine and Israel 1947-1949.* London: Macmillan Press Ltd., 2000.

Pauker, K. "Race salience and essentialist thinking in racial stereotype development." *Child Development* 81, no. 6 (2010): 1799-1819.

Pawloswki, Arthur. *Sustainable Development as a Civilizational Revolution : A Multidisciplinary Approach to the Challenges of the 21st Century.* Boca Raton, FL: CRC Press, 2011.

Paz, Uzi (Former Director, National Parks Authority). (January 2012).

Pepper, David. "Tensions and Dilemmas of Ecotopianism." *Environmental Values* 16, no. 3 (August 2007): 289-312.

Persky, Joseph. "Retrospectives: The Ethology of Homo Economicus." *The Journal of Economic Perspectives* 9, no. 2 (Spring 1995): 221-231.

Pessoa, L. "On the relationship between emotion and cognition ." *Nature Reviews Neuroscience* 9, no. 148-158 (2008).

Peters, Ellen, Daniel Vastfjall, Tommy Garling, and Paul Slovic. "Affect and decision making: a "hot" topic." *Journal of Behavioral Decision Making* 19, no. 2 (2006): 79-85.

Peterson, Jordan B. (*Professor of Psychology, University of Toronto*) Interview (April 26, 2014).

—. *Maps of Meaning.* New York: Routledge, 1999.

Peterson, Jordan B., and Joseph L. Flanders. "Complexity Management Theory: Motivation for Ideological Rigidity and Social Conflict." *Cortex* 38 (2002): 429-458.

Pinkerton, Evelyn, and Danielle N. Edwards. "The elephant in the room: The hidden costs of leasing individual transferable fishing quotas ." *Marine Policy* 33, no. 4 (July 2009): 707-713.

Pittock, A. Barrie, Roger N. Jones, and Chris D. Mitchell. "Probabilities will help us plan for climate change." *Nature* 413 (September 2001): 249.

Pradhan, Manas Ranjan, and Usha Ram. "Perceived gender role that shape youth sexual behaviour: Evidence from rural Orissa, India." *Journal of Adolescence* 33, no. 4 (2010): 543-551.

Prentice, Deborah A., and Dale T. Miller. "Pluralistic Ignorance and the Perpetuation of Social Norms by Unwitting Actors." *Advances in Experimental Social Psychology* 28 (1996): 161-209.

Prokhovnik, Raia. *Rational Woman: A feminist critique of dichotomy.* Florence, KY: Routledge, 1999.

Ratner, Blake D. "“Sustainability” as a Dialogue of Values: Challenges to the Sociology of Development." *Sociological Inquiry* 74, no. 1 (2004): 50-69.

Raved, Ahiya. "Druze protestors torch police station." *Ynet News.* September 1, 2009. http://www.ynetnews.com/articles/0,7340,L-3770739,00.html (accessed December 4, 2013).

Ravetz. "The post-normal science of precaution ." *Futures* 36, no. 3 (April 2004): 347-357.

Raymond, Christopher M., et al. "Ecosystem Services and Beyond: Using Multiple Metaphors to Understand Human-Environment Relationships." *BioScience* 63, no. 7 (2013): 536-546.

Read, J. D. "The availability heuristic in person identification: the sometimes misleading consequences of enhanced contextual information." *Applied Cognitive Psychology* 9 (1995): 91-121.

Redclift, Michael. "Sustainable development (1987-2005): an oxymoron comes of age." *Sustainable Development* 13, no. 4 (October 2005): 212-227.

Rees, Geriant. "Vision: The Evolution of Change Detection ." *Current Biology* 18, no. 1 (January 2008): R40-R-42.

Rees, William E., and Mathis Wackernagel. "The Shoe Fits, but the Footprint is Larger than Earth." *PLoS Biol* 11, no. 11 (2013): 1-3.

Reuveny, Raphael. "Taking Stock of Malthus: Modeling the Collapse of Historical Civilizations." *Annual Review of Resource Economics* 4 (August 2012): 303-329.

Rice, Jake. "The British Columbia Rockfish Trawl Fishery." *FAO Corporate Document Repository.* 2002. http://www.fao.org/docrep/007/y5242e/y5242e0f.htm (accessed July 24, 2014).

Robinson, John. "Squaring the circle? Some thoughts on the idea of sustainable development." *Ecological Economics* 48, no. 4 (2004): 369-384.

Robinson, Michael P. *Sea Otter Chiefs.* Calgary: Bayeux Arts, 1996.

Rodríguez-Labajos, Beatriz, and Joan Martínez-Alier. "The Economics of Ecosystems and Biodiversity: Recent Instances for Debate." *Conservation & Society* 11, no. 4 (2013): 326-342.

Roemer, Lizabeth, Susan M. Orsillo, T.D. Borkovec, and Brett T. Litz. "Emotional response at the time of a potentially traumatizing event and PTSD symptomatology: A preliminary retrospective analysis of the DSM-IV Criterion A-2." *Journal of Behavior Therapy and Experimental Psychiatry* 29, no. 2 (June 1998): 123-130.

Roeser, S. "Risk communication, public engagement, and climate change: a role for emotions." *Risk Analysis* 32, no. 6 (2012): 1033-1040.

Ronen, Gil. "Fire or a Massacre? Israeli Media Downplays Arson Suspicion." *Arutz Sheva.* December 2, 2010. http://www.israelnationalnews.com/News/News.aspx/140974#.UpPkKGTwKap (accessed November 25, 2103).

Ropke, I. "Trends in the development of ecological economics from the late 1980s to the early 2000s." *Ecological Economics* 55, no. 2 (2005): 262-290.

Rosas, Pedra Araya, and Miguel Clusener-Godt, . *Reservas de la Biosfera: Su contribucion a la provision de servicios de los ecosistemas--Experiencias exitosas en Iberoamerica.* Paris: Editorial Valente Ltda., 2010.

Rosenberg, Ben (Carmel Region Ecologist, Israel Nature and Parks Authority). Personal communication (July 24, 2011).

Ross, Norbert, Doug Medin, and Doug Cox. "Epistemological Models and Culture Conflict: Menominee and Euro-American Hunters in Wisconsin." *Ethos* 35, no. 4 (December 2007): 478-515.

Roth, Alvin E., Prasnikar Vesna, Masahiro Okuno-Fujiwara, and Shmuel Zamir. "Bargaining and Market Behavior in Jerusalem, Ljubljana, Pittsburgh, and Tokyo: An Experimental Study." *American Economic Review* 81, no. 5 (December 1991): 1068-1095.

Ruth, M. "A quest for the economics of sustainability and the sustainability of economics." *Ecological Economics* 53, no. 3 (2006): 332-342.

Saab, David. "A conceptual investigation of the ontological commensurability of spatial data infrastructures among different cultures." *Earth Science Informatics* 2, no. 4 (2009): 283-297.

Safriel, Uriel. "The Biosphere Reserve--a paradigm shift in nature conservation? (Presentation)." *Climate Change & Forest Fires in the Mediterranean Basin: Management and Risk Reduction.* Ministry of Environmental Protection (Israel), 2012.

Sakschewski, Boris, Werner von Bloh, Veronika Huber, Christoph Muller, and Alberte Bondeau. "Feeding 10 billion people under climate change: How large is the production gap of current agricultural systems?" *Ecological Modelling* 288 (2014): 103-111.

Sarkar, Sahotra. " Conservation Biology: the new consensus (Preface) ." *Journal of Biosciences* 27, no. 4 (2002): i-iv.

Schaller, Mark, Lucian Gideon III Conway, and Tracy L. Tanchuk. "Selective pressures on the once and future contents of ethnic stereotypes: Effects of the communicability of traits." *Journal of Personality and Social Psychology* 82, no. 6 (June 2002): 861-877.

Schlapfer, F., and B. Fischhoff. "Task familiarity and contextual cues predict hypothetical bias in a meta-analysis of state preference studies." *Ecological Economics* 81 (2012): 44-47.

Schreiber, Dorothy, and Diane Newell. "Negotiating TEK in BC Salmon Farming: Learning from Each Other or Managing Tradition and Eliminating Contention?" *BC Studies* 150 (2006): 79-102, 147-148.

Schulkin, Jay. "Pragmatism and the cognitive and neural sciences." *Psychological Reports* 78 (1996): 499-506.

Schulter, A. "Institutional change and ecological economics: the role of mental models and sufficient reason." *Institutions and Sustainability* 4 (2009): 315-340.

Seidl, Irmi, and Clem A. Tisdell. "Carrying capacity reconsidered: from Malthus' population theory to cultural carrying capacity." *Ecological Economics* 31, no. 3 (1999): 395-408.

Sen, A. K. *On ethics and economics.* Oxford: Blackwell, 1988.

—. "Rational fools: a critique of the behavioral foundations of economic theory." *Philosophy and Public Affairs* 6, no. 4 (1997): 317-344.

Shadmi, Erella. "Gendering and racilaizing israeli jewish ashkenazi whiteness." *Women's Studies International Forum* 26, no. 3 (May-June 2003): 205-219.

Shah, Anuj K., and Daniel M. Oppenheimer. "Heuristics made easy: An effort-reduction framework." *Psychological Bulletin* 134, no. 2 (March 2008): 207-222.

Shantz, Jeffrey. "Scarcity and the Emergence of Fundamentalist Ecology." *Critique of Anthropology* 23, no. 2 (2003): 144-154.

Shi, T. "Ecological economics as a policy science: rhetoric or commitment towards an improved decision-making process on sustainability." *Ecological Economics* 48, no. 1 (2004): 23-36.

Shore, B. *Culture in mind: cognition, culture and the problem of meaning.* Oxford: Oxford University Press, 1996.

Shove, E. "Beyond the ABC: climate change policy and theories of social change." *Environment and Planning A* 42 (2010): 1273-1285.

Siebenhuner, B. "Homo sustinens: towards a new conception of humans for the science of sustainability." *Ecological Economics* 32, no. 1 (2000): 15-25.

Simon, Herbert A. *Models of bounded rationality.* Cambridge, MA: MIT Press, 1982.

Singh, Gerald, Russell W. Markel, Rebecca G. Martone, Anne K. Salomon, Christopher D. G. Harley, and Kai M. A. Chan. "Sea otters homogenize mussel beds and reduce habitat provisioning in a rocky intertidal ecosystem." *PloS One* 8, no. 5 (May 2013).

Slade, S. "Case-based reasoning: a research paradigm." *AI Magazine* 21, no. 42 (1991): 55.

Slingerland, Edward. "Conceptual Metaphor Theory as Methodology for Comparative Religion." *Journal of the American Academy of Religion* 72, no. 1 (2004): 1-31.

—. *What Science Offers the Humanities: Integrating Body and Culture.* Cambridge: Cambridge University Press, 2008.

Slovic, P., Fincucane. M. L., E. Peters, and D. G. MacGregor. "The affect heuristic." *European Journal of Operational Research* 177, no. 3 (2007): 1333-1352.

Slovic, Paul. "Trust, Emotion, Sex, Politics, and Science: Surveying the Risk-Assessment Battlefield." *Risk Analysis* 19, no. 4 (August 1999): 689-701.

Slovic, Paul, Melissa Finucane, Ellen Peters, and Donald G. MacGregor. "Risk as Analysis and Risk as Feelings: Some Thoughts about Affect, Reason, Risk, and Rationality." *Risk Analysis* 24, no. 2 (April 2004): 311-322.

Small, J. Kenneth. "Confronting a Surfeit of People: Reducing Global Human Numbers to Sustainable Levels An Essay on Population Two Centuries after Malthus." *Environment, Development and Sustainability* 4, no. 1 (2002): 21-50.

Smith, Adrian, and Andy Sterling. "The post-normal science of precaution." *Ecology and Society* 15, no. 1 (2010): 11.

Smith, Barry. "Formal ontology, common sense and cognitive science." *Int. J. Human-Computer Studies* 43 (1995): 641-667.

Smith, E. T., and G. R. Semin. "Socially situated cognition: cognition in its social context." *Advances in Experimental Social Psychology* 36 (2004): 53-117.

Smith, Gregory Bruce. "Environmentalism, postmodernity, and political philosophy." *Perspectives on Political Science* 27, no. 1 (1998): 21-31.

Smith, J. Jerome, and Stephen P. Borgatti. "Salience Counts—And So Does Accuracy: Correcting and Updating a Measure for Free-List-Item Salience." *Journal of Linguistic Anthropology* 7, no. 2 (1997): 208-209.

Spash, C. "New foundations for ecological economics." *Ecological Economics* 77 (2012): 36-47.

Springer, Nathaniel P., and Faye Duchin. "Feeding Nine Billion People Sustainably: Conserving Land and Water through Shifting Diets and Changes in Technologies." *Environ. Sci. Technol.* 48, no. 8 (2014): 4444–4451.

Stanislawsky, Michael. *Zionism and the Fin de Sielce: Cosmopolitanism and Nationalism from Nordau to Jabotinsky.* Berkeley, California: University of California Press, 2001.

Stanovich, K. E., and R. F. West. "Individual differences in reasoning: implications for the rationality debate?" *Behavioural and Brain Sciences* 23 (2000): 545-726.

Statistics Canada. *Population, urban and rural, by province and territory.* 02 04, 2011. http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/demo62a-eng.htm (accessed July 8, 2014).

Steffen, Will, et al. "The Anthropocene: From Global Change to Planetary Stewardship ." *Ambio* 40, no. 7 (November 2011): 739-761.

Stocking, S. Holly, and Lisa W. Holstein. "Manufacturing doubt: journalists' roles and the construction of ignorance in a scientific controversy." *Public Understanding of Science* 18, no. 1 (September 2008): 23-42.

Storbeck, J., and G. L. Clore. "The affective regulation of cognitive priming." *Emotion* 8, no. 2 (2008): 208-215.

Sullivan, Kathleen M. "(Re)Landscaping Sovereignty in British Columbia, Canada." *PoLAR* 29, no. 1 (2006): 44-65.

Sun, Ron, ed. *Grounding social sciences in cognitive sciences.* Cambridge, MA: MIT Press, 2012.

Sutrop, Urmas. "List Task and a Cognitive Salience Index." *Field Methods* 13, no. 3 (August 2001): 263-276.

Tal, Alon. *Pollution in a Promised Land: An Environmental History of Israel.* Berkeley, California: University of California Press, 2002.

Tallis, Heather, Peter Kareiva, Michelle Marvier, and Amy Chang. "An ecosystem services framework to support both practical conservation and economic development." *PNAS* 105, no. 28 (July 2008): 9457–9464.

Tapinos, Efstathios. "Perceived Environmental Uncertainty in scenario planning." *Futures* 44, no. 4 (2012): 338-345.

Taylor, Shelley E. "Adjustment to threatening events: A theory of cognitive adaptation." *American Psychologist* 38, no. 11 (November 1983).

Taylor, Shelley E., Jennifer Crocker, Susan T. Fiske, Merle Sprinzen, and Joachim D. Winkler. "The generalizability of salience effects." *Journal of Personality and Social Psychology* 37, no. 3 (March 1979): 357-368.

Thaler, R. "From homo economicus to homo sapiens." *Journal of Economic Perspectives* 14, no. 1 (2000): 133-141.

Thompson, Eric C., and Zhang Juan. "Comparative Cultural Salience: Measures Using Free-List Data." *Field Methods* 18, no. 4 (November 2006): 398-412.

Tol, Richard S. J., Thomas E. Downing, Onno J. Kuik, and Joel B. Smith. "Distributional aspects of climate change impacts ." *Global Environmental Change* 14, no. 3 (October 2004): 259-272.

Tschakert, Petra, and Kathleen Ann Dietrich. "Anticipatory Learning for Climate Change Adaptation and Resilience." *Ecology and Society* 15, no. 2 (2010): 11.

Turner, N.J., and K.L Turner. "Where our women used to get the food: cumulative effects and loss of ethnobotanical knowledge and practice; case study from coastal British Columbia." *Botany* 86 (2008): 103-115.

Turner, R. K., W. N. Adger, and R Brouwer. "Ecosystem service value, research needs, and policy relevance: a commentary." *Ecological Economics* 25, no. 1 (1998): 61-65.

Turner, Will R., et al. "Global Biodiversity Conservation and the Alleviation of Poverty." *BioScience* 62, no. 1 (January 2012): 85-92.

Tversky, A, and D. Kahneman. "Availability: A heuristic for judging frequency and probability." *Cognitive Psychology* 5 (1973): 207-232.

—. "Advances in prospect theory: cumulative representation of uncertainty." *Journal of Risk and Uncertainty* 5, no. 4 (1992): 297-323.

—. "The framing of decisions and the psychology of choice." *Science* 211, no. 4481 (1981): 453-458.

UN DESA. *World Population Prospects: The 2012 Revision.* 2013. http://esa.un.org/unpd/wpp/unpp/panel_population.htm (accessed June 29, 2014).

UNESCO. "Ecological Science for Sustainable Development." *Mount Carmel.* August 2012. http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/europe-north-america/israel/mount-carmel/ (accessed January 6, 2014).

—. *Main Charateristics of Biosphere Reserves.* 2014. http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/main-characteristics/ (accessed July 2, 2014).

—. "UNESDOC." *UNESCO.* 2013. http://unesdoc.unesco.org/images/0022/002229/222915m.pdf (accessed July 2, 2014).

UNESCO-Jakarta. "Lessons from Biosphere Reserves in the Asia-Pacific Region, and a Way Forward." *UNESDOC.* 2010. http://unesdoc.unesco.org/images/0018/001883/188345e.pdf.

UNESCO-MAB. *Madrid Action Plan for Biosphere Reserves (2008-2013).* Paris, 2008.

Uu-a-thluk. "Trial Updates for Ahousaht et al vs. Canada ." *Uu-a-thluk.* January 30, 2014. http://uuathluk.ca/wordpress/litigation/fishingrights (accessed July 24, 2014).

Valladas, Helene, et al. "Dating the Lower to Middle Paleolithic transition in the Levant: A view from Misliya Cave, Mount Carmel, Israel." *Journal of Human Evolution* 65, no. 5 (November 2013): 585-593.

Van den Bossche, Piet, Wim Gijselaers, Mien Segers, Geert Woltjer, and Paul Kirschner. "Team learning: building shared mental models." *Instructional Science* 39, no. 3 (2011): 283-301.

Van den Burgh, J., A. Ferrer-i-Carbonell, and G. Munda. "Alternative models of individual behaviour and implications for environmental policy." *Ecoogical Economics* 32, no. 1 (2000): 43-61.

Veltfort, Helene Rank, and George E. Lee. "The Cocoanut Grove Fire: a study in scapegoating." *The Journal of Abnormal and Social Psychology* 38, no. 2 (April 1943): 138-154.

Victor, Bart, F. Fischer, Bruce Cooil, Alfredo Vergara, Abraham Mukolo, and Meredith Blevins. "Frustrated Freedom: The Effects of Agency and Wealth on Wellbeing in Rural Mozambique." *World Developmen* 47 (July 2013): 30-41.

Waldoks, Ehud Zion. "Nearly half of Carmel forest destroyed by blaze." *The Jerusalem Post.* 12 5, 2010. http://www.jpost.com/National-News/Nearly-half-of-Carmel-forest-destroyed-by-blaze (accessed 1 6, 2014).

Wallace, Ken J. "Classification of ecosystem services: Problems and solutions." *Biological Conservation* 139, no. 3-4 (October 2007): 235-246.

Warren, Caleb, Peter A. McGraw, and Leaf Van Boven. "Values and preferences: defining preference construction." *Wiley Interdisciplinary Reviews: Cognitive Science* 2, no. 2 (March/April 2011): 193-205.

Watson, Jane, and James A. Estes. "Stability, resilience, and phase shifts in rocky subtidal communities along the west coast of Vancouver Island, Canada ." *Ecological Monographs* 81, no. 2 (May 2011): 215-239.

Weenig, M. W. H., and M. Maarleveld. "The impact of time constraint on information search strategies in complex choice tasks." *Journal of Economic Psychology* 23, no. 6 (2002): 689-702.

Welsh, H., and J. Kuhling. "Determinants of pro-environmental consumption: the role of reference groups and routine behaviour." *Ecological Economics* 69, no. 1 (2009): 166-176.

West Coast Aquatic. "About Us." *West Coast Aquatic.* 2014. http://westcoastaquatic.ca/about/ (accessed July 24, 2014).

Westphal, Kenneth R. *Realism, Science, and Pragmatism.* London: Taylor and Francis, 2014.

Wilmers, Christopher C., James A. Estes, Matthew Edwards, Kristin L. Laidre, and Brenda Konar. "Do trophic cascades affect the storage and flux of atmospheric carbon? An analysis of sea otters and kelp forests." *Frontiers in Ecology and the Environment* 10, no. 8 (October 2012): 409-415.

Winch, D. "Adam Smith: Scottish moral philosopher as political economist." *The Historical Journal* 35, no. 1 (1992): 91-113.

Wojcieszak, Magdalena, and Vincent Price. "What Underlies the False Consensus Effect? How Personal Opinion and Disagreement Affect Perception of Public Opinion." *International Journal of Public Opinion Research* 21, no. 1 (2009): 25-46.

Wray, R., et al. "Towards a complete, multi-level cognitive architecture." *Proceedings of ICCM 2007 Eighth International Conference on Cognitive Modelling*, 2007: 325-330.

Wright, Andrew J., Sarah J. Dolman, Michael Jasny, E. C. M. Parsons, Doris Schiedek, and Sharon B. Young. "Myth and Momentum: A Critique of Environmental Impact Assessments." *Journal of Environmental Protection* 4, no. 8A2 (August 2013): 72-77.

Ynet. "Initial probe: Negligence cause of fire." *Ynet.* December 4, 2010. http://www.ynetnews.com/Ext/App/TalkBack/CdaViewOpenTalkBack/0,11382,L-3994080,00.html (accessed December 4, 2013).

—. "Judge Winograd reveals war committee's findings." *Ynet News.* January 30, 2008. http://www.ynetnews.com/articles/0,7340,L-3500810,00.html (accessed January 8, 2014).

Young, Oran R., Frans Berkhout, Gilberto C. Gallopin, Marco A. Janssen, Elinor Ostrom, and Sander van der Leew. "The globalization of socio-ecological systems: An agenda for scientific research." *Global Environmental Change* 16, no. 3 (August 2006): 304-316.

Zajonc, R. B. "Closing the debate over the independence of affect." In *Feeling and thinking: the role of affect in social cognition*, edited by J. Forgas, 31-58. Cambridge: Cambridge University Press, 2000.

Zala, Benjamin. "Weighing up the balance: What role for the balance of power in the twenty-first century?" *Cooperation and Conflict* 45, no. 2 (2010): 245-252.

Zarchin, Tomer. "State comptroller report: Netanyahu, Yishai and Steinitz responsible for failures of Carmel fire." *Haaretz.* June 20, 2012. http://www.haaretz.com/news/national/state-comptroller-report-netanyahu-yishai-and-steinitz-responsible-for-failures-of-carmel-fire-1.439806 (accessed January 7, 2014).

Zehr, Stephen C. "Public representations of scientific uncertainty about global climate change." *Public Understanding of Science* 9, no. 2 (April 2000): 85-103.

Zerubavel, Yael. "The Forest as a National Icon: Literature, Politics, and the Archeology of Memory ." *Israel Studies* 1, no. 1 (1996).

Zhang, J., and V. L. Patel. "Distributed cognition, representation and affordance." *Pragmatics & Cognition* 14, no. 2 (2006): 31-58.

ZIA. *Excavations and Surveys.* 2014. http://arch.haifa.ac.il/excav.php (accessed January 10, 2014).

Zizek, Slavoj. "Philosophy, the "unknown knowns," and the public use of reason." *Topoi* 25, no. 1-2 (2006): 137-142.

Zorn, Theodore E., Juliet Roper, C. Kay Weaver, and Colleen Rigby. "Influence in science dialogue: Individual attitude changes as a result of dialogue between laypersons and scientists." *Public Understanding of Science* 21, no. 7 (October 2012): 848-864.

Appendices

Appendix A

Interview protocol for structured interviews in Mt Carmel UNESCO Biosphere Reserve.

1) "How good an idea do you think it would be to have multistory multi-family apartment blocks in ‘Isfiyya-Daliat al-Karmel? Please rank on a scale of 1 to 10, where ‘10’ means very good, ‘1’ means very bad.”
2) “Can you please explain your answer to Question 1 in more detail? Why is it a [*degree of expressed ranking; e.g., good, bad*] idea?”
3) “What do you think other people in ‘Isfiyya-Daliat al-Karmel will say in response to this question?” [I.e., Question 1].
4) “What are some things that nature provides for people, or does for people, here on Mt. Carmel?” [I.e., this question explores participants’ lay understandings of ecosystem services].
5) “Did you know that ‘Isfiyya and Daliat al-Karmel are located inside a Biosphere Reserve, which is an area specifically designated by the United Nations for balancing human well-being with the conservation of nature?”