Perspectives

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Evolving ecosystem management in the context of British Columbia resource planning

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Abstract

Ecosystem management is an approach to natural resource planning that theoretically places environmental issues on an equal footing with the economic concerns that dominate resource use. This approach recognizes the importance of both a healthy environment and access to natural resources. Each of these factors is an implicit element of human security, a political concept that promotes the protection of human lives and livelihoods. Ecosystem management acknowledges the role of humans as an integral part of the ecosystem; however, it does not define the ways in which humans and the ecosystem interact. This lack of definition makes the practical application of ecosystem management difficult.

In this paper, we examine the application of ecosystem management principles in British Columbia's Clayoquot Sound. We propose that human security can act as an imperative for the expanded consideration of social networks and environmental pathways in the practice of ecosystem management. Theories from the social and natural sciences are supplied to support the science-based application of ecosystem management. These underpinnings enable managers to better define ecosystem boundaries and to integrate expanded social networks into management plans.

KEYWORDS: *ecosystem management, human security, Clayoquot Sound, British Columbia, ecosystem boundaries, stakeholders, conflict.*

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Introduction

Ecosystem management is a concept that seeks to balance ecosystem function and human requirements in the stewardship and use of the world's natural resources. In this paper, we use the term "ecosystem management" (or EM) to refer to a number of similar and related concepts, including "ecosystem approach" and "ecosystem-based management." The goal of EM has been described as the development of "long-term sustainable relationships with the land" (Yibarbuk *et al.* 2001). In practice, EM represents an attempt to minimize trade-offs between social, economic, and ecological needs, which ultimately reduces conflicts over resources that these competing goals might engender. This approach integrates both the use and conservation of resources and represents a convergence of historical management philosophies, which tended to separate these issues (e.g., Pinchot 1910; Engberg and Wesling [editors] 1980).

In the early 1930s and 1940s, some naturalists advocated managing natural resources for an expanded set of objectives that would include non-economic criteria (Leopold 1949). Grumbine (1994) traced the development of this concept through early case studies. These studies highlighted the differences between ecosystem ranges and legal boundaries of protected areas on public lands in the United States (Caldwell 1970; Craighead 1979; Newmark 1985; Grumbine 1994; Grumbine 1997). This represented the beginnings of a move away from single-species management, which focuses primarily on human requirements, towards a more holistic, science-based approach that recognizes the intrinsic values and interconnected nature of ecosystem function (Blockstein 1999).

Over the past thirty years, the concept of EM has evolved as the broad range of ecological, cultural, and social values inherent in ecosystems have been explored and catalogued. By the mid-1990s, the science-based approach to EM was referenced in government land and resource use policy in both Canada and the United States (Beattie 1996; Nelson *et al.* 2000). In their report on the scientific basis for EM, the Ecological Society of America defined the following as necessary principles in its application (Christensen *et al.* 1996):

- long-term sustainability;
- clear operational goals;
- sound ecological models and understanding;
- recognition of ecosystem complexity and interconnectedness;
- recognition of the dynamic nature of ecosystems;
- acknowledgement of humans as ecosystem components;
- commitment to adaptability and accountability; and
- attention to context and scale.

Changes to the environment, and to the ecological services it provides, act to reduce human well-being and threaten the security of populations at multiple spatial scales.

These principles recognize the relationship between the social and ecological requirements that implicitly link EM to the broad political concept of human security. The term "human security" is often considered synonymous with national security, or "freedom from threats to human lives and liverQhoods from conflict or war" (Department of Foreign Affairs and International Trade 1999; McRae and Hubert 2001). Since the end of the Cold War in the late 1980s, there has been pressure from academics and human rights advocates to broaden the definition of human security to include both national and individual security, and to apply the term to a wide range of threats to well-being, including those of environmental origin. This notion is not unanimously accepted within the literature, as evidenced by an attempt to differentiate human security from national security. Some define the term human security as threats to the lives or livelihoods of a broad range of populations, from individuals to nations. This may justify a number of non-military responses and reserve the term national security to apply to situations of conflict and war (Liotta 2002). Some interpret this as allowing the isolation of national security from environmental problems or solutions (Deudney 1999).

The literature shows a growing conviction, however, that environmental change and the loss of ecological function gravely threatens the security of individuals, communities, and nations (Lonergan 1999; McRae and Hubert 2001; Simms 2001; Barnett 2003). Changes to the environment, and to the ecological services it provides, act to reduce human well-being and threaten the security of populations at multiple spatial scales (Conceptual Framework Working Group of the Millennium Ecosystem Assessment 2003).

Indeed, the Pentagon reportedly views climate change as a far greater threat to security than terrorism (Townsend and Harris 2004). Thus, in this paper, we use the term "human security" in the broadest sense to include both nations and individuals.

In the application of EM, human security may play an important role in providing context and scale, issues that continue to present serious challenges to natural resource managers. The landscape management approach, in which local decisions on resources reflect long-term trends in the greater ecosystem, offers a partial answer to issues of context and scale. However, a human "landscape" also exists. This landscape represents social networks and exists at multiple scales (i.e., from local to national and global). Mechanisms are needed, in the form of institutions or frameworks, to incorporate the context of these social networks into management decisions. In this paper, we explore the ways in which the concept of human security can inform the application of EM. In particular, we discuss the imperatives that human security brings to EM, and consider the role of human security in identifying social networks and environmental connections.

Clayoquot Sound

Clayoquot Sound, located on the west coast of Vancouver Island in the province of British Columbia, is the site of one of the first and best-known applications of ecosystem management in Canada. This case study provides an example of how the concept of human security relates to EM in practice, and highlights its value to management philosophy.

The forests of Clayoquot Sound form part of the Coastal Temperate Rain Forest biome. These forests are remarkably old on many sites and contain the high biodiversity associated with such forests. Forests in this area are vulnerable to disturbance from high winds, but are less often subject to fire or insect outbreaks.

The conflict over the forest resource in Clayoquot Sound began in 1959, the year a logging road was built to connect the sawmills and pulp mills of Port Alberni with the logging industry around Ucluelet. In 1970, Pacific Rim National Park was created on the west coast between the communities of Tofino and Ucluelet. The road and the park attracted many tourists to the region and a tourism industry developed, bringing with it new residents. These circumstances set the stage for a showdown between the proponents of forest utilization and the proponents of ecosystem conservation. A non-profit society, the Friends of Clayoquot Sound, was founded in 1979 and began a campaign to save Meares Island from logging. This society includes both native and non-native members, and actively works with the Nuu-chah-nulth people whose traditional territory includes the lands and islands of the Sound.

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In the mid-1980s and early 1990s, the conflict between conservationists and the forest industry ignited and became known provincially, nationally, and internationally as the "War in the Woods." Local environmental non-governmental organizations (ENGOs) including the Friends of Clayoquot Sound worked closely with First Nations in British Columbia and international ENGOs such as Greenpeace to set up blockades on logging roads, which prevented forest companies from proceeding with their harvesting operations. The resulting work stoppages and arrests would become international headlines. Championing conservation, local and international ENGOs built an anti-logging campaign around the biological importance of this area, and targeted timber markets in North America, Europe, and Asia. The success of this campaign led to the suspension of logging activities and, later, the 1999 development of Iisaak Forest Resources Ltd., a joint venture between the Nuu-chah-nulth First Nation and Weyerhaeuser Ltd. (known as MacMillan Bloedel at the time) (B.C. Ministry of Sustainable Resource Management 2002). The campaign also resulted in the establishment of the Clayoquot Sound Scientific Panel. This panel was brought together to study timber management and land-use planning in the Sound and thus created a foundation for science-based ecosystem management.

Local participation, particularly in the form of dialogue with local communities and Indigenous peoples, played an important role in reducing the level of conflict in Clayoquot Sound. The Nuu-chah-nulth people have lived in the Clayoquot Sound region for generations; archeological studies indicate that the area has had continuous human occupation for at least

4200 years (Efrat and Langlois [editors] 1978). The Nuu-chah-nulth Tribal Council comprises 14 Bands or First Nations on the west coast of Vancouver Island, three of whom have traditional territories in Clayoquot Sound. The Ahousaht is the largest of these nations with approximately 1700 members, followed by the Tla-o-qui-aht Nation with about 800 members, and the Hesquiaht Nation with about 600 members. An important turning point in the dispute over resources in Clayoquot Sound occurred in 1985 when chiefs of the Ahousaht and Tla-o-qui-aht First Nations obtained an injunction from the B.C. Court of Appeal to stop logging on Meares Island until their land claim was resolved. This was the first time the courts had halted resource development on Crown land because of an Aboriginal title claim, and it eventually forced the provincial government to enter into treaty negotiations.

The Clayoquot Sound Scientific Panel introduced ecosystem management as a tool for future planning decisions (Clayoquot Sound Scientific Panel 1995a). The Panel worked closely with the various stakeholders in the Sound and informed these groups about the goals of EM (Clayoquot Sound Scientific Panel 1994). This process showed that most groups (including experts) lacked the fundamental knowledge required to make good management decisions. Correcting this deficiency became one of the general principles around which the scientific recommendations for managing forest resources of Clayoquot Sound were built (Clayoquot Sound Scientific Panel 1995b).

The Clayoquot experience led to the development of a new approach to strategic resource management planning in British Columbia. The Clayoquot Sound Scientific Panel proposed that hierarchical planning should be required to maintain ecosystem integrity from the subregional to site-specific levels and to ensure that the intent of higher-level plans is reflected in the execution of lower-level or operational plans (Commission on Resources and the Environment 1996). As a legal term, "higher-level plan" (HLP) refers to specific objectives for resource management. When an HLP is established, the outcome of the planning exercise for the resource becomes legally binding on operational planning and forest practices. Sustainable resource management (SRM) plans were announced in May 2002 as a tool to streamline landscape-level planning. These plans integrated the generation of HLP objectives with the approval of regional or subregional management plans (B.C. Ministry of Sustainable Resource Management 2002). Detailed plans describing resource management at the regional scale are known as regional land use plans (RLUPs) and at the subregional scale as land and resource management plans (LRMPs). The Clayoquot experience showed that establishing the range and diversity of local needs necessary to determine the objectives of an HLP requires a significant investment of both time and effort (Clayoquot Sound Scientific Panel 1994).

Conflict played a cathartic role in determining realistic resource management objectives. By applying EM to the situation in Clayoquot Sound, the Scientific Panel was able to identify the environmental, social, and economic goals (Clayoquot Sound Scientific Panel 1995a) that had emerged during the previous uncertainty and conflict. Clearly, mechanisms are needed to identify and articulate goals which support future management of the province's resources so that conflicts can be minimized. These mechanisms may be useful to the practice of EM in British Columbia and elsewhere.

In British Columbia, the Joint Solutions Project embodied one of the main efforts to create such a mechanism. This project was created in 2000 by four major timber companies (Weyerhaeuser, Canfor, Norske Skog, and Western Forest Products) and three major ENGOs (ForestEthics, Greenpeace, and the Sierra Club of BC). It establishes points of agreement between industry and ENGOs, including the need to create viable economies, stable communities, and new ways to deal with social and economic change in the province's coastal temperate rainforests (Smith and Coady 2001). It does not plan or make decisions on resources, but instead acts to support change in management practices within the Coast region. This project adopted the principles of ecosystem management, and is actively pursuing the implementation of these principles (Smith and Coady 2001). The project's goal is to avoid similar conflicts in part by assessing social, economic, and ecological needs before management decisions are taken.

After Clayoquot Sound, the Joint Solutions Project asked the province's scientific community to improve our understanding of human-environment relationships. This

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led to the creation of the Coast Information Team (CIT) in 2001. The CIT advises land management planning regions within the Coast Temperate Rain Forest biome, including the Central Coast, North Coast, and Haida Gwaii-Queen Charlotte Islands planning regions. The Team conducted a series of meetings with technical planning tables in each region, and then developed a number of planning tools and a final report for each.

One of the tools recommended by the CIT was the "Well-being Assessment," a methodology pioneered by Robert Prescott-Allen (2001). It combines social and ecological variables in a single matrix and provides a rating of community, regional, or national well-being. This assessment is largely an interactive process—stakeholders determine both the range of indicators used to measure human and ecological well-being and the criteria applied to these indicators to rank their performance. Experts in ecological and social indicators are involved in the process as advisors. Stakeholders are provided with a neutral forum in which goals and objectives for resource management can be determined on a number of scales. The well-being assessment is designed, in part, to inform stakeholders and resource planners about the environmental implications of human needs and the consequent effect of land-use decisions on human well-being or security. Therefore, using the assessment process to inform EM explicitly introduces the concept of human security into the province's resource planning process.

The overall influence of the Coast Information Team, and particularly the well-being assessment, on the planning process is currently difficult to gauge. However, the well-being assessment enabled interaction between multiple stakeholders and helped to ascertain goals and objectives for the strategic management plans. These activities were at least as important as the resulting analysis and reporting associated with the tool.

The experiences of Clayoquot Sound, and the subsequent role of the Joint Solutions Project and Coast Information Team in the province's land management, show that the concept of human security can inform ecosystem management and provide planners with a new context with which to review their decisions. In particular, an awareness of human security provides a strong imperative in determining the goals and requirements for both society and the environment, which is essential to the ultimate success of EM. Building on these experiences, we propose that fundamental theories in social and natural sciences may be useful to planners when applying EM.

Integrating Social Networks into Ecosystem Management

Conflict over Clayoquot Sound resources is now at least partially resolved. This required unprecedented co-operation between numerous stakeholders including government, industry, First Nations, and communities. However, the role of other less obvious populations cannot be discounted. For example, pressure from Canadian and international consumer groups raised the conflict from one involving resource management in a localized area on Vancouver Island to one having the potential to affect economic performance and livelihoods in both the province and elsewhere in the world. In handling the situation, the provincial government's approach to resource management changed from one that focused on simple environmental or resource policy to one that emphasized the more pressing and multi-faceted areas of economic performance, public perception, trade, and community well-being.

Decisions concerning resource use may affect populations at a number of spatial scales, which makes applying EM more challenging and complex. Therefore, planners must assess all human interactions with the resource, including the economic, political, or cultural. Ecosystem management, however, tends to focus on the immediate difficulties of understanding the interactions within the ecosystem itself, and underemphasizes the effect of socio-economic forces on the ecosystem (Christensen *et al.* 1996). Indeed, this highlights some of the barriers faced when trying to implement EM, such as,

- disagreement among stakeholders,
- distrust from the local population, and
- scepticism from decision makers about the usefulness of the process (Gray 2000).

In the aftermath of the Clayoquot Sound dispute, the Scientific Panel found that an improved dialogue,

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involving all stakeholder groups, is an essential part of the planning process, and one that should take place before land-use planning is started (Clayoquot Sound Scientific Panel 1995a).

Stakeholders are defined by analyzing the social networks that relate to the resource. Just as biophysical pathways define ecological boundaries, political, economic, and cultural networks define how populations interact with, and rely upon, the ecosystem for both lives and livelihoods. Gray (2000) suggested that, in the United States, understanding these social networks is at least as important as understanding ecological processes. Defining these networks, however, is a challenge. Previous attempts to develop a framework that describes how communities rely on ecological resources have proven vague. For example, the Intergovernmental Panel on Climate Change (IPCC) proposed that the list of socio-economic variables relevant to ecological performance and management included everything cultural, economic, and political (as quoted in Yohe and Tol 2002). For the planner attempting to apply EM, it is neither possible nor useful to review this amount of data, and thus a middle ground must be identified between the overly simplistic and the hopelessly complex. Similarly, understanding social networks becomes more complex as the spatial scales at which they function expand from local to global. As social information is often collected using household-level data, it is inevitable that a researcher or policy-maker will use aggregate data to analyze regional, national, or global trends (Cash and Moser 2000).

Sen's *entitlement theory* can help us to define the social networks relevant to ecosystem management with more precision and to understand the relationships between ecological systems and human security (Sen 1980). Entitlement theory suggests that assessing the interaction between human and ecological networks is possible through an examination of the various strategies that populations use to obtain resources (Sen 1980). This theory identifies three strategies, or entitlements:

- direct entitlements, in which resources are locally produced and used;
- indirect entitlements, in which resources are obtained through the marketplace; or
- transfer entitlements, in which resources are obtained through charity or gifts (such as an aid system).

Today's society relies on the flow of natural resources through the global marketplace, which makes indirect entitlements the dominant strategy for allocating resources. Therefore, the resulting loss of local ecosystem function can now affect the security and well-being of both local and remote populations. Entitlement theory disaggregates the causes behind a population's vulnerability to resource loss (Chisholm and Tyers 1982).

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By applying entitlement theory, the meaningful list of stakeholders with an interest in the resource can be expanded. This makes it more likely that the full range of opinion and requirements are heard before planning begins. For example, in the dispute over Clayoquot Sound, people in Europe and Asia were pivotal in resolving the conflict by participating in market-based campaigns or boycotts against wood from this region. This boycott marked a rejection of their indirect entitlement to these resources. Entitlement theory enables the identification of populations who are spatially removed from local stakeholders.

By incorporating entitlement theory into ecosystem management, the planner can determine which populations rely on local resources, and which members are vulnerable to changes in resource availability. Homer-Dixon's theory of *process tracing* further identifies the social networks that enable the flow of resources to these populations. This theory can help construct webs, or networks, of causal relations that link social and environmental variables (Homer-Dixon 1995, 1999, 2000). Based in part on entitlement theory, process tracing allows a researcher or planner to differentiate the ways in which resource availability causes vulnerability (Chisholm and Tyers 1982). In the Clayoquot Sound example, this may include conflict over the resource, or other disturbances such as fire or pest outbreaks. To incorporate process tracing into EM, planning must involve careful study of the social network itself. However, this approach is uncommon in current applications of EM. It was not identified or used during the Clayoquot Sound conflict, and only partially addressed by the follow-up initiatives carried out by the Coast Information Team.

Consulting with stakeholders to define goals and expectations for the resource is an important component of the practical application of ecosystem management. By integrating social networks into EM, a resource manager is more able to identify the full range of important stakeholders; these stakeholders can then help to identify expectations, which helps the manager to deal with the long-term goals of natural resource production and conservation. By expanding the number of stakeholders that are involved in the process, this approach accommodates off-site or non-resident influences. In any given area, natural resource management must change over time to counter shifts in the pool of natural resources and the human security requirements placed on those resources. For resource management to meet the goal of human security, the needs of various political, cultural, and economic units must be co-ordinated within the EM framework.

Defining Environmental Pathways

Another way to identify important stakeholders in EM is to consider the populations that might be affected by management decisions. This concept builds on one of the original rationales for the emergence of EM—that is, the need to account for the differences between legal and ecological boundaries, which are rarely in accordance (Caldwell 1970; Craighead 1979). To make appropriate decisions for the resource, managers require effective definitions of planning boundaries. This boundary definition currently remains a significant challenge because of difficulties surrounding scale and the context in which the ecosystem is considered. Ecosystems range in scale from local to global, and the interactions between ecosystems are inherently unpredictable. To reduce complexity, resource managers are often forced to define ecosystem boundaries according to the distribution of commercially viable resources, at scales where plausible decisions can be made (Rozdilsky *et al.* 2001). In the resolution of the dispute in Clayoquot Sound, a landscape management approach used a hierarchy of planning scales that were defined as increasing in size from site to watershed to subregion (Clayoquot Sound Scientific Panel 1995a). Even within this hierarchy, however, the data necessary to describe actual ecosystem boundaries were not available to most resource managers, and were missing from the information available to people working in Clayoquot Sound (Clayoquot Sound Scientific Panel 1995a). In part, this situation reflects the lack of knowledge about basic ecosystem functions; therefore, the effect of lost biodiversity cannot be accurately gauged (Clark 1999).

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The human security perspective provides a different context for the consideration of ecological systems, one that expands the role of human populations. This creates additional challenges for the planner. By introducing the human security perspective, planners must consider how the management of ecosystems, and disturbances which arise within these ecosystems, affect communities (Kasperson *et al.* 1995; Kasperson *et al.* 2001; Smith 2001). Thus, planners must consider the interconnected nature of ecosystems, which allows disturbances to pass quickly from one population to the next across a number of scales.

The concept of *fugacity* helps us evaluate ecosystem connectivity and assess the ways in which a disturbance might travel through the landscape, affecting human systems and creating vulnerability. Fugacity, or the "fleetingness of chemicals," was first described in 1901 as a convenient way to describe thermodynamic equilibrium criteria (Lewis 1901; MacKay 1994). The concept builds on the thermodynamic equilibrium that exists as chemicals pass between different phases (i.e., solid to liquid to gas), but also includes the complex structures and mobile elements of the environment that describe the pathways a disturbance might take through the ecosystem (MacKay 1994).

A recent example illustrates how the pathway approach can link human vulnerability to natural resource management. In the spring of 2000, bacteria infected the drinking water of Walkerton, Ontario. As a result, an estimated 2300 people became ill and seven died. This incident was eventually linked to a multiplicity of failures in the water safety system (Hrudey *et al.* 2002). A combination of *Escherichia coli* and *Campylobacter jejuni* pathogens attributed to cattle manure from a local farm was the source of the Walkerton outbreak. Immediately before a period of intense spring rainfall, manure was spread on fields overlying a shallow aquifer near one of the town's wells (O'Connor 2002). The rain-soaked fields provided a new pathway that carried the pathogens through the soil and into the groundwater source. This aquifer was still

used for drinking water purposes, even though warnings had circulated for over 20 years that it could be affected by surface activities. Agricultural practices did not change, and the town did not take any other measures to safeguard the aquifer. Interestingly, recommendations from the subsequent government inquiry dealt with monitoring and safety issues rather than stopping the practices that caused the problem in the first case.

The pathways approach to connectivity can also link events that occur at great spatial removes, and shed new light on phenomena that until now have been thought natural in origin. For instance, the drought experienced in the Sahel region of Africa in the late 1980s led to significant famine in countries such as Ethiopia and Sudan. Recent studies show that sulphate aerosols released from power stations and industrial facilities in both Europe and North America may have led to shifts in tropical rainfall patterns, which caused or exacerbated these droughts (Nowak 2002; Rotstayn and Lohmann 2002). This example illustrates the global reach of the atmosphere as an environmental pathway.

The relationship between human populations, both local and remote, and the environment is uncertain in nature. Ecosystem management tends to deal with uncertainty by recognizing that it exists and that unlikely events are certain to happen eventually (Christensen *et al.* 1996). The pathways approach offers a more effective way of dealing with the connections between the local ecosystem and both local and distant populations, and human security is the imperative for including this approach in planning. This approach does not contradict the existing landscape approach to management, which is evident in the hierarchical planning scales described by the Clayoquot Sound Scientific Panel. Rather than change the borders of current administrative or planning areas, this approach provides another alternative that complements legal and ecological boundaries.

The pathways approach provides linkages between EM and the effects that management decisions may have on both local and remote human populations. Including human security in ecosystem management allows the components of the ecosystem to be considered in the context of human-environment relations. For example, if a local industry discharges pollutants into the atmosphere, then the human impact of this activity can be determined by following the aerosol and atmospheric pathways of the discharge. Similarly, if an activity results in changes to an ecosystem's hydrology, then aquatic pathways require study. When human security issues form the context of management decisions, the scale of effects related to the decisions is generally enlarged. By including human security issues into EM, managers are forced to evaluate the human implications of resource use.

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We recognize that the environment is a network of highly complex systems; however, by identifying potential causes of vulnerability, the pathways approach simplifies the number of variables required to make informed decisions. By focusing on pathways, we build on Holling's argument that there is ". . . a requisite level of simplicity behind the complexity" (Holling 2001). He concluded that complex systems may be characterized by a handful of variables, making the successful analysis of environmental threats to human security possible. By identifying the pathways that link human populations with the resource, we can anticipate, and possibly avoid, the negative effects of management decisions on humans, and detect a set of non-obvious stakeholders in the resource.

Summary and Conclusions

The concept of human security, drawn from political science theory, recognizes that the security of populations is threatened by the loss of access to the resources required to sustain lives and livelihoods. The conflict over the forest resources of Clayoquot Sound led to a situation where international unhappiness over management decisions threatened the livelihoods of entire communities. This elevated discussions about managing this resource beyond environmental resource policy into the realm of human security. Conflict galvanized the attention of stakeholders from around the world to the issues of Clayoquot. This helped create a comprehensive list of goals that was then used to inform the application of ecosystem management in the region. We propose that human security can act as an imperative for the expanded consideration of social networks and environmental pathways in the practice of EM.

The presence of conflict in the Clayoquot Sound example resulted in new mechanisms that provided information to the planning process, which in turn supported the use of EM in other coastal regions of the

province. These mechanisms were generated through the Joint Solutions Project and some of its initiatives, including the Coast Information Team. It is currently unclear whether the same mechanisms will aid planners in the future, or whether new institutions or tools will be created to fit each unique situation as it arises. Regardless of the mechanism chosen, applying ecosystem management—whether provincially or elsewhere—will largely be controlled by the information provided to the process.

A consideration of human security issues that arise from management decisions can provide new context and perspective to the application of EM. By identifying stakeholders whose security is linked to the resource use, the views of non-resident stakeholders may be included, and conflicts over the resource use may ultimately be avoided. These stakeholders may be identified by analyzing social networks, or by considering environmental pathways.

We propose that planners use the theories of entitlement and process tracing to incorporate social networks into the application of EM. The notion of human security provides the imperative to include social networks that rely on the resource at stake through direct or indirect entitlements. Our proposed approach identifies non-local stakeholders who are connected to provincial resources through an indirect entitlement. This allows an opportunity for dialogue. The Clayoquot Sound example shows that a science-based approach has a greater chance of success with significant dialogue among all stakeholders.

The interconnected nature of ecosystems is important in the practice of ecosystem management. The natural science concept of fugacity treats components of the ecosystem as environmental pathways that transmit the effects of disturbances to local or remote locations. This approach helps to anticipate the human security implications of management decisions. The environmental pathways concept offers a science-based approach to describe these implications. Analyzing environmental pathways allows an assessment of the effects of EM on both local and remote populations. This provides another spatial analysis option that complements the legal and ecosystem boundaries currently considered.

Of the theories offered to support the introduction of human security considerations into the practice of EM, the entitlement theory describes a qualitative approach to analysis that ecosystem managers could adopt relatively easily. The concept of environmental pathways is more science-based, but requires the serious consideration of quality data inputs. This approach presents a greater challenge in EM, but offers a scientific linkage between the cause and effect of land-use decisions.

The Clayoquot Sound example shows that a science-based approach has a greater chance of success with significant dialogue among all stakeholders.

Natural resource planning must be carried out within the context of a larger ecosystem, which carries the impacts of planning decisions to an extended range of human populations. At the same time, however, the planning region is embedded in a hierarchy of larger socio-economic systems that can threaten the integrity and security of the ecosystem. A consideration of human security implications, using the tools we suggest, can provide a scaled analysis of both ecological and social systems. This will make the principles of EM more flexible, will provide a greater understanding of the reflexivity of the relevant systems, and will allow a more realistic assessment of threats to security both of environment and humanity. This should ensure that planning in British Columbia finds the best compromise between the needs of environmental conservation, community livelihoods, and security requirements.

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