

Deconstructing the Modern Research Paper: A Case Study Analyzing the
Role of Values in Scientific-Decision Making

by

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Submitted in partial fulfillment of the requirements
of an Undergraduate Honours Degree in Sustainability

at

Dalhousie University
Halifax, Nova Scotia
October 2015

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Chalker-Scott, Latour, Larson, Cockburn

DALHOUSIE UNIVERSITY

DATE: April 22 2016

AUTHOR: Caitrin Pilkington

TITLE: Deconstructing the Modern Research Paper: A Case Study Analyzing the Role of Values in Scientific-Decision Making

DEPARTMENT OR SCHOOL: College of Sustainability

DEGREE: Bachelor of Arts

Convocation: May 2016

Environment, Sustainability and Society and Early Modern Studies

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ABSTRACT

My aim is to challenge the widespread notion among scientists that science is, or should be, the predominant basis for decision-making about natural resources and the environment. This misconception among researchers results in issues that begin with problem framing and continue along to data-gathering, as well as in the presentation of results. I will show that values should be the predominant basis for decision-making. The appropriate role for science is to provide insight into the potential consequences associated with decision alternatives. I will support these claims with an analysis of the scholarly literature on decision-making and demonstrate the issues through a case study in urban forest management literature. The case study will examine Chalker-Scott's (2015) paper entitled "Nonnative, noninvasive woody species can enhance urban landscape biodiversity" as a demonstration of problematic claims about the role of science in resource and environmental decision-making.

Acknowledgements

Nothing better than a good old fashioned head injury prior to engaging in a rigorous examination of problematic teleology, a little structuralist and post-structuralist linguistics and human values and desire.

In all seriousness, I would like to extend my sincere thanks to Steven Mannell and Peter Duinker for their patience, compassion and support throughout this year. You have both driven me to ask more questions and to trust my own curiosity. I couldn't ask for a better lesson from an educator.

Special thanks also to Georgia Klein and Kaarin Tae for reaching out and checking in. You really made the College of Sustainability a friendly and encouraging space. Also, Andrew Bergel, one thousand thanks, your input was really helpful to me.

All in all, the guidance I have experienced this year has served to thoroughly re-frame this writer's value system.

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Chapter 1: INTRODUCTION

This case study will examine problematic literature as well as scholarly study on the native versus non-native species debate in order to re-evaluate the respective roles of scientists and decision-makers. The native versus non-native species debate serves as an illustrative example, as the dialogue surrounding this issue is rife with value-laden language and a priori assumptions. Lack of clarity, along with misplaced emphasis on what the author subjectively considers to be the most significant aspect of the problem, serves not only to obscure the problem itself, but also impacts the decisions we as a society make to address it. The examination and the ensuing discussion will serve to identify the roles of science and personal values in decision-making as they appear in Chalker-Scott's paper (2015).

Susan Canney and Paul Jepson, researchers at Oxford College, teamed together to define the ethics of conservation for *Global Ecology & Biogeography*. Their article defines values as the "social ideals and beliefs to which people individually and collectively aspire and desire to uphold" (2003). The article establishes values as the guiding force of environmental management: these ideals and beliefs fundamentally inform decisions made by policy-makers and ordinary citizens. However, this perspective is far from accepted, and a great deal of research refuses to acknowledge that empirical evidence is not the only factor which should influence personal and public decisions about planting 'native' vs. 'non-native' species.

For example, in Chalker-Scott's (2015) paper, "Nonnative, noninvasive woody species can enhance urban landscape biodiversity," the author operates under the assumption that she has the ability to inform readers what they should value by presenting an arbitrary collection of data. This paper merits investigation not through particularly egregious claims made by the author, but rather because the paper functions as illustrative of a wider problem: Chalker-Scott's (2015) article is emblematic of a series of recent academic works which explicitly dismiss the role of values as a valid basis for decision-making. The assumption made in these works is that scientists should be responsible for making crucial societal decisions, but in doing so, these researchers give implicit preference to their own values as scientists. As Canney and Jepsen (2003) state, science-based values exist within a spectrum of diverse and equally valid priorities for change.

The purpose of this paper is to clarify the relative roles of science and values in decision-making by making use of both postmodern theory and literature on sustainable development. Canadian professor and geologist William H. Matthews stated the issue as follows: "It must be recognized ... that decisions resulting from environmental impact assessments may be based as much on subjective judgements involving values, feelings, beliefs and prejudices, as on the results of scientific studies" (1975). Decision-making is not the domain of the scientist — it is the responsibility of managers and policy-makers (Beanlands et. al, 1983). The role of science is to illuminate the potential consequences of decision alternatives (Duinker, 2007). When scientists fail to acknowledge the value-laden nature of their work, or prioritize their own perspective in the decision-making process on

scientific grounds, they make the rejectable claim that their values should dominate those of others (Beanlands et. al, 1983).

In respect of the limitations of this study, while I have sought to fully understand the issue of the basis for scientific decision-making from a wide variety of sources, the analysis of the problem and the discussion of its effects and possible solutions will be conducted by a single individual, myself, potentially resulting in an overly subjective treatise.

CHAPTER 2: LITERATURE REVIEW

This review will examine the three key pieces of work that have proved most influential on my thinking: *Weed Whackers: Monsanto, glyphosate, and the war on invasive species* by Andrew Cockburn (2015), *Metaphors for Environmental Sustainability* by Brendan Larson (2014), and Bruno Latour's *We Have Never Been Modern* (1991). These texts will serve to establish a critical framework for examining named presumptions or biases, and later the framework will be used to examine Chalker-Scott's (2015) text in particular.

Andrew Cockburn

A 2015 article by Andrew Cockburn featured in *Harper's Magazine* describes a conference on native and non-native tree species. A speaker brings up the eucalyptus tree, and the ensuing reaction from the audience perfectly illustrates the intense feeling scientists bring to the native vs. non-native debate: "In the eyes of those gathered at the San Jose DoubleTree, [the eucalyptus] qualified as 'invasive,' 'exotic, 'alien'—all dirty words to this crowd... A reference to the tree as "indigenously Californian" elicited an abusive roar" (Cockburn, 2015).

This kind of emotional investment among scientists is not unusual, but it is widely unacknowledged in discussions about urban forestry issues, and indeed, in wider conversations about academic bias. Rejecting the eucalyptus for being either alien or indigenous is not a matter of objective fact but rather of individual values. Scientists clearly bring personal judgments into their work. This is unavoidable; scientists are only human.

However, the problem occurs when these values are given priority, and the individual perspective, ‘the eucalyptus does not belong in the Californian landscape,’ is written as if it is objective scientific fact, and therefore taken as a basis for policy decisions. This article, while not a scholarly piece of work, is useful in establishing that scientists are not always cool, detached observers. They are perfectly capable of becoming quite emotional and dogmatic about their work, and then neglecting to consider perspectives other than their own (Cockburn, 2015).

This text, along with Chalker-Scott’s *Nonnative, Noninvasive Woody Species Can Enhance Urban Landscape Biodiversity*, provides material for outlining the premise of my argument: first, that scientists do bring value sets to their work, and second, that scientists should not prioritize these values over those of others. The perspectives that are featured in Cockburn’s article provide a diverse series of examples of the phenomenon under consideration: while these researchers dismiss one another’s findings as if they are questioning the academic validity of one another’s work, their critiques are plainly motivated by sentiment.

Brendan Larson

Larson draws from the existing body of thought on contemporary science in order to support his claims, and in doing so, the text serves as an anthology of perspectives on research theory. Larson quotes from scholars throughout the 20th century who have put forward valuable thoughts on the problems inherent in scientific presumption, and have made significant contributions towards improving the way scientists study. For example, he

draws on the advice of eminent philosopher and MIT professor Donald Schön: “the essential difficulties in social policy have more to do with problem setting than with problem solving, more to do with ways in which we frame the purposes to be achieved than the selection of optimal means of achieving them” (Schön, 1993). Schön’s insight is invaluable in analyzing the medium of the research paper, in order to define exactly what they should accomplish; Schön usefully points out that a lack of clarity or a misdirected focus in terms of problem setting results in a great deal of attention paid to the wrong part of the problem. By acknowledging that values motivate research, scientists may provide the most useful resources to decision-makers; politicians make better use of data when scientists explicitly state their own value judgments (Duinker).

Larson works throughout *Metaphors* to carefully situate the role of scientific inquiry. He states that a traditional view of research “elevates scientists into purveyors of objective knowledge, knowledge that everyone needs and nonscientists become dependent on how it is presented to them. This hierarchy gives tremendous epistemic authority to scientists” (Larson, 2011). This emphasis on the authority of science obscures the intent of that research, which is to benefit the public and inform decision-makers (Duinker). Larson describes the problematic relationship between scientists and the public, and presents an alternative:

“Traditionally, scientists have understood the purpose of their communication to be remedying the public’s knowledge deficit... this deficit model is inadequate because it ignores how we now live in a society where information is over-abundant, so we rely on experts in diverse realms to obtain it.” (Larson 2014, p. 13)

While this thesis will make use of analysis dating as far back as the 1970s, Brendan Larson's comparatively recent *Metaphors for Environmental Sustainability* will take into account the changing nature of what society needs from scientists. He focusses specifically on use of terms and how the language that is used to define problems necessarily affects the way that they are understood. The text analyzes how academic literature can err in its use of language and in its distance from problems; Larson criticizes the way in which sustainability metaphors encourage the separation of nature and culture, or contain problematic value judgments.

Bruno Latour

In Bruno Latour's text, *We Have Never Been Modern*, he describes the arbitrary categorization of science into fields, and the inability of modern society to understand the ways in which they interrelate. He introduces the subject by stating: "on the left, they have put knowledge of things; on the right, power and human politics" (3). By adopting the erroneous notion that research must be a sterile mechanism as a predicate to scientific inquiry, scientists allow a false hierarchy to pervade their work and the way that work is perceived by the public. Latour argues that this misleading sense of divide allows scientists to falsely elevate their work above human machinations into pure, and, for Latour, non-existent, objectivity. Latour charts the evolution through which a traditional understanding of scientific study has evolved, and suggests how scientists may begin to address this shift.

Bruno Latour's contribution to the literature review is as a kind of 'meta-literature'; Latour's postmodern perspective dissects modernist presumptions and acknowledges their side-effects. Postmodernism in general creates a dialogue between the two interpretations of science and the arts. By introducing this the philosophical and artistic perspective, Latour enters into a broader analysis of the work of scientists. Latour argues that when one does not consider the sociological implications of research, it becomes a less effective tool. The more insular science becomes, the more protected it is from criticism, and the more it becomes "science for science's sake" rather than a more broadly useful field. Helping science take on a more cohesive role in society and acknowledging the context which surrounds the work of science has the potential to make science a more applicable study for decision-makers. In this way, Latour's work has been fundamental in a critical examination of recent academic literature.

CHAPTER 3: METHODOLOGY

Analysis of Chalker-Scott's (2015) text will be divided into three themes: teleology, linguistics and values. This thesis will begin with the problematic manner in which research papers begin with an end in mind, and in this way fundamentally reverse the basic model of the hypothesis. From there, I will dissect and examine the terminology at work in scientific literature, and how these terms can obscure meaning and promote misleading paradigms. Finally, I will make use of existing scholarship to determine the rightful place of values in scientific inquiry and in decision-making in general.

Teleology

Much research contains false teleology. A teleology explains phenomena in terms of their ends or rather than final purpose. When scientists make the problematic assumption that data, and data alone, should inform every step of decision-making, this impacts the form of the research paper and therefore the overall effectiveness of the work. Ideally, a hypothesis should be made and the results neutrally explored. Instead, a great number of scientists have a pre-existing conception of the political decision they want to see and structure research in order to prove this point (Cockburn, 2015).

Including argument that actions should be taken in one direction or another because of scientific data detracts from the goal of study. As Latour states: “Scientists... never learn concepts, laws and theories in the abstract and by themselves. Instead, these intellectual tools are from the start encountered in a historically and pedagogically prior unit that displays them with and through their applications” (46). Concepts, laws, and theories are necessarily value-based; we must simply present them in the most compelling manner possible. However, research papers should not conclude by telling the reader what he or she should do with this information: this ought be left up to the reader.

Thomas Kuhn’s *The Structure of Scientific Revolutions* is also helpful in terms of analyzing structural flaws in the current form of the research paper. Kuhn considers the intentionality of scientific study — the intended outcome should be clearly stated as well as justified in the text, instead of taken as a given. He points out the issues that arise when scientists “agree in their identification of a paradigm without agreeing on, or even attempting to produce, a full interpretation or rationalization of it” (44). This phenomenon is especially apparent in the context of the native vs. non-native species debate, in which scientists argue about which trees are alien without addressing why trees should or should not be. Widely respected criterion for deciding whether species are native or alien have yet to be established; Cockburn states in his article that popular timelines among scientists and the public for establishing the ‘nativeness’ of a given species vacillate between the 17th century to the last 100 years to far longer (2015).

In addition, papers on either side of the debate cite “increased biodiversity” and “habitat for wildlife” as reasons to plant native or non-native species, without rationalizing why these outcomes are beneficial. Brendan Larson states that, “our assumption that we must rely on science for environmental solutions because it is purely empirical and neutral... ignores broader questions about the role of science in environmental affairs” (Larson, 2011). For example, species diversity is not always the valued end point for a society, nor is it an objective measure of success for an ecosystem. Once a researcher has acknowledged personal values and the intended objectives for the work, decision-makers may use the results in forming social policy more effectively, and draw on the expertise of researchers where necessary (Beanlands et. al, 1985).

Linguistics

Brendan Larson’s text, *Metaphors for Environmental Sustainability*, provides valuable context in terms of establishing the landscape of contemporary scientific thought. In particular, Larson’s focus on linguistics reveals implicit assumptions made throughout scientific academia: “the way we speak about the natural world is not a transparent window, because it reflects the cultures in which we live and its priorities and values” (2015). Larson provides a table of the most commonly used environmental science terminology, and specifically draws attention to the problems associated with the terms “native” and “alien.” He uses these as examples of problematic anthropocentric metaphor, in that they are highly dependent on human value sets, although they are used as objective terms. Use of terms and metaphors without sufficient rationalization and exploration of their use results in implicit bias (Larson,

2011). I will apply this focus on terminology to Chalker-Scott and other contemporary researchers.

The Role of Values

Two papers present valuable definitions for the role of values in academic literature: John C. Cobb's "Public Involvement in Scientific Decision-Making" (1976) and Canney and Jepson's "Values-led Conservation" (2003). These two articles are useful in that they are written by scientists themselves, and engage in a thorough investigation of the function of their own work. Cobb, in particular, establishes that all stakeholders have a part to play in decision-making, and that the voices of scientists should not be louder than anyone else's:

"Crucial value decisions have to be made and they should not be made only by involved scientists closeted with financially interested industrialists and governmental authorities. They should be made by unbiased and informed members of the general public after hearing all sides of the questions, with balanced input from scientists, humanists, historians, philosophers, theologians, and most of all, from ordinary citizens." (Cobb, 1976)

To ensure democratic decision-making, Cobb posits that science should not be considered the primary conduit of relevant information. He argues that humanists and historians have equally valid insight to share, and questions the idea that science should be the fundamental basis for policy.

Canney and Jepson not only point out the necessity of egalitarian decision-making, but also bring up particular issues associated with the treatment of science as an objective authority:

“The relevant ends for economics and science in conservation are material wealth and environmental health, respectively. However, humanity’s set of valid ends is more eclectic and includes, for example, emotional and spiritual well-being.” (Canney, Jepson, 2003)

This perspective recognizes that values held by scientists and by other members of the public may substantially diverge. Furthermore, the paper identifies emotional human health, for example, as a value equally legitimate to biodiversity, while the value-primacy of biodiversity may be more readily acknowledged in a scientific community. Ultimately, it is in the interest of scientists to understand the role of their work in a societal context. Scientists must learn to inform decision-making without seeking to lead it. These papers endeavor to stress the validity of diverse input, and to remind the scientific community to accept a humble position within this spectrum.

CHAPTER 4: COCKBURN

Teleology in Cockburn and Chalker-Scott

The role of sustainability science is ostensibly to educate, both within the scientific community and the wider public; science may explore both the causes of environmental problems and possible methods of assuaging environmental concerns (Merkel, 1998).

However, when the literature shifts from a diagnostic, predictive or analytic perspective to a prescriptive one — when those in science attempt to inform decision-makers what they should do — this limits the possible benefits of the field (Larson, 2015). This phenomenon is especially problematic when scientists mask their values as facts either through the structure of a paper, their use of language or in their assumptions about what the most desirable outcome looks like. This misleads those who could benefit from the material into assuming they are learning objective information about a problem when what they are gaining merely amounts to a scientist's personal choices and priorities.

Andrew Cockburn's article functions as an aggregate of diverse but equally problematic attitudes in science surrounding this issue; his work is especially helpful in depicting how subtly these 'prescriptive' judgments can be woven into legitimate study. It is worthwhile

investigating Cockburn's article in order to understand how these paradigms can manifest themselves in contemporary literature.

Cockburn describes a number of stances which reveal implicit value judgments on the part of scientists. By providing links between Cockburn's more demonstrative examples and Chalker-Scott's, I will establish that these issues are recurring and indicative of wider trends in academic literature.

In terms of teleology, Cockburn provides the example of Cornell academic David Pimentel, whose works have proved influential in providing cost-benefit analyses of sustainability issues. Pimentel has been an outspoken critic of native species. In the year 2000, Pimentel co-authored a report which appeared in *Agriculture, Ecosystems and Environment*. According to Cockburn, Pimentel "concluded that cats were costing us \$17 billion every year, after calculating that our furry (and, in his view, non-native) friends kill an annual 568 million birds, and arbitrarily valuing each bird at \$30" (2015). The figures used in this study have since been criticized (Goldstein, 2011).

Regardless, this figure of \$17 billion, a figure that was later quoted by the United States Department of Interior, went viral, and has since become interwoven into public perception about sustainability. An online search for the phrase, "*cats cost \$17 billion annually*," yields over 4 million hits, and appears in links leading to articles by the Huffington Post, Business Insider, and the website of conservation groups such as the National Audubon Society. The

echo chamber of popular dialogue quickly creates a reality: while this state of affairs is not ideal, acknowledging this reality is crucial. This demonstrates the potential danger of scientists imposing value judgements and masquerading them as facts.

Pimentel and his fellow authors value species which they classify to be indigenous, and they used these figures in order to urge governments to introduce legislation to limit the introduction of non-native species (Pimentel et. al, 2000). While this aim is far from nefarious, presenting these figures as if they are objective truths rather than reflections of personal values is misleading for readers.

The study does not disclose how the authors arrived at these figures, and even close examination of the paper reveals no justification or explanation for the pricing of animals. Using an economic framework to assign value to the environment is not a new phenomenon, but obscurity and a lack of a scientific foundation for these claims renders them unsuitable ground for decision-making.

Value-based decision-making is not a problem in and of itself, and in fact should be recognized as the predominant basis for decision-making, but the framing of this paper implicitly advances the values of the authors over the readers. The structure of the work itself is tantamount to prioritizing the perspectives of the scientist; by creating a series of arbitrary definitions which prove a priori judgments about native species, the authors use the tool of science to advance their personal opinions.

This teleological structure does not benefit the public or politicians, because it renders the work a purely value-based treatise. Individuals already have their own set of equally valid ideas of what is important; the role of scientists is not to push values onto the public (Cobb et. al, 1976). In fact, Pimentel's paper is a perfect example of the concerns expressed in *Public Involvement in Scientific Decision-Making*: "our concern is that overemphasis on expert-led science and economic rationalism as a means to deliver the goals of conservation obscures some values and stresses others" (Cobb et. al, 1976). Science, insofar as it is used as one of many tools for decision-making, is useful in helping people understand what is and what can be (Duinker, 2007). By using the paper to prove prior, pre-determined ends — the personal values of the writers — the paper elevates the role of scientists and reduces that of the public.

This example is mirrored in Chalker-Scott's work. In the introduction, Chalker-Scott introduces her thesis, which is that cities should plant non-native species (2015). She then systematically assembles and presents a body of data which proves her point and finally advocates which decisions should be made based on what is essentially a subjective ideal. The author then criticizes all those who would choose exclusively to plant native species as neglecting to make science-based decisions, even though the paper she has created expresses a personal perspective. To assume that her recommendations should be followed would be to prioritize her perspective exclusively for her role as a scientist.

Chalker-Scott asserts that non-native tree species are the same as native species in terms of tree functionality as well as management. Chalker-Scott claims that the sole reason arborists refuse to plant non-native species is misinformation, which she claims could easily be rectified if the data she cites were more widely circulated. However, the selective manner in which she presents this information is a clear indication of a value-motivated perspective. She assembles the benefits of non-native species, such as “reducing air pollution” and “providing shelter and food for wildlife” without drawing direct quantitative comparison of these benefits with native species (2015). For example, all trees are clearly capable of sheltering wildlife, but the question she is not asking is which species does it better — from a scientific, and therefore empirical, perspective.

The very structure of the document therefore rebuts itself; Chalker-Scott criticizes those who favour native species for personal reasons, while she herself fails to properly present convincing data as to why non-native species are superior. In this way, the Chalker-Scott’s (2015) paper is itself a primarily value-driven, opinion-based treatise. There is nothing wrong with value-driven, opinion based treatises. The error here is the manipulation — again, while not nefarious, it is nonetheless, in its structure, a manipulation — of data to prove points which were held prior to the writing of the paper, in the name of science.

Linguistics in Cockburn and Chalker-Scott

Cockburn’s article explores slang and value-laden terminology in the scientific community and beyond. Cockburn writes that ‘exotic’ ‘invasive’ and ‘alien’ are “dirty words” to some

scientists, and implies that David Pimentel’s dislike of ‘alien’ plant and animal species is linked to views on human immigration, given his “public opposition to both legal and illegal immigration” (Cockburn, 2015). Cockburn also implies that there is fear of the effects of the zebra mussel because it poses as a threat to the “God-fearing American mussel” (Cockburn, 2015). Cockburn indicates value-laden terms by his use of quotations, and indicates by strong implication that they are worthy of being questioned. Figure 1 includes all the terms Cockburn deemed indicative of personal values.

Term	Implied Objection
Invasive	Arbitrary.
Exotic	Arbitrary.
Alien	Arbitrary.
Native	Arbitrary.
Wildfire-risk reduction	Used in government report — Insufficient justification for the destruction of the forested areas.
American weed	Vietnamese slang for cogongrass, which spread rapidly in Vietnam on land defoliated by Agent Orange.
New water	Used in government report — Insufficient justification for the destruction of trees in order to save water.
Life-sciences company	Used in government report — Implication that this is an inappropriate term to describe the company Monsanto.
Habitat-restoration markets	Target for Monsanto’s application of the chemical compound glyphosate — Implication habitat restoration is an insufficient justification for the destruction of habitat.

Figure 1. Use of value-laden terminology in WEED WHACKERS: Monsanto, glyphosate, and the war on invasive species.

While Cockburn does heavily focus on value-laden language, it is worth noting that this is not a research paper published in an academic journal, but an article published in a magazine devoted to politics and the arts. Nonetheless, *Harper's Magazine* came out with an editorial the following month written by a Monsanto representative who had found Cockburn's comments too critical. In any attempt to criticize the way value judgments appear in contemporary scientific literature, it is difficult to avoid becoming an example of the phenomenon oneself¹.

However, the issue with values I am attempting to address is not that they exist, or even that scientists have them. It is rather that scientists sometimes prioritize their own values over those of others, or worse, they sometimes attempt to pass them off as objective science. As stated in *An Ecological Framework for Environmental Impact Assessment in Canada*, "value judgements which permeate nearly all aspects of scientific studies associated with impact assessments are acceptable if they are explicitly stated" (Beanlands et. al, 1983).

Chalker-Scott successfully navigates many uncertain terms in her methodology, and makes sure to note that there is no scientific consensus on the strict meaning of the terms 'native', 'nonnative', 'alien', 'introduced' and 'invasive' (2015). She also clarifies her use of the terms 'trees', 'shrubs' and 'urban landscapes'. However, difficulty arises with the most crucial terms of her report: 'enhance,' 'biodiversity' and 'species richness' (used both in the title and throughout the work). She neglects to indicate what 'enhance' means as it applies to

¹ See: this thesis.

biodiversity, which leads to considerable confusion. The reader is left to wonder if Chalker-Scott is implying that non-native species ‘enhance’ biodiversity by increasing the sheer number of different species — for example, if there were 10 single representations of 10 tree species, and one million oak trees in one city, how would that rate in terms of biodiversity? Technically, 11 species would be represented. This matter is further complicated by Chalker-Scott’s interchangeable use of the terms ‘species richness,’ ‘species evenness’ and ‘species diversity’. It is difficult to ascertain from Chalker-Scott’s (2015) report whether species were consistently reported.

Another example is in her discussion of birds, where she merely states that the presence of non-native species cause bird species to ‘increase.’ She cites no figures, nor does she specify what ‘increase’ entails: whether more nests spotted, or more birds were spotted in trees, et cetera. These details are essential to the discussion of bird species in particular, as mere presence of birds in trees is no indication of whether tree species are benefiting birds in terms of providing viable habitat (MacLoed et. al, 2011). It is necessary to measure ‘occupancy’, which is the phenomenon of repeat visits to tree sites, and it is a delicate and exacting science (MacLoed et. al, 2011). It is difficult for decision-makers to benefit from Chalker-Scott’s (2015) paper as it currently exists, because this vagueness results in a failure to adequately inform readers of possible outcomes.

There are many extraneous factors to consider here, and it is critical to do so, considering that Chalker-Scott’s entire argument hinges on whether non-native species ‘enhance’

'biodiversity'. Readers must know exactly what these terms mean, or Chalker-Scott's final recommendations are not of significant utility.

Values in Cockburn and Chalker-Scott

Cockburn pauses in his thorough criticism of every angle of the native versus non-native species debate to advocate for a return to the battles that environmentalists used to wage, namely "chemical pollution, nuclear power, shale-oil drilling, logging devastation, and other corporate onslaughts" (2015). Again, while Cockburn's piece is far from objective, he is clear about his perspective, which is that the native versus non-native debate detracts from more important sustainability issues. Cockburn's perspective is still valid; as Canney and Jepsen state, "reliance on scientific argumentation alone risks alienating those who have other valid motivations for conservation" (2003). Voices which come from cultural and arts publications have equally legitimate input to offer (Cobb, 1976). Cockburn also presents his perspective without explicitly demanding specific actions from readers, and in this way, he allows for his opinion to exist within the diverse spectrum of interests he has described in his article. However, when one concludes with specific recommendations, it becomes more critical to acknowledge the inevitable value-ladenness of such an endeavour, and to provide some justification for one's claims.

The bulk of Cockburn's terminology, noted in Table 1, deals with government problem-solving in response to environmental issues. Both government leaders as well as

leaders in the scientific community would benefit from a more substantial connection to those they are addressing either in their legislation or through their research (Cobb, 1976). Although it is widely accepted that governments exist to serve their constituencies, I would argue that the same is true of scientists. When authors attempt to use scientific insight to move beyond science for science's sake — beyond research which is to be circulated exclusively within the scientific community — to try and address societal concerns and influence decision-making, it becomes necessary to take into account their audience.

Cockburn paints a picture of a local government which has become detached from the values of its public in terms of native versus non-native species. While government officials in Delaware determined a purge of non-native species to be beneficial, the destruction this entailed was out of step with the desires of its populace:

Phragmites is accused of robbing other plants, fish, and wildlife of essential nutrients and living space. Delaware has responded by spraying and respraying on an annual basis a 6,700-acre expanse of the Delaware River estuary with thousands of gallons of glyphosate-based weed killer. In 2013, locals in the Hudson River community of Piermont, New York, discovered a plan to destroy a 200-acre reed marsh fronting the town. Outraged, they fought back. “We love the marsh,” an indignant Marthe Schulwolf, who is active in opposing the scheme, told me. “It’s beautiful, a living environment, with lots of wildlife, and it protected us from the Hurricane Sandy storm surge.” (Cockburn 2015, p. 59).

In the early sixties, Jane Jacobs wrote a critique of modern cities which has come to shape contemporary public dialogue and the importance of feedback. Jacobs argued in her work, *The Death and Life of Great American Cities*, that it is easy to lose sight of the larger picture when it comes to city-building, and to forget the essential fact that cities are built to best

serve the people who live in them. Jacobs wrote, “In creating city success, we human beings have created marvels, but we left out feedback. What can we do with cities to make up for this omission?” (Jacobs, 1961). Although it is easy to stand back and privately determine the best possible outcome based on our own individual values, it is crucial to acknowledge the interconnectedness of it all, and who will be affected by these decisions (Jacobs, 1961). I will engage more thoroughly with the work of Jane Jacobs later, as her work rightly belongs alongside her postmodern contemporary, Bruno Latour.

To return to Chalker-Scott, she too, along with the other decision-makers that Cockburn and Jacobs criticize, falls into dismissing the values and motivations of others. For example, Chalker-Scott dismisses the New York’s City Council’s preference for a native landscape, and goes on to suggest they plant non-native species in order to improve biodiversity. She justifies this suggestion as a “science-based recommendation” (2015). While the New York City Council also supports their statements with data, Chalker-Scott neglects to investigate this logic but instead dismisses their claims as unscientific. What Chalker-Scott fails to see is that the New York City Council was never looking to increase biodiversity, but was endeavouring to “provide habitat for local birds, insects and other animals that are indigenous to [the] region” (2010). Chalker-Scott’s assumption that *her personal values* (such as increased biodiversity) should be the values that affect policy decisions — because of her position as a scientist — is an unfair prioritization of Chalker-Scott’s own desires, regardless of her scientific background. If New Yorkers wish to see a particular collection of birds they

have, whether arbitrarily or not, decided belong on their streets, that is a reflection of their own values..

However, Chalker-Scott does not let the wishes of landowners and city council members get in the way of advising them the best way to realize the outcome she herself values. The fact that having greatest possible number of tree species present in a single area may not be an ideal outcome for a policy-maker does not enter into the equation; Chalker-Scott continues to direct decision-makers towards the best way to make that happen. In analyzing Chalker-Scott through the lens of Donald Schön's work, it is easy to see that this is a classic case of expounding upon the optimal means of solving a problem without adequate proof that there is a problem in the first place.

CHAPTER 5: LATOUR

Teleology in Latour and Chalker-Scott

Using Latour's text to deconstruct issues at stake in Chalker-Scott will take a slight readjustment, as Latour by nature approaches both science and philosophy from the perspective of an outside cultural observer, and yet seeks to unite the two domains. In order to understand Bruno Latour's work, it is necessary to consider his intellectual contributions as components of the broader movement of postmodernism.

Postmodernism fundamentally attempts to deconstruct previously held modernist belief frameworks. Where modernism seeks to separate, simplify and clarify the world, postmodernism celebrates complexity, pluralism and the individual perspective. Where modernism celebrates economic rationalism and deductive reasoning, postmodernism considers both methods to be mere human constructions.

When considering teleology, or the study of perceiving phenomena or events in terms of end-goals, it makes sense to re-examine Chalker-Scott's conclusions and recommendations

(2015). Chalker-Scott writes that, “these science-based recommendations for increasing species biodiversity stand in stark contrast to the list of characteristics used to promote the exclusive use of native plant species” (2015). Chalker-Scott draws a clear distinction here between ‘science-based recommendations’ and the ‘list of characteristics’ which are used to justify the planting of native tree species (2015). Chalker-Scott firmly prioritizes decisions which descend from quantitative information, and therefore heavily implies superior status to the decision to plant non-native species (2015). Latour criticizes the followers of this form of rhetoric, describing them as “prisoners of an absolute dichotomy between things and signs, facts and values” (Latour, 1993). Chalker-Scott refuses to allow for the possibility of equally valid facets to both the native and the non-native arguments, and in doing so, she establishes that her position is ‘right’ as a result only of it being more scientific — in other words, she justifies her subjective claim on the basis that it is more objective.

This is the twisted sort of paradox that Latour delights in pointing out: “the more we forbid ourselves to conceive of hybrids, the more possible their interbreeding becomes” ... “So long as we imagine objective stakes for our disputes... [we] adorn objects with values that are not their own” (Latour, 1993). What Latour argues here is that the modernist instinct to impose divisions between science and politics, between fields of study, between what qualifies as objective and subjective, necessitates a kind of slavery to the order of things. A scientist may come to value the notion that a fact is objective more than their own individual values. In doing so, scientists adorn objectivity itself with a value judgment, as Chalker-Scott demonstrates above.

Latour above all advocates for transparency with respect to the interrelation of values and the sciences. Decision-making necessarily comes about as a result of a spectrum of influences, so why not state this outright and incorporate this understanding into scientific literature, as opposed to presuming the possibility of a pure, removed and dispassionate science. After all, as Latour states, when scientists write that one stance is more “scientific” than another, they necessarily refute the basic tenets of science. Scientists may explore the outcomes of various possible decisions, but they cannot definitively state what constitutes the “best decision” according to empirical truth (Latour, 1993).

To understand decision-making as its own complex field is to “strive for more glamorous and more revolutionary programmes of action, rather than underlining what is already dimly discernible in the shared practices of scientists, politicians, consumers, industrialists and citizens” (Latour, 1993). All of the groups that Latour mention possess personal values and motivations. There is therefore a false teleology at work in Chalker-Scott’s conclusion: while the paper itself explores the valid possibility of a place for native tree species in urban landscapes, the ending structures the entire work in terms of a singular, limited answer.

Linguistics in Latour and Chalker-Scott

Chalker-Scott’s (2015) paper continually emphasizes “research-based” decisions, without any substantive investigation into what they entail. Chalker-Scott establishes a framework in which science forms the basis of choice, and the only reason one might make a poor

decision is faulty data. Chalker-Scott's use of terms such as "science-based decision-making" assumes the possibility of an objective perspective obtained through science. In doing so, Chalker-Scott makes unsupportable claims about what scientific insight can accomplish. This perspective fails to acknowledge the key role of values in the way the public interprets research. Chalker-Scott reduces decision-making to a mechanized process of input and output without considering the human perspective. Decision-making is not as simple as data input and choice output. Values are a fundamental element which not only guides scientific inquiry itself, but also determines how that research is put into practice (Latour, 1993).

Again, the terminology Chalker-Scott's uses in her concluding paragraph are the most revealing of this paradigm: she cites 'science-based' reasoning about non-native species. The use of these terms create a false trajectory in the project; in which the paper necessarily leads to the 'scientific' priority of Chalker-Scott's perspective. Latour describes this phenomenon as an essentially modernist approach, in which scientists become "purified by carefully separating the part that belonged to things themselves and the part that could be attributed to the functioning of the economy, the unconscious, language, or symbols" (Latour, 1993). In this way, scientists exist at an awkward remove from their own subjective values. The modernist, structuralist perspective holds concrete and abstract ideas sharply apart from one another. For Latour, this perspective can only lead to confusion both within the individual scientist and in the work that scientists produce.

Values in Latour and Chalker-Scott

The most compelling element of Bruno Latour's text is in the way it provides fresh commentary on the often insular field of science, and reveals the way in which scientific study is far more interrelated with society and political than it would first appear. When research is considered to be a project conducted by professionals far away and removed from the general public, it becomes separate from criticism and interpretation. Latour's examination of the sociological implications of scientific study, and of widely accepted scientific paradigms, provides meaningful feedback and insight into the larger relevance and context which surrounds scientific inquiry. Latour criticizes the paradox within modern science as follows:

“Are not most ethicists busy with those two opposite but symmetrical tasks: defending the purity of science and rationality from the polluting influence of passions and interests; defending the unique values and rights of human subjects against the domination of scientific and technical objectivity?” (Latour, 1993).

Latour interprets this relation between passion and interests through philosophy and the arts. By re-framing science as a field that is cohesive with societal values, Latour introduces a cross-disciplinary element to scientific study which ultimately renders it more useful to other fields (Bergel, 2016).

Jane Jacobs illustrates the remarkable potential benefit to an inquisitive postmodern approach. A highly influential scholar and activist, Jacobs literally and metaphorically changed the landscape of urban planning. Her lack of formal training in architecture or urban design and unconventional method resulted in an arts-based rather than strictly quantitative book: *The Death and Life of Great American Cities*. However, the text was

nonetheless extremely significant in terms of municipal and federal city planning in New York City and beyond. The ‘Jacobs’ approach is to look at a rigid, sanitized problem and turn it upside down and backwards. It is also worth noting that Andrew Cockburn, previously cited in this thesis, also presents an arts-based critique of science, and he, too, rejects a rigid dichotomy between native and non-native species. He concludes that both definitions are ultimately arbitrary, and advocates for a new framework for determining environmental well-being and species viability to better serve the public. Similarly, although on a different scale, Jacobs’s inquiry provides an alternate model which connected more effectively with the public than any of her contemporaries. Her open-ended search for answers yielded substantial findings.

In her book, Jacobs presents a picture of the classic Latourian definition of the insular scientific paradigm: “In city after city, precisely the wrong areas, in the light of planning theory, are decaying. Less noticed, but equally significant, in city after city the wrong areas, in the light of planning theory, are refusing to decay” (Jacobs, 1961). Cities continued to refute previous literature and scholarship made with regard to city planning: real-life situations were complex, chaotic, and confusing to early 20th century modernist thinkers. Jacobs compares the scientific stalemate to the outdated medical practice of bloodletting, in which practitioners are, “thoroughly enmeshed in descriptions of reality which are at variance with reality” (Jacobs, 1961). Jacobs does not stop there, however, but elevates the metaphor to pinpoint the most dangerous aspect of science: how intelligent, rational individuals can persist in error past all logic when they choose to exist in separate,

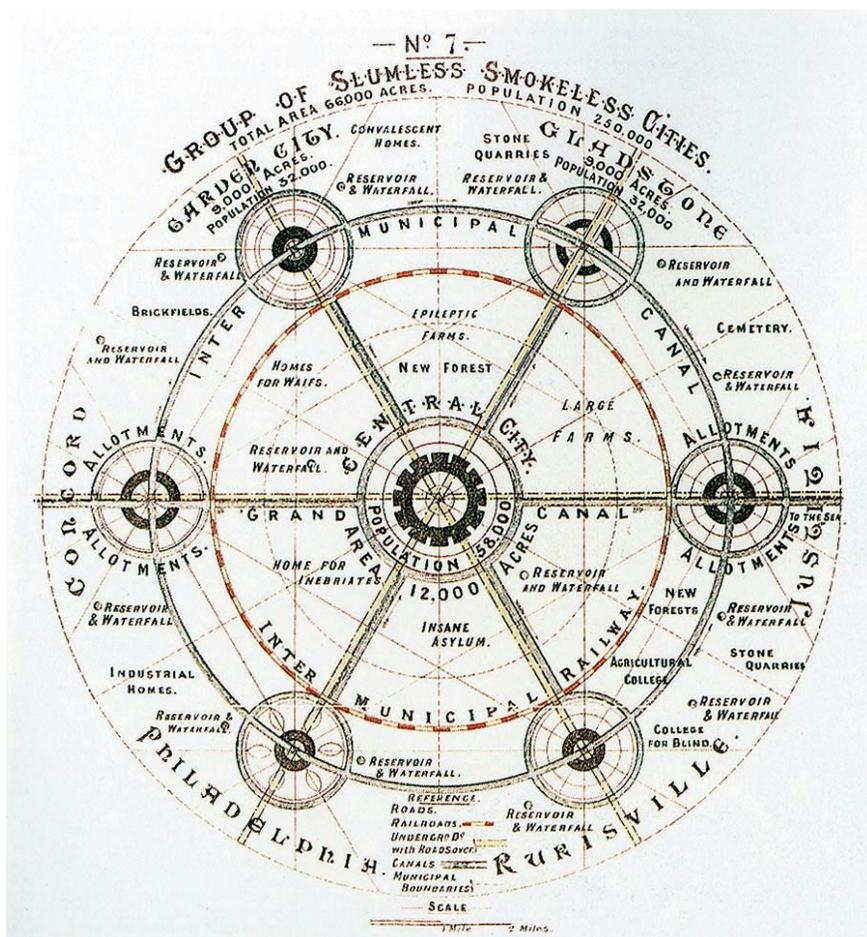
unquestioned spheres of reason. She describes an encounter with an expert city planner who spoke to her at length about the beauty and fun to be had in a particular ‘North-end’ neighbourhood, including the general well-being of the area’s inhabitants. But at the end of the conversation, the gentleman still persisted in concluding that the neighbourhood would have to eventually be torn down and rebuilt, as it was a dirty slum (Jacobs, 1961).

Jacobs rejects the teleologies and a priori judgments frequently made in the field. She instead relies on case studies, and thorough understanding as opposed to reliance on pre-existing theory and widespread generalizations. It is worth comparing this method to that of Chalker-Scott, whose (2015) report, although thoughtful, essentially repeats in a different order the same collection of beliefs scientists already hold about both native and non-native species. Chalker-Scott then concludes this contribution to the urban forestry echo chamber with a final message which has only vaguely been substantiated by the body of the paper. When scientists on either side of the native versus non-native species debate staunchly believe that their position is the one that is most beneficial to the urban ecosystem, a treatise like this one does little to inform anyone, or to inspire the public to make better decisions about selecting tree species.

Jacobs’s work parallels that of Latour, who complains of academic dogma and a body of researchers who assume the dominance of their value sets because they practice science, and he says, “science is a mere intermediary allowing access to [pure, objective, transcendent]²

² Latour uses this terms in the prior two sentences.

Nature” (Latour, 1993). Before Jacobs embarks on her diagnosis of city-planning problems, she first delineates the boundaries and origin of the problem: essentially, her analysis comes down to a few influential theorists well-versed in urban planning concepts who truly did mean well in their designs (see Figure 2). These early 19th century planners neglected to engage in any study whatsoever in what the population really needed and desired in a city. Instead, Ebenezer Howard, among other planners, trusted his own instincts, generalizations,



interests — essentially, his own subjective values — and combined these values with a strong belief in pure, rational and removed science. In the end, the physical manifestation of Howard’s aesthetically superior “garden city” was something of a shock. While he had

Figure 2. Ebenezer Howard’s Masterplan for “Slumless, Smokeless” Grouping of Garden Cities

schmed and dreamed of a plan in which miniature cities nest charmingly in celestial spheres and existed apart from dirty overcrowded cities, his work has had a different kind of lasting legacy: the ancestor of the sprawling, impractical suburb (See Figure 3). Essentially, the resulting literature and the resulting cities were perfectly logical works, with only one problem: a crippling deficiency in basic practical utility. As Jacobs tartly observes, “Both in his

preoccupations and in his omissions, Howard made sense in his own terms but none in terms of city planning” (Jacobs, 1961). When the work of science involves advising



decision-makers about choices to be made in wider world, it is crucial that researchers devote a modicum of effort to analyzing how these decisions will affect those they are seeking to advise. Jacobs’s work, in a quintessentially postmodern paradox,

Figure 3. The Modern Suburb

outlines the two true biggest culprits in contemporary scientific literature: the overly subjective treatise as well as the overly objective.

Chalker-Scott, in neglecting to properly frame the problem and in insufficiently explaining her use of terms, as well as in her biased final conclusions, manages in one paper to present a compelling example of both phenomena.

CHAPTER 6: LARSON

Teleology in Larson and Chalker-Scott

Throughout Larson's text, he engages in good-natured deconstruction of "value-creep"; the phenomenon in which use of sustainability metaphors and broader cultural assumptions influence scientific inquiry. However, over the course of his analysis throughout *Metaphors for Environmental Sustainability*, he cites a number of issues inherent in the use of these metaphors and cultural assumptions, but ultimately acknowledges that value judgements are an inevitable component of science.

Chalker-Scott, by contrast, expresses indignation in *Normative, Noninvasive Woody Species Can Enhance Landscape Biodiversity* that values of allegiance to landscape would affect policy decisions. She describes a document in which the New York City Council comments, "native plants provide habitat for local birds, insects, and other animals that are indigenous to our region" (174). Her next statements skewer this thought process: "the urban environment

[of New York City] surely bears little resemblance to the ecosystem that existed prior to development” (174). However, the concept of an ecosystem, or indeed of New York, is held together by a similarly arbitrary sets of beliefs, just as in Larson’s metaphors. One must acknowledge one’s desired outcome, and strategically work to bring it about using science as a tool, rather than quibble about the “scientific” definition of an “appropriate” landscape.

For example, if one wanted to increase biodiversity in New York, one could measure how effective particular native trees or non-native trees were at promoting a plurality of species. But one gets nowhere in positing that an ecosystem should be one way or another according to science; this descends into teleology (Larson, 2011). An ecosystem should not be pruned and directed according to a purely objective scientific end goal. Science, being a method of study developed by human beings, is inescapably a reflection of a human understanding of the world (Larson, 2011). This should not be a concern, but an accepted precondition to scientific inquiry.

Science and politics are necessarily intertwined. The aims of political endeavours drive the direction of scientific research. And they are not such very different fields. Both politics and science can fall into the realm of ideology. Persuasion and rhetoric result in concrete beliefs when they began as a mere series of contrivances: as Richard Lewontin states in *Biology as Ideology*, “the problems that science deals with... are all deeply influenced by predispositions that divine from the society in which we live” (Lewontin). In terms of the native vs. non-native debate, while researchers cannot deny that the paradigm exists, but they can

acknowledge that the divide is a construction, which will lead to a better understanding of the issues. To do this, scientists must acknowledge the idea's anthropocentric roots: inevitably, humans idealize landscapes, use value-laden terminology and impose aesthetic or morality on nature.

For Larson, acknowledging the basic and unavoidable anthropocentrism of the scientific endeavour is what enables use of metaphor. These concepts create crucial links between science and society, and shape how the public comprehends scientific ideas:

“Metaphor is a key element in scientific inquiry because it enables us not only to understand one thing in terms of another but also to think of an abstraction in terms of something more concrete and everyday. According to cognitive linguists, this association between abstract and experiential realms often results from a conceptual mapping that develops during childhood.” (Larson, 2011, p. 6)

In conclusion, to indulge in the erroneous belief that “science is above the social fray” is to limit the academic merit of a given theory (Lewontin, 8). Research only becomes more useful as scientists acknowledge the human component of science, and allow for a diverse spectrum of values to motivate decisions.

Linguistics in Larson and Chalker-Scott

While Larson's entire text functions as a robust critique of issues at stake in contemporary sustainability science, he draws particular attention to the problematic “self-reinforcing and self-fulfilling character” of environmental science, and he says this is a particular danger when it comes to linguistics.

In Larson's argument, similar to Jacob's metaphor about the dated practice of medical bloodletting, he writes about about the long history in science of working within pre-determined paradigms and of only finding data which serves to confirm an a priori opinion.

For example, when 19th century researchers entered the field with the understanding that anyone that was not a white man was clearly physically and intellectually inferior, these opinions were proved by their subliminally biased studies: "Scientists thus directed their inquiry towards confirmatory data (and unconsciously ignored contrary data), data that seemed neutral and objective only because the analogy meshed invisibly with widespread cultural assumptions" (Larson, 2011). While Larson uses a historical example, he also stresses the continual challenge of breaking these feedback cycles within science. Larson focusses particularly on the way languages and concepts are unconsciously repeated and affirmed throughout scientific literature and come to take on a reality of their own.

Chalker-Scott in this respect is at once clear-sighted and blinded; she questions pre-existing reverence for native species, but still will only consider perspectives that are "supported by published research" ... in other words, perspectives very much part of the framework in which she herself operates (2015).

Values in Larson and Chalker-Scott

Throughout the text, Larson vacillates between a stance which frankly acknowledges and celebrates the role of value-judgments in sustainability and points out the ways in which

these judgments are obscurative: “In the discourse about sustainability, for example, we look to environmental science for the facts, often neglecting the value-laden language in which they are communicated” (Larson). In the same way, Chalker-Scott, ostensibly frames the text in order to benefit homeowners and policy-makers, but becomes muddled in justifying what they should value, and lists a few ‘universal’ sustainability values such as “reduced air pollution” and that non-native species “require less water” (2015). This assumption about the values of others appears on the first page of her report, and this misleading assignation of values guides the remainder of the text. However, the study of science necessitates the occasional arbitrary value-laden term or metaphor, just as Larson indicates.

CHAPTER 7: CONCLUSION and RECOMMENDATIONS

Moving forward, it is necessary to continue to challenge the conception that science holds any definitive power over decision-making: scientists perform this role no better than any other individual, as decisions are fundamentally based on individual values. The goal of science has been, and should continue to be, to inform the public about resources, the environment, and beyond.

While Chalker-Scott bore the brunt of criticism over the course of this case study, this report owes a huge debt to Chalker-Scott's work as an invaluable example of modernist rhetoric resurfacing in contemporary scientific literature. Chalker-Scott is by no means the only working scientist who operates within the paradigms I have just delineated, and this is a phenomenon which is truly worthy of future study: Why, despite decades of ongoing criticism, are scientists still assuming roles of superiority when it comes to decision-making? Why do scientists shrink from explicit value judgments only to subtly shape entire research papers to prove what is essentially a matter of opinion?

Alas, the cause of this state of affairs is the basis for another case study. Instead, through this report, I have provided three frameworks through which to critique contemporary scientific

literature in future study. Were I to go further, I would address the final and most difficult point of Larson’s work — balancing the incorporation of value systems without descending too far into personal bias — through the establishment of a kind of ‘Goldilocks’ tool, in the manner of Kai Lee. An abbreviation of Kai Lee’s influential adaptive management strategy, is explained through the structural elements of a compass and gyroscope in the figure below (Lee, 1993).

<p>First, they are explicit about what they expect, so that they can design methods and apparatus to make measurements.</p>
<p>Second, they collect and analyze information so that expectations can be compared to actuality.</p>
<p>Finally, they transform comparison into learning that correct errors, improve their imperfect understanding, and change action and plans.</p>

Figure 4. “Compass and Gyroscope model”

Lee’s urge towards explicitness, information gathering and integrated learning holds a great deal of potential as a model of basic reform to the contemporary research paper. Lee’s response to Larson’s question of balance is synthesis: “linking science and human purpose, adaptive management serves as a compass for us to use in searching for a sustainable future” (1993).

This idea of the synthesis of disparate parts was a recurring one throughout this report. It was my goal that the diversity of perspectives compiled in this case study would serve in and of itself to further the stated goal of interconnected postmodern pluralism. I worked to find perspectives not only from environmental scientists but also from journalists, politicians, philosophers and sociologists. By using Chalker-Scott as a typical example of the problems brought up by philosophers in their critiques of science, I aimed to ground abstract academic theory by providing concrete examples of their claims. Scientists, in addition, have a great deal to gain by exposure to works such as Jane Jacob's *The Death and Life in Great American Cities*, which point out the pitfalls and the limits of objective study. It is my opinion that bridging the epistemic gap between the arts and the sciences is an endeavour which works to their mutual benefit.

While a great deal of contemporary scientific literature dismisses works such as that of Bruno Latour as mere value-based judgments, it serves scientists well to acknowledge that values are a fundamental to the way societies make choices. When researchers forget the impossible ideal of purely 'science-based decision-making' and of assembling purely 'science-based recommendations', they will move closer to the humbler but far more fascinating goal of the scientific endeavour — to understand the world, and one another.

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