A Systems-Based Approach to Green Criminology

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Abstract
Green criminology is grounded in debates regarding the ethics, legality, and reality of harms vis-à-vis the lives of non-human animals and the environment. The complex, uncertain, and ambiguous nature of these harms reveals the need for a more holistic approach: one that more firmly ties together social and ecological systems. In this paper, key aspects of systems thinking (e.g., leverage points) are outlined to illustrate the value of a systems-based approach. While not completely absent from green criminology literature, systems thinking offers a well-spring of underutilized ideas, concepts, theories, and frameworks that warrant further attention. A systems-based approach to green criminology is presented as a means to (re)imagine, (re)define, (re)examine, and respond to environmental harms.

Introduction
In 1998, for the first Special Issue of *Theoretical Criminology*, editors South and Beirne (1998: 147) suggested “that the time is right for criminology to take a keen theoretical interest in green issues.” Indeed, the timing was right, as this Issue expanded interest in green criminology exponentially (Lynch, 2013), effectively setting the stage for “the greening of criminology” that Lynch (1990) called for eight years prior. Since 1990, the field of green criminology has developed into a substantial area of environmental inquiry, as green criminologists have carefully expounded the meanings and conceptions of harms (and crimes) against non-human animals and the environment—hereafter denoted collectively as environmental harms. As green criminology continues to develop, future work must attend to both institutional-level and individual-level environmental harms (Brisman and South, 2018a) and incorporate an intra-disciplinary and extra-disciplinary engagement with the etiology, meaning, and representation of these harms (Brisman, 2014). Certainly, green criminology must remain open to new ways of imagining what environmental harms comprise, how they are experienced, who are responsible for them, and what can be done in response.

A central feature, and distinct advantage, of green criminology is the ability to engage with many other fields of inquiry, such as law (Gacek and Jochelson, 2021), political economy (Lynch et al., 2013; Stretesky et al., 2013), politics (Mol, 2017), and geography.
(Potter et al., 2016). There is also a continued interest in advancing green criminology by combining it with complementary areas within criminology, such as green victimology (Flynn and Hall, 2017; Hall, 2014; Barclay and Bartel, 2015), green-cultural criminology (Brisman and South, 2018b; Ferrell, 2013), southern green criminology (Goyes, 2019), and critical green criminology (Sollund, 2015; South and Brisman, 2013; White, 2018a). All these fusions between theories, disciplines, and approaches help to illustrate South’s (1998) notion that green criminology is best understood as a perspective, not a totalizing theory, as it can adopt a range of different positions and act as a “rallying-point” for research on criminologically relevant environmental issues. Systems thinking is an approach and body of literature that is arguably underutilized within green criminology, considering it is already being effectively used to study environmental issues in a range of other disciplines. By showcasing the importance of pairing systems thinking with green criminology, my aim is not only to outline another fruitful position from which to investigate environmental harms, but to articulate new ways for disparate ideas to come together for a common purpose.

Green criminology has both evolved and bifurcated throughout its development, with arguments over how best to imagine, define, examine, and respond to environmental harms. This includes debates over where to focus—activities that are harmful, or only those that are criminal (Nurse, 2015). That is, while some criminologists prefer a legal-procedural approach that limits the focus to environmental harms proscribed by law, many have pushed for a socio-legal approach that engages with all environmental harms, regardless of legality (Brisman and South, 2020). The latter approach is often justified by the significant environmental harms caused by legal, everyday practices. Indeed, some of the most environmentally damaging activities (such as clearfelling old growth forests) are permitted, while comparatively benign (and even ecologically beneficial) activities that could offer a suitable replacement (i.e., hemp farming) are prohibited or tightly controlled (Halsey, 1997; Tourangeau, 2015). This criminalization of environmentally beneficial activities adds to the complexity of conceptualizing environmental harms (Brisman, 2013). Harms manifest in many forms (Hillyard and Tombs, 2007), and accounting for the many forces that constitute environmental harms necessitates a diverse approach that is sensitive “to all voices and all concerns” (Takemura, 2013: 217). Green criminologists have effectively explored environmental harms using a wide range of conceptual lenses, including capitalism (Lynch et al., 2013), speciesism (Beirne, 1999), globalization (White, 2013, 2018b), North–South divides (Goyes, 2019), risk (Gibbs et al., 2010), and language (Halsey, 2004a). But as green criminology grows and flourishes within the more critical spaces of criminology, there is still more to learn. Literature on systems thinking presents an opportunity to see environmental harms through a more holistic lens, one that is specifically designed to grapple with complex problems, and envisions diverging ideas and perspectives working together. That is, systems thinking offers green criminology a much-needed platform for imbricating ideas and disciplines to create a practical toolbox for tackling the most complex environmental problems.

Imbued with complexity, uncertainty, and ambiguity, environmental problems such as climate change and biodiversity loss present green criminologists with a unique challenge. It is difficult to imagine, examine, and respond to environmental harms as discrete, cause-effect events; interconnected actors and elements, incomplete knowledge, and conflicting values work together to create dynamic and intractable challenges—often called “wicked problems” (Rittel and Webber, 1974). Applying systems thinking to green criminology means seeing environmental harms as events within complex social–ecological systems, with interconnected and interrelated actors, resources, perspectives, and discourses. By embracing complexity (Kay and Schneider, 1995; Stirling, 2010; Kay, 2008)—and thereby

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acknowledging underlying uncertainties and ambiguities and welcoming messy, chaotic solutions—systems thinking offers a means to grapple with these environmental problems and debates and productively engage with as many ideas, perspectives, and disciplines as necessary. When paired with green criminology, systems thinking can offer a useful means of studying environmental harms and charting pathways toward sustainable, ethical, and just alternatives. More than a body of the literature, systems thinking “is a way of thinking that gives us the freedom to identify root causes of problems and see new opportunities” (Meadows, 2008: 2). Systems thinking offers a toolbox of concepts, frameworks, and methods for (re)imagining, (re)defining, (re)examining, and responding to environmental harms, forming what I refer to as a systems-based approach to green criminology. Prior to presenting an outline of this approach, I offer a brief overview of systems thinking and a discussion of previous literature pairing systems thinking (and related ideas) with criminology, including green criminology.

**Systems Thinking**

Ludwig von Bertalanffy’s (1950) development of general system(s) theory, Jay Forrester’s (1971) work on system dynamics, Talcott Parsons’ (1951) *The Social System*, and Norbert Wiener’s (1948) work in cybernetics represent some of the key starting points for systems thinking (as cited in Ramage and Shipp, 2020; Jackson, 2007); though its origins can be traced back much further, including to systems ideas used in ancient Greece (Jackson, 2007). For Ramage and Shipp (2020), systems thinking can be summed up as the idea “that to make sense of the complexity of the world, we need to look at it in terms of wholes and relationships rather than splitting it down into its parts and looking at each in isolation” (p. xiii). Offering another definition, Arnold and Wade (2015) write:

> Systems thinking is a set of synergistic analytic skills used to improve the capability of identifying and understanding systems, predicting their behaviors, and devising modifications to them in order to produce desired effects. These skills work together as a system (Arnold and Wade, 2015).

At its core, systems thinking is about looking at a system as a whole—be it a social system, ecosystem, criminal justice system, management system, economic system, information system, or some other type. Put more briefly, systems thinking is “a system of thinking about systems” (Arnold and Wade, 2015), or even, thinking in systems (Meadows, 2008).

A hallmark of systems thinking is the numerous concepts, theories, and frameworks that have been developed to better understand and respond to problems within complex systems. Some examples include: adaptive cycles and panarchy (Gunderson and Holling, 2002), complementarism (Flood and Romm, 1996), post-normal science (Funtowicz and Ravetz, 1993), wicked problems (Rittel and Webber, 1974), and leverage points (Meadows, 2008). Abson et al. (2017) utilize a leverage points framework to explore where interventions are needed to make transformations towards sustainability. Drawing on Meadow’s (2008, 1997) list of 12 types of system interventions, Abson et al. (2017) illustrate the importance of implementing changes at “deep” leverage points tied to social structures and underlying goals, worldviews, and expectations to identify root causes of unsustainability. The various tools (i.e., concepts, theories, frameworks, etc.) of systems thinking provide ways of engaging with the diverging viewpoints, incomplete knowledge, and complex relationships that constitute whole systems.
Systems thinking, or “thinking in systems,” allows for the study and celebration of complexity (Meadows, 2008), and when systems are kept complex, we are able to recognize “the intrinsically plural, conditional nature of knowledge” and make decisions that are robust and democratically informed (Stirling, 2010: 1029). Systems thinking is also about studying the relationships between structure and behavior—systems are nested within other systems, comprising varying and changing elements, interconnections, and purposes (Meadows, 2008). Systems thinkers envision phenomenon as comprising elements with relationships and interconnections, all interacting as a whole system with some form of function or purpose (Flood and Carson, 2013; Meadows, 2008). For example, climate change can be imagined as a dynamic phenomenon arising from a complex social–ecological system comprised of various elements, including humans, non-human animals, coal, oil, gas, forests, fertilizers, and many others—all of which interact as a whole system through various forces, connections, and relations, such as mining, farming, logging, greenhouse gas emissions, emissions regulations, market competition, climate change discourses, and environmental values. Understanding and addressing the interconnectivity and overwhelming complexity of such intractable (i.e., “wicked”) problems is a key aim (and advantage) of systems thinking. A selection of key ideas from systems thinking is reviewed below, with a particular focus on applications in criminological and environmental literature, respectively.

**Systems Thinking in Criminology**

Some key ideas within systems thinking have been applied to research in criminology, law, and criminal justice over the past several decades. Examples include applying dynamic systems simulation modeling to criminal sanctioning to analyze the impacts of sentencing policy reforms (Auerhahn, 2008), using systems theory to examine decision making regarding the detention of sexual offenders (Williams, 2008), applying chaos theory to key criminological problems and theories (Walters, 1999, 2017), and exploring the wider ontological and epistemological implications that chaos theory may have for criminological philosophy (Arrigo and Barrett, 2008). Led by “a small but devoted group of scholars” (Brisman, 2016), the most enduring applications of systems thinking within criminology are in chaos theory and complexity theory, much of which is rooted in postmodernism (see Arrigo, 1994, 1995; Arrigo and Williams, 1999; Milovanovic, 2018, 1996, 1997b; Williams and Arrigo, 2002).

Situated within the “larger conceptual prism” of postmodernism, Williams and Arrigo (2002: 9) deploy chaos theory to examine mental health law and social justice in the context of clinicolegal decision making. Additionally, Lacan’s ideas have been combined with chaos theory to explore a range of criminological questions (Arrigo, 1994; Milovanovic, 2019, 1997b, 1992). For example, Arrigo (1994) combines chaos theory with Lacan’s work in psychoanalytic semiotics to examine the juridical treatment of offenders found to be not criminally responsible on account of mental illness. According to Arrigo (1994: 96), clinicolegal courtroom discourses limit and distort the articulation of ideas, realities, and experiences—“master signifiers in law, imbued with ideological content, announce a truth, a meaning, abstractly designed to encompass the interests (both linguistically and socially) of all juridic subjects.” In other words, the courtroom dynamic contributes to the narrowing of accepted discourses, privileging the language of law and health sciences. A key focus here is the limitations of modernist approaches to knowledge (whether in law,
science, or elsewhere), which emphasize certainty, predictability, and linearity in decision making.

Milovanovic’s (1997a) edited volume *Chaos, Criminology, and Social Justice: The New Orderly (dis)order* provides detailed discussions of chaos theory, and how it can be utilized to push criminological explorations beyond modernist thought. This work is closely connected to constitutive criminology, which also engages with postmodernist writings (see Henry and Milovanovic, 1991). Included in this work on postmodernism, chaos theory, and constitutive criminology is a focus on *transpraxis*, or transformative practices, which involves an awareness of the ways discourses of social change can work to reproduce the same structures and relations they seek to challenge and supplant (Henry and Milovanovic, 1991; Milovanovic, 2015). Also, from a postmodern approach—or even a “post, postmodern approach” (Milovanovic, 2013a: 353)—the idea of “quantum holography” is presented as a new means by which to push beyond (post)modernist thought in critical criminology (Milovanovic, 2013a, b, 2015). Instead of treating reality as orderly and predictable, an alternative ontology is proposed wherein notions of reality are treated like waves (in the sense of quantum theory, i.e., wave functions) that collapse into one instantiation (that is, one reality, one observation, one discourse) out of a multiplicity of virtual possibilities (Milovanovic, 2013a, 2013b, 2015). Combining chaos theory with postmodernism has presented criminologists with a lens from which to critique modernist approaches to complex, nonlinear/“chaotic” problems. Overall, however, ideas from systems thinking appear rather scarcely in criminological literature.

**Systems Thinking and the Environment**

Looking at environmental issues from a systems-based approach appears to be much more common than applying systems thinking in criminology, particularly in environmental management, conservation science, ecology, and inter- and transdisciplinary approaches to environmental research. A wide range of well-established areas of environmental research can be placed within the overarching category of systems thinking. This includes the following (overlapping) research areas: complex adaptive systems (e.g., Levin, 1998), leverage points (e.g., Leventon et al., 2021), resilience (e.g., Folke, 2006), social–ecological systems (e.g., Ostrom, 2009), systems dynamics (e.g., Hjorth & Bagheri, 2006), the Gaia hypothesis (e.g., Lovelock & Margulis, 1974), the ecosystem approach (e.g., Waltner-Toews et al., 2008), and world-ecology and world-systems (e.g., Moore, 2003; 2011). An exhaustive coverage of these approaches is not feasible, so instead, a selection of notable authors, foundational texts, and relevant case studies are presented to briefly illustrate systems thinking as a means of studying environmental issues.

Elinor Ostrom’s (1990) work on the management of common-pool resources and C.S. Holling’s (1973) work on ecological resilience are among the foundational ideas that created the space for research on “social-ecological systems” within environmental literature. Sometimes referred to as coupled human and natural systems, social–ecological systems offer both a concept and analytic framework to explore the complex dynamics of social and environmental change (Ostrom, 2009; Berkes et al., 2000; Fischer et al., 2015). According to Fischer et al. (2015: 145), “[a]s interactions between people and ecosystems increase in scale, scope, and intensity, understanding the dynamics of social–ecological systems is becoming increasingly important.” The goal is to find new ways of examining, understanding, and responding to the complexity and uncertainty of social–ecological systems, and finding ways to foster sustainability (Waltner-Toews et al., 2008; Kay and Schneider, 1995;
Sustainability—“the use of environment and resources to meet the needs of the present without compromising the ability of future generations to meet their own needs” (Berkes et al., 2008)—is a central feature of research on social–ecological systems, and environmental research more broadly. Sustainable systems persist, evolve, and change (Holling, 2008), necessitating approaches that grapple with complexity and uncertainty, integrating multiple perspectives, concepts, and frameworks capable of building more resilient and adaptive social–ecological systems. As a result, research on social–ecological systems tends to focus on building capacities for resilience, adaptation, and transformation.

Donella Meadows’ work, including the widely read co-authored report Limits to Growth (1972) and the posthumously published book Thinking in systems: A primer (2008), illustrates the potential applications of system dynamics to environmental problems and beyond. A complex system (whether it be an organization, an ecosystem, or some other system) can be mapped and analyzed using tools and concepts from system dynamics, such as the stocks and flows of resources and the feedbacks, structures, and rules that control the use of resources (Meadows, 2008, 1997). The modeling of systems (using stocks, flows, feedback loops, etc.) can be used to better understand complex systems, as well as explore the best places to intervene in a system—also termed leverage points (Meadows, 2008, 1997). Meadows’ work on leverage points has recently been used in research on the sustainability of sheep grazing and wool production (Tourangeau and Sherren, 2020), and a social network analysis of sustainability organizations (Lam et al., 2021). Additionally, the concept of leverage points has inspired new perspectives, frameworks, and approaches for pursuing sustainable transformations (Abson et al., 2017; Fischer and Riechers, 2019; Leventon et al., 2021). In their Editorial, Leventon et al. (2021) outline nine guiding questions for working with leverage points, in hopes that these questions “open up exploration across systems and worldviews and encourage researchers and practitioners to embrace uncertainty and complexity.” Overall, the systems thinking literature offers a range of underutilized ideas, approaches, concepts, and theories for grappling with environmental problems within criminology. Green criminologists engaging with this literature (which to date remains few) help to showcase a starting point for a new approach that integrates systems-based approaches with the study of environmental harms.

A Starting Point for Pairing Systems Thinking with Green Criminology

Applications of systems thinking are not completely absent from the green criminology literature. Over the past couple decades, as green criminology has begun to cement itself firmly within the criminological canon, a handful of scholars have applied ideas from systems thinking to study various environmental problems. These applications mark a potential starting point for pairing systems thinking with green criminology in the exploration of environmental harms. Below, select works are reviewed as groundwork for establishing what I call a systems-based approach to green criminology. Specifically, this includes Gibbs and coauthors’ (2010) work on “conservation criminology,” Hill’s (2015) application of systems thinking to wildlife poaching, Takemura’s (2013) combination of green criminology and chaos theory, and Halsey’s (2006) Deleuzian take on environmental damage. Further, developments within green criminology that more broadly reflect the tenets of systems thinking are also reviewed for their potential contributions to this new direction in green criminology.
During a time when green criminology was gaining momentum, but still in the earlier stages of forming its identity, Gibbs et al. (2010) introduced “conservation criminology” as an approach for examining “environmental crimes and risks that lie at the intersection of criminology, natural resources and risk sciences” (p. 129). By highlighting the potential contributions of interdisciplinary scholarship—including research in sustainability science and coupled human and natural systems—Gibbs et al. (2010) are among the first to highlight the potential applications of systems thinking ideas to environmental crimes. Positioned as a solution to the limitations of dominant approaches in green criminology (Gibbs et al., 2010), conservation criminology has arguably developed alongside green criminology as an effective and pragmatic approach to applying conservation science to criminological questions. Conservation criminology is guided by inductive reasoning and seeks to develop generalizable knowledge about risk calculation and decision making regarding environmental crimes (Gibbs et al., 2010). Applications of conservation criminology include Weekers and colleagues’ (2019) research on illegal fishing in marine protected areas, as well as Gore’s (2017) edited volume Conservation Criminology, which includes contributions like Moreto and Gau’s (2017) chapter on wildlife crimes.

Written in Sollund’s (2016) Green harms and crimes: Critical criminology in a changing world, Hill’s (2015) chapter applies systems thinking to wildlife poaching. Possibly the first example wherein “systems thinking” is explicitly named and applied in a green criminology paper, Hill (2015) explores wildlife poaching as a complex biological-social system, examining the problem as a whole system of interconnected and interacting components. Additionally, ideas from routine activities theory inform the examination of actors within this system, and computer simulation modeling is used to map out the system and develop solutions for reducing poaching (Hill, 2015). By drawing from systems thinking literature and deploying systems-based tools (e.g., simulation modeling), this paper effectively demonstrates the potential for a more holistic approach to green criminology. Also highlighting the criminological value of systems thinking, green criminology has been paired with chaos theory (Takemura, 2013), as well as research on space capitalism and astroenvironmentalism to propose an “astro-green criminology” perspective (Takemura, 2019). Takemura (2013) introduces “chaos criminology” (and “chaos justice”) to advance a reflective and responsive approach to social justice and global environmental problems—one that is always in flux and adjusted to a given context. That is, according to Takemura (2013: 223) “because the causality of environmental crime/harm is too complicated to be ascribed to only one cause-effect relation or one factor, it is necessary to introduce a nonlinear way of thinking in order to recognize this problem as a whole.” This approach avoids the privileging of grand narratives, universal truth claims, and the Enlightenment-era enthusiasm to control nature and society (Arrigo and Young, 1996 as cited by Takemura, 2013). For example, while some see nuclear power and biofuels as a welcomed innovation (via modernist linear logic) due to their improvements over fossil fuels, from another vantage point they have resulted in unequally distributed harmful side-effects (Takemura, 2013). Chaos theory presents a nonlinear way of thinking, looking at a given environmental problem as a whole, and chaos criminology/justice shifts the focus from what is just for the individual to “what is just for the social whole” (Takemura, 2013: 224). Chaos criminology/justice, as presented by Takemura (2013), is situated among other postmodern approaches, such as postmodern criminology (see Milovanovic, 2019) and constitutive criminology (see Henry and Milovanovic, 1991), and draws on related work from Halsey (2004a, 2006).

Although not explicitly written as applications of systems thinking or a green criminology perspective, Halsey’s (2004a, b, 2005, 2006) work offers important contributions to
these fields by exploring environmental harms and the role of text—including its potential for violence. In applying the philosophical work of Deleuze and Guatarri, and other writers contributing to postmodernist and poststructuralist approaches, Halsey (2004a; 2004b) advances a critique of modernist approaches to environmental law and governance, and the discursively produced meanings of, for example, “harm,” “justice,” and “conservation.” In doing so, Halsey (2005) challenges efforts to reduce the world into what can be known, quantified, and categorized. Borrowing concepts from Deleuze and Guatarri—such as “machinic assemblage,” “rhizome,” “plane of consistency,” and “multiplicities”—Halsey (2005; 2006) engages with notions such as chaos and complexity in examinations of environmental problems like deforestation, arguably fitting into (if not at least complementing) the broader systems thinking literature. Postmodern ideas can be seen as complementary to systems thinking approaches (Milovanovic, 2015, 2019) and may even offer metaphors for imagining systems. Indeed, the rhizome as a model for thinking—named after the underground plant stem that spreads roots horizontally and sends shoots to the surface—offers a means to imagine multiple, connected, and continually produced ways of seeing and naming the world (see Halsey, 2005, 2007; Deleuze and Guattari, 1988).

In addition to the above contributions, there are key directions within green criminology that, in essence, draw from and contribute to the principles of systems thinking. Brisman and South’s (2013, 2018b) “green-cultural criminology” highlights the interactions and interconnectedness of cultural and environmental systems, and, when combined with narrative criminology, Brisman (2019) demonstrates the capacity for green-cultural criminology to challenge dominant narratives on climate change and explore alternative stories, discourses, and perspectives. McClanahan’s (2020) “darker green criminology” is also situated within (or adjacent to) systems thinking ideas, where “dark ecology” provides a critical lens for exploring the relationship between culture and ecology, with important challenges to the ontological and epistemological assumptions of green criminology. According to McClanahan (2020), a potential starting point for a dark green criminology “is to reconsider the assumptions at the core of romantic western ‘nature’ in order to open up new lines of inquiry and new modes of thinking ecology” (p. 646). Finally, White’s (2018b) fusion of ecology, justice, and global studies—“eco-global criminology”—presents important developments in green criminology that echo themes in systems thinking; in particular, the attention to “ecological well-being and holistic understandings of harm” (p. 34). These developments in green criminology, which adopt more critical and comprehensive approaches and effectively challenge dominant understandings of nature, provide important groundwork for future pairings of systems thinking with green criminology.

While the examples presented here mark a key starting point for pairing systems thinking with green criminology, further engagement is needed between green criminology and the extensive scholarship already exploring complex environmental problems through systems-based standpoints. It is the aim of this paper to more fully articulate and formalize an approach to facilitate future research in this area. A systems-based approach to green criminology has the potential to influence the ways in which environmental harms are engaged with in theoretical, empirical, and policy-focused research. This is made possible by welcoming and working with complexity (Kay and Schneider, 1995; Funtowicz and Ravetz, 1994; Stirling, 2010), viewing environmental problems as events within whole systems (Meadows, 2008), contending with varied and diverging viewpoints (Takemura, 2013), and engaging with tools, concepts, and ideas that are capable of crossing multiple disciplines, for example, incorporating insights from ecology, physics, conservation science, ecological economics, and so forth. With a systems-based approach, green criminology remains
opened to new ideas and a wider community of scholars working to address the world’s most pressing environmental problems.

**Imagining a Systems-Based Approach to Green Criminology**

When green criminology first emerged, environmental harms were a public concern, but not a focus of criminology (Lynch et al., 2017). In many ways, green criminology is “a call to arms,” an ongoing mission to undo the historical neglect of ecological issues within mainstream criminology and to advance a collection of perspectives, theories, and ideologies that grapple with the many harms (legal and illegal) being perpetrated against non-human animals and the environment (Nurse, 2017). When engaging with such harms, it is essential to understand the inter-relationality between humans and the environment—humans are dependent upon the environment, while also being responsible for it (Brisman and South, 2018a). Brisman and South (2018a) elaborate:

> What we therefore propose is that we consider ordinary acts and omissions in both relational or (comparative) and inter-relational terms. By relational, we mean based on the specific circumstances of (the) harm; by inter-relational, we wish to accentuate that our interactions with our environment are fundamentally mutual and reciprocal—even if humans do not engage fairly, generously or responsibly in this relationship. Thus, for example, instead of absolutist positions, such as ‘the taking of wild animals is bad and should be illegal’ or ‘the taking of wild animals is bad because it is illegal’, we might consider the poor person who poaches for food to feed his family in relation to—or in comparison to—the wealthy person who poaches for sport and trophy. Our inter-relationship with nature then needs to be conceptualized in relation to our means and capacity to act. Thus, to offer another example, someone who drives a private vehicle because he/she finds subways to be crowded and smelly would, under our proposed orientation, be viewed differently from someone who drives a private vehicle because he/she lives in an area without (reliable) public transportation.

Thinking in relational and inter-relational terms is about accounting for various circumstances, interactions, and conceptualizations. Arguably, part of what Brisman and South (2018a) are calling for is a green criminology capable of thinking in systems. Considering the complex nature of environmental issues, green criminology’s ongoing engagement with environmental harms will benefit from the holistic approaches offered through systems thinking. Drawing from systems thinking literature, and its potential for generating new insights into environmental harms, below I outline how a systems-based approach to green criminology might be imagined.

By way of a hypothetical example (grounded in real events), the need for—and strengths of—a systems-based approach to green criminology can be illustrated. If, for example, a group of birds becomes harmed in an accidental oil spill, there are numerous questions that could be asked to uncover all the relevant actors, factors, and relations involved in the event. These questions include (but are not limited to): What conditions, experiences, and effects made this event possible? What discourses impact how these harms are imagined and understood? What actors have the power to control this discursive space? What circumstances must be present for the harms to be labelled a crime? What regulations are (or should be) in place to prevent oil spills? What actors are involved in the clean up? Is a complete restoration of the affected ecosystem possible? Is it more harmful if the birds
belong to a threatened species, like the piping plover? What other species are impacted within this social–ecological system? Are birds and mammals prioritized over other species (e.g., plants) when considering the environmental harms of oil spills? And what are the experiences, perspectives, and realities of the birds being harmed in the oil spill? A systems-based approach is well-suited to explore these (and other) questions, mapping connections and locating affected actors, and looking at the event as a series of dynamic interactions within a complex social–ecological system, perceived and experienced from a range of different values and vantage points, with incomplete knowledge in various areas. Overall, there is a need to look at, examine, and respond to environmental harms holistically, maintaining and engaging with the inherent complexities, uncertainties, and ambiguities presented by all these dynamic interactions. It is a matter of considering all the actors (and their different perspectives) involved in the system, and exploring sustainable, ethical, and just alternatives to damaging relations and effects. While the systems thinking literature comprises a range of theories and perspectives for seeing the world through a whole systems point of view, a few key ideas are introduced here to further demonstrate potential applications in green criminology.

Visualizing the different components of a system—like the one discussed above regarding an oil spill—can help with understanding the intricate connections and relationships between different system components. Causal loop diagrams are a common tool within systems thinking for mapping and conceptualizing systems. Sometimes referred to as influence diagrams, system maps, and mental/cognitive maps, causal loop diagrams are a way to depict cause-effect relationships among a collection of interconnected variables, often with a range of symbols that indicate relationship types such as a delayed effect, or negative and positive feedback loops that result in balancing and reinforcing effects, respectively (Rissman and Gillon, 2017; Sedlacko et al., 2014). Diagrams are a means to visually process and illustrate what variables (actors, institutions, resources, etc.) are connected to one another and, as a result, map out the various elements involved in each event, such as an oil spill. That is, a causal loop diagram could be built to visualize environment harms from a specific oil spill, such as the harms experienced by Piping Plovers. Interconnected elements in such a diagram might include migration routes, wintering locations, predators, climate change impacts, conservation programs, species protection legislation, and a range of others (Gratto-Trevor and Abbott, 2011), all of which may impact how harms caused by the oil spill are imagined. In addition to visualizing social–ecological systems, causal loop diagrams can also provide a means to collect and process data.

Fazey et al. (2006) utilize causal loop diagrams to depict the knowledge of conservation managers in the Macquarie Marshes in New South Wales, Australia, and Fazey et al. (2011) utilized causal loop diagrams in their research in the Solomon Islands, examining dynamic responses to change at individual, group, and societal levels to better understand future trajectories and vulnerabilities. Importantly, data for these two studies (collected via interviews, focus groups, workshops, etc.) include knowledges, experiences, and perceptions from individuals and communities directly involved in these social–ecological

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1 Hill (2015) provides a clear summary of the different approaches to systems thinking—divided into hard systems thinking, soft systems thinking, and critical systems heuristics—which adopt different ontological starting points, making them liable to imagine systems in different ways. Gaudreau (2013) provides another means for grouping perspectives in systems thinking, imagined as a combination of the complexity of science and the science of complexity. While the former includes approaches to learning and decision making in a complex world, the latter includes approaches that seek describe the structure and dynamics of complex systems (ibid).
systems (Fazey et al., 2006, 2011). Causal loop diagrams, built from the narratives of those directly involved in a system, help to showcase issues of complexity, ambiguity, and uncertainty, and the various ways environmental harms are understood and experienced, acknowledging the importance of multiple ways of knowing. Systems thinking literature can also sharpen the critical edge of green criminology by problematizing the limitations (and linearity) of conventional science, which further supports the inclusion of diverging perspectives.

According to Ravetz (1999: 649), in many scientific debates on environmental issues “facts are uncertain, values in dispute, stakes high, and decisions urgent.” Climate change, for example, is a pressing issue with contentiously debated assessments regarding human impacts on the atmosphere, demanding decision-making processes that can account for incomplete knowledge, conflicting goals, and differing values. Funtowicz and Ravetz (1993) developed post-normal science to contend with these high-stakes complex systems. Situated within systems thinking literature on complexity, post-normal science is a fusion of “facts” and “values,” comprising “inquiries that occur at the interfaces of science and policy where uncertainties and value-loadings are critical”; as a result, decisions are evaluated on their overall quality, not based on objective, scientific “truths” (Funtowicz and Ravetz, 2003). To improve the quality of decision-making and policy development for these types of complex problems, post-normal science emphasizes the importance of pluralism. The idea of extended peer-communities (and their “extended facts”) is promoted as a way of opening a dialogue between all of those affected by a given issue—a concept comparable to citizens’ juries and consensus conferences (Ravetz, 1999). For example, Ravetz (1999) points to a report by the UK Royal Commission on Environmental Pollution that broadly embodies the tenets of post-normal science, outlining the important role of uncertainty, value judgements, and consultations that explore people’s wide-ranging viewpoints. Returning to the example of birds harmed by an oil spill, insights from post-normal science help to question the acceptability of risks when it comes to transporting oil; beyond the calculable odds of a spill and the estimated “damage,” there are immeasurable harms experienced and understood in a range of different ways (by different people, and different species), which may warrant a more precautionary approach to oil transport, and fossil fuels more generally. Approaches that address environmental complexities (e.g., post-normal science) and emphasize the importance of diverse perspectives help to uncover what decisions and actions are needed to make sustainable, ethical, and just transformations.

Deliberate transformations toward sustainability are a primary goal within systems-based approaches (O’Brien, 2012, 2018; Westley et al., 2011; Gunderson and Holling, 2002), offering green criminology a means to seek interventions that will eliminate (or at least reduce) the environmental harms being generating in a given social–ecological system. To respond to global environmental problems like climate change, O’Brien (2012) explains that in addition to mitigation and adaptation efforts, there is a need to focus on transformations to more sustainable systems. This involves addressing human behavioral causes of environmental change, and not relying solely on technological fixes (Fazey et al., 2010). Adaptations to expected changes (via technologies, regulations, policies, etc.), while important, can be thought of as accepting and working to accommodate change, as opposed to contesting it (O’Brien, 2012). Pursuing sustainable, ethical, and just transformations requires questioning values, assumptions, fixed-beliefs, and prevailing norms, and taking into consideration a range of perspectives to explore alternative ideas and approaches to addressing social–environmental changes (O’Brien, 2018). Leverage points are a key means of triggering transformations, particularly regarding interventions at “deep” leverage points (Meadows, 2008, 1997). While change is often pursued in simpler ways (“shallow”
leverage points), for example, adjusting numbers regarding the rates of resource extraction, deeper leverage points that entail paradigmatic changes to the ways in which a system operates have the potential to produce lasting, meaningful change (Meadows, 1997, 2008; Abson et al., 2017). Returning once again to the hypothetical example of birds harmed in an oil spill, while there are several technological solutions for detecting, tracking, containing, and removing oil spills (Fingas, 2002), these sorts of interventions fail to challenge the overall status quo of mining, transporting, processing, and consuming fossil fuels at current rates. Intervention is arguably needed at deeper leverage points, including the goals and paradigms that influence the overall system (Meadows, 2008). This might involve challenging the ways we think about fossil fuels, engaging with ideas like divestment from fossil fuels and increasing the use of renewable energy and human-powered transport. Overall, a better understanding of the social–ecological systems that lead to oil spills helps build a better understanding of the harms that result, and what interventions and transformations might be needed.

Criminologists are calling for further extra-disciplinary engagement regarding the nature of environmental harms (Brisman, 2014), research focusing on both institutional-level and individual-level environmental crimes and harms (Brisman and South, 2018a), and approaches capable of contributing to transformative practices that see beyond the limitations of modernist dualisms like legal/illegal, harmful/harmless (Milovanovic, 2015; Halsey, 2004a). Systems thinking literature may help to meet these demands, and many other objectives in green criminology. By embracing the complexity of social–ecological systems (Kay and Schneider, 1995), and finding ways of thinking in systems (Meadows, 2008), systems thinking literature presents new ways of grappling with green criminological questions. A systems-based approach to green criminology comprises an evolving toolbox of ideas, concepts, theories, and frameworks that treat environmental harms as events within social–ecological systems, helping create a clearer picture of their real and potential impacts, and gain insights on how best to respond.

Conclusion

Described in 1998 as “a new ‘green field’ of study for criminology” (South and Beirne, 1998), green criminology has since flourished, offering cutting-edge theoretical and empirical developments regarding crimes and harms against non-human animals and the environment. In this article, systems thinking and green criminology are highlighted as an underrecognized and underutilized combination, capable of advancing a more holistic approach. I contend that what I term a systems-based approach to green criminology can offer new ways to (re)imagine, (re)define, (re)examine, and respond to environmental harms. This approach provides a means of looking at environmental harms as events within complex and dynamic social–ecological systems that necessitate multiple ideas and perspectives to account for uncertainties, ambiguities, and change. Such an approach may provide new understandings of environmental harms and aid in the discovery of sustainable, ethical, and just alternatives.

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References

Abson DJ, Fischer J, Leventon J, et al. (2017) Leverage points for sustainability transformation. Ambio 46(1): 30-39.
Arnold RD and Wade JP (2015) A definition of systems thinking: A systems approach. Procedia computer science 44: 669-678.
Arrigo BA (1994) Legal discourse and the disordered criminal defendant: Contributions from psychoanalytic semiotics and chaos theory. Legal Stud. F. 18: 93.
Arrigo BA (1995) The peripheral core of law and criminology: On postmodern social theory and conceptual integration. Justice Quarterly 12(3): 447-472.
Arrigo BA and Barrett L (2008) Philosophical criminology and complex systems science: Towards a critical theory of justice. Critical criminology 16(3): 165-184.
Arrigo BA and Williams CR (1999) Chaos theory and the social control thesis: A post-Foucauldian analysis of mental illness and involuntary civil confinement. Social Justice 26(1,75): 177–207.
Auerhahn K (2008) Dynamic systems simulation analysis: A planning tool for the new century. Journal of Criminal Justice 36(4): 293-300.
Barclay E and Bartel R (2015) Defining environmental crime: The perspective of farmers. Journal of Rural Studies 39: 188-198.
Beirne P (1999) For a nonspeciesist criminology: Animal abuse as an object of study. Criminology 37(1): 117-148.
Berkes F, Colding J and Folke C (2008) Navigating social-ecological systems: building resilience for complexity and change. Cambridge University Press.
Berkes F, Folke C and Colding J (2000) Linking social and ecological systems: management practices and social mechanisms for building resilience. Cambridge University Press.
Bertalanffy L (1950) An outline of general system theory. British Journal for the Philosophy of Science, 1: 134–165. https://doi.org/10.1093/bjps/L2.134
Brisman A (2013) The indiscriminate criminalisation of environmentally beneficial activities. Global Environmental Harm. Willan, pp.179–210.
Brisman A (2014) Of theory and meaning in green criminology. International Journal for Crime, Justice and Social Democracy 3(2): 21-34.
Brisman A (2016) Pyramids, Squares, and Prisms: Severity of Harm, Public Awareness and Perceptions of Severity of Harm, Power Relations, and Society’s Response. Geometries of Crime. Springer, pp.35–58.
Brisman A (2019) The fable of the three little pigs: Climate change and green cultural criminology. International Journal for Crime, Justice and Social Democracy, 8(1), 46.
Brisman A and South N (2013) A green-cultural criminology: An exploratory outline. Crime, Media, Culture, 9(2), 115-135.
Brisman A and South N (2018a) Green criminology, zemiology, and comparative and inter-relational justice in the Anthropocene era. Zemiology. Springer, pp.203–221.
Brisman A and South N (2018b) Green cultural criminology. Routledge handbook of critical criminology. Routledge, pp.132–142.
Brisman A and South N (2020) The growth of a field: A short history of a ‘green’criminology. Routledge International Handbook of Green Criminology. Routledge, pp.39–51.
Deleuze G and Guattari F (1988) *A thousand plateaus: Capitalism and schizophrenia*. Bloomsbury Publishing.

Fazey I, Gamarra JG, Fischer J, et al. (2010) Adaptation strategies for reducing vulnerability to future environmental change. *Frontiers in Ecology and the Environment* 8(8): 414-422.

Fazey I, Petorelli N, Kenter J, et al. (2011) Maladaptive trajectories of change in Makira, Solomon Islands. *Global environmental change* 21: 1275-1289.

Fazey I, Proust K, Newell B, et al. (2006) Eliciting the implicit knowledge and perceptions of on-ground conservation managers of the Macquarie Marshes. *Ecology and Society* 11(1).

Ferrell J (2013) Tangled up in green: Cultural criminology and green criminology. *Routledge International Handbook of Green Criminology*. Routledge, pp.365–380.

Fingas M (2002) *The basics of oil spill cleanup*. CRC Press.

Fischer J, Gardner TA, Bennett EM, et al. (2015) Advancing sustainability through mainstreaming a social–ecological systems perspective. *Current Opinion in Environmental Sustainability* 14: 144-149.

Fischer J and Riechers M (2019) A leverage points perspective on sustainability. *People and Nature* 1(1): 115-120.

Flood RL and Romm NR (Eds.) (1996) *Critical systems thinking: current research and practice*. Plenum Press: New York.

Flood RL and Carson ER (2013) *Dealing with complexity: An introduction to the theory and application of systems science*. Springer Science & Business Media.

Flynn M and Hall M (2017) The case for a victimology of nonhuman animal harms. *Contemporary Justice Review* 20(3): 299-318.

Folke C (2006) Resilience: The emergence of a perspective for social–ecological systems analyses. *Global Environmental Change*, 16(3), 253-267.

Forrester, J. (1971). *World dynamics*. Cambridge: Wright-Allen Press.

Gacek J and Jochelson R (2021) Green criminology and the law. *Palgrave Studies in Green Criminology*. Springer.

Gaudreau K (2013) *Sustainability assessment of energy systems*. University of Waterloo, Waterloo, Ontario, Canada.

Gibbs C, Gore ML, McGarrell EF, et al. (2010) Introducing conservation criminology: Towards interdisciplinary scholarship on environmental crimes and risks. *The British Journal of Criminology* 50(1): 124-144.

Goyes DR (2019) *Southern green criminology: A science to end ecological discrimination*. Emerald Group Publishing.

Gore ML (Ed.). (2017) *Conservation criminology*. Wiley & Sons.

Gratto-Trevor CL & Abbott S (2011) Conservation of Piping Plover (*Charadrius melodus*) in North America: Science, successes, and challenges. *Canadian Journal of Zoology*, 89(5), 401–418.

Gunderson LH and Holling CS (2002) *Panarchy: Understanding transformations in human and natural systems*. Island press.

Hall M (2014) Environmental harm and environmental victims: Scoping out a ‘green victimology’. *International Review of Victimology* 20(1): 129-143.

Halsey M (1997) The wood for the paper: Old-growth forest, hemp and environmental harm. *Australian & New Zealand Journal of Criminology* 30(2): 121-148.

Halsey M (2004a) Against ‘green’ criminology. *British Journal of Criminology* 44(6): 833-853.

Halsey M (2004b) Environmental visions: Deleuze and the modalities of nature. *Ethics and the Environment*, 33–64.

Halsey M (2005) Ecology and machinic thought: nietzsche, deleuze, guattari. *ANGELAKI journal of the theoretical humanitites* 10(3): 33-55.

Halsey M (2006) *Deleuze and environmental damage: Violence of the text*. Ashgate Publishing, Ltd.

Henry S and Milovanovic D (1991) Constitutive criminology: The maturation of critical theory. *Criminology* 29(2): 293-316.

Hill JF (2015) A systems thinking perspective on the motivations and mechanisms that drive wildlife poaching. *Green Harms and Crimes*. Springer, pp.189–219.
Hillyard P and Tombs S (2007) From ‘crime’to social harm? *Crime, law and social change* 48(1-2): 9-25.

Hjorth P, & Bagheri A (2006) Navigating towards sustainable development: A system dynamics approach. *Futures*, 38(1), 74-92.

Holling CS (1973) Resilience and stability of ecological systems. *Annual review of ecology and systematics* 4(1): 1-23.

Holling CS (2008) Foreword: The backloop to sustainability. In: Berkes F, Colding J and Folke C (eds) *Navigating social-ecological systems: Building resilience for complexity and change*. Cambridge University Press.

Jackson MC (2007) *Systems approaches to management*. Springer Science & Business Media.

Kay JJ (2008) An introduction to systems thinking. *The ecosystem approach: Complexity, uncertainty, and managing for sustainability*, 3–13.

Kay JJ, Regier HA, Boyle M, et al. (1999) An ecosystem approach for sustainability: Addressing the challenge of complexity. *Futures* 31(7): 721-742.

Kay JJ and Schneider E (1995) Embracing complexity the challenge of the ecosystem approach. *Perspectives on ecological integrity*. Springer, pp.49–59.

Lam DP, Martin-Lopez B, Horcea-Milcu AI, et al. (2021) A leverage points perspective on social networks to understand sustainability transformations: Evidence from Southern Transylvania. *Sustainability Science* 16(3): 809-826.

Leventon J, Abson DJ and Lang DJ (2021) Leverage points for sustainability transformations: nine guiding questions for sustainability science and practice. *Sustainability Science* 16(3): 721-726.

Liu J, Dietz T, Carpenter SR, et al. (2007) Complexity of coupled human and natural systems. *Science* 317(5844): 1513-1516.

Lovelock JE, & Margulis L (1974) Atmospheric homeostasis by and for the biosphere: the Gaia hypothesis. *Tellus*, 26(1-2), 2-10.

Lynch MJ (1990) The greening of criminology: A perspective on the 1990s. *The Critical Criminologist* 2(3): 3-12.

Lynch MJ (2013) Reflections on green criminology and its boundaries. In: South N and Brisman A (eds) *Routledge International Handbook of Green Criminology*. Abingdon: Routledge.

Lynch MJ, Long MA, Stretesky PB, et al. (2017) *Green Criminology: Crime, Justice, and the Environment*. Univ of California Press.

McClanahan, B. (2020). Earth–world–planet: Rural ecologies of horror and dark green criminology. *Theoretical Criminology*, 24(4), 633-650.

Meadows D (1997) Places to Intervene in a System. *Whole Earth* 91(1): 78-84.

Meadows D (2008) *Thinking in systems: A primer*. Chelsea Green Publishing.

Meadows DH, Meadows DL, Randers J, et al. (1972) *The Limits to Growth*. New York: Universe Books.

Milovanovic D (1992) *Postmodern law and disorder: Psychoanalytic semiotics, chaos, and juridic exegeses*. Deborah Carlos Publications.

Milovanovic D (1996) Postmodern criminology: Mapping the terrain. *Justice Quarterly* 13(4): 567-610.

Milovanovic D (1997a) *Chaos, criminology, and social justice: The new orderly (dis) order*. Greenwood Publishing Group.

Milovanovic D (1997b) *Postmodern Criminology*. Taylor & Francis.

Milovanovic D (2013a) Postmodernism and thinking quantum holographically. *Critical criminology* 21(3): 341-357.

Milovanovic D (2013b) Quantum Holographic Critical Criminology. *Journal of Theoretical & Philosophical Criminology* 5(2).

Milovanovic D (2015) The quantum holographic turn. *What is Criminology About?: Philosophical Reflections*, 66.

Milovanovic D (2018) Postmodern criminology. *Routledge handbook of critical criminology*. Routledge, pp.156–164.

Milovanovic D (2019) *Postmodern criminology*. Routledge.

Mol H (2017) *The Politics of Palm Oil Harm: A Green Criminological Perspective*. Springer.

Moore JW (2003) Capitalism as world-ecology: Braudel and Marx on environmental history. *Organization & Environment*, 16(4), 514-517.

Moore JW (2011) Transcending the metabolic rift: A theory of crises in the capitalist world-ecology. *Journal of Peasant Studies*, 38(1), 1-46.
Williams CR (2008) Predictive efficacy and the preventive detention of dangerous sexual offenders: Contributions from nonlinear dynamical systems theory. *Critical criminology* 16(3): 185-196.

Williams CR and Arrigo BA (2002) *Law, psychology, and justice: Chaos theory and the new (dis) order*. SUNY Press.

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