CLAYOQUOT SOUND BIOSPHERE RESERVE REGION SUSTAINABILITY INDICATORS

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ABSTRACT

This paper identifies fifteen (15) manageable, balanced and relevant indicators of sustainability for the Clayoquot Sound Biosphere Reserve Region. Indicators are necessary as they aid in the understanding of community health and provide a measure of progress towards a regional state of sustainability. This is of particular importance to Biosphere Reserves, as it exists within the UNESCO mandate that these areas act as a laboratory, testing and demonstrating approaches to conservation and sustainable development. All indicators chosen have been based on a review of literature. Indicators of both local and global importance have been selected. Indicators identified should now be taken into an arena of public discussion and community consultation in order for them to assume full effectiveness.

1.0 INTRODUCTION

In their 2007-2009 business plan, the Clayoquot Biosphere Trust (CBT) recognizes the development of a comprehensive monitoring initiative as a key commitment for the Clayoquot Biosphere Reserve Region of Vancouver Island. This monitoring initiative is to report on socio-economic and environmental indicators of sustainability. Indicators are necessary as they aid in the understanding of community health and provide a measure of progress towards a regional state of sustainability. Their development also complements the CBT's organizational vision: "*Living sustainably in a healthy ecosystem, with a diversified economy and strong, vibrant and united cultures while embracing the Nuu-chah-nulth First Nations "living" philosophies of* Iisaak *(Living respectfully),* Qwa'aal qin teechmis *(Life in the balance), and* Hishuck ish ts'awalk *(Everything is one and interconnected)."*

In recognition of the CBT's key commitment and organizational vision, the goal of this investigation is to identify a suite of indicators that are manageable, balanced and

relevant to the region. Indicators are to be monitored by organizations and agencies independent of the CBT.

1.1 DEFINING SUSTAINABILITY

Sustainability can be defined as the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland 1987). It is a concept which is both people-centered, concentrating on improving the human condition, and conservation-based, aiming to maintain the variety and productivity of nature (International Union for Conservation of Nature and Natural Resources [IUCN] 1991). Sustainability is not a thing; it is a state and therefore, is not an absolute quantity to be measured (Mitra 2003). It is often based on perception and is frequently designated as an abstract and subjective concept (Mitra 2003). However, the following paragraphs aim to provide shape and character to this concept in order to offer a consistent perspective throughout this paper.

To begin, Mitchell (2002) identifies the following seven (7) characteristic objectives of sustainability: (i) to revive growth; (ii) to change the quality of growth, working towards less material and energy intensive development; (iii) to meet the essential needs for jobs, food, energy, water and sanitation; (iv) to ensure a sustainable level of population; (v) to conserve and enhance the resource base; (vi) to reorient technology and manage risk; and, (vii) to merge the environment and economics in decision-making. These objectives effectively summarize sustainability.

These objectives will not be met without difficulty. In addition to the need for a profound and global paradigm shift in relation to our current approach to development, there exist a number of contradictions within these objectives which make them challenging to fulfil. As highlighted by Dovers and Handmer (1992), eight (8) contradictions to sustainability are: (i) the paradox of technology, where technology has traditionally been applied to facilitate resource intensive growth; (ii) the choice of humility or ignorance in decision-making when faced with increasing uncertainty concerning the global environment; (iii) the presence of intergenerational or intragenerational equity; (iv) economic growth versus ecological limits; (v) the reconciliation of individual and collective interests; (vi) the balance between democracy and purposeful action, where there is needed balance between harmony in decision-making and a capacity for overview or oversight; (vii) adaptability versus resistance, where tension and conflict will inevitably arise over the best way to institute change; and, (viii) the role of optimization, where optimization is the idea that it is desirable to achieve the best possible use of resources. It becomes evident that sustainability is not a clear-cut concept. Therefore, indicators of sustainability have been a useful tool in order to promote comprehension of, and achieve progress towards, a state of sustainability. They are able to achieve this as they allow the concept to be segmented into specific issues affecting sustainability which are comparatively easier to comprehend.

1.2 DEFINING INDICATORS

Indicators are statistical data that can be selected and observed to gain insight into the functioning of a complex system (Fraser Basin Council 2000). They are instrumental tools for measuring environmental performance and are an essential component in the assessment of progress towards sustainability (Diamantis 1999). In addition, they act as an effective feedback mechanism in adaptive management. Indicators should be clear, comprehensible and inspiring (Mitchell 1996). They should act as an early warning system for the state of sustainability in a region and should serve to document trends (Mitchell 1996). More specifically, McAlpine & Birnie (2006) identify the following four (4) roles of sustainability indicators, to: (i) monitor; (ii) evaluate and inform policy; (iii) raise awareness in the community; and, (iv) raise awareness of decision makers.

2.0 LITERATURE REVIEW

There are over 480 biosphere reserves world wide. They have all been designated as such as they are recognized as sites of excellence under UNESCO's Man and the Biosphere Programme. These reserves are to act as laboratories, testing and demonstrating approaches to conservation and sustainable development. Priorities of action within these sites should include research, monitoring, as well as networking and sharing of information, ideas on and solutions to sustainable development (UNESCO 2007). Thus, through the development of regional indicators of sustainability, the Clayoquot Biosphere Reserve Region will begin to address these priorities.

Measurement of sustainable development is an essential pre-requisite for the promotion of a sustainable society (Mitchell 1996). With use of data from the social, economic and physical environments the measurement of sustainable development is attainable. However, although the information technology revolution has rapidly increased the volume of available data, the rate at which functional information is produced from these data is increasing only very slowly (Mitchell 1996). Thus, an efficient way to isolate functional information in a widening sea of data is with the use of indicators (Mitchell 1996). As Mitchell (1996) describes, an indicator is a means to reduce a large quantity of data to its simplest form, retaining only essential information. In the process of this simplification some information will be lost; however, if the index is designed suitably, the lost information will not seriously distort and nullify the results of the indicator (Mitchell 1996). Therefore, great care should be taken in order to ensure that an index is designed suitably.

Indicator development has generally consisted of meeting with a variety of groups who have an interest in sustainable development (Mitchell 1996). McAlpine & Birnie (2006) suggest that rather than being the exclusive domain of governments and educated professionals, sustainable development is a process involving ordinary people and, in particular, those people who have been traditionally disenfranchised from mainstream decision making processes. Indeed, community involvement in the identification and monitoring process is advantageous to the success of any indicator initiative (Bell & Morse 2004; Clayoquot Sound Scientific Panel 1995; Fraser Basin Council 2000; Lui &

Ou 2007; McAlpine & Birnie 2006; Mitchell 1996). That said, Bell & Morse (2004) recognize that indicators are devices which are deeply embedded within social, political and moral issues, and hold implications far beyond the understanding of any one specific methodology or the function of any one indicative statistic. They are therefore aware that under community consultation methods there will inevitably be many, and often conflicting, perspectives over needed indicators and their associated reasoning. Nevertheless, with extensive consultation, Mitchell (1996) argues that the development of sustainability indicators works well; however, he recognizes that it requires significant resources, perseverance and commitment to a process that may last several years.

While acknowledging the importance of community engagement within the development of sustainability indicators, McAlpine & Birnie (2006) cite that many authors and practitioners have begun questioning the extent to which meaningful participation can be realized due to time constraints, financial constraints and the ability to stimulate public interest in the process. Mitchell (1996) suggests that if the resources are not available to allow a prolonged and in-depth consultation, a more theoretical, top-down approach can be adopted which draws on published indicator work. McAlpine & Birnie (2006) distinguish between top-down and bottom-up methods, where in top-down decision making is led by educated professionals. They recognize that the top-down approach is often blamed for misdirecting resources and alienating local communities through lack of sensitivity to local issues; however, they advocate that bottom-up approaches to planning via participatory methods may lack depth of understanding. Therefore, they suggest an approach where the top-down support of experts is complemented by the vision of

bottom-up community engagement. Community engagement is especially important in small isolated communities which emanate a traditional scepticism towards policies which seem to originate from outside their own locality (McAlpine & Birnie 2006). Overall then, the suggested format for the development of indicators is to create a theoretical draft using a top-down expert-led approach and enter this draft into an arena of broad-based community consultation (McAlpine & Birnie 2006). This would allow the community to review the relevance of indicators, to identify improvements needed in the methodology and to provide general feedback (McAlpine & Birnie 2006).

If a theoretical approach is adopted for the early stages of indicator development, Mitchell (1996) outlines the following steps that are to be adhered to: (i) clearly define the objectives of the indicators programme, specifying the purpose of the indicators and their user group; (ii) state what is understood by sustainable development by specifying the definition of sustainable development and the sustainability principles to be applied; (iii) define the issues that are important both locally and globally; (iv) ensure indicator properties are matched to the users of the indicators and the objectives of the programme; and, (v) evaluate the indicators against criteria and programme objectives.

In any indicator programme initiative there will be a challenge to strike a balance between local and global issues; however, while attaining this balance may be a complex task, it is an important feat to achieve (Mitchell 1996). If indicator development relies solely on processes of community consultation there is a risk that undue emphasis will be placed on local issues (Mitchell 1996). Overemphasizing local issues can lead to the

disregard of global connectivity and result in a tragedy of the commons (Mitchell 1996). Thus, it is important to recognize critical global issues, like the protection of biodiversity, in all indicator sets (Mitchell 1996). In order to balance local and global issues, Mitchell (1996) recommends that indicator sets should include a broad range of specific indicators in order to generate a strong sense of community ownership, as often large scale indicators are lost at the local level. In addition, a limited number of global indicators should be included. All indicators should be resonant – that is, be clear, comprehensible and inspirational (Mitchell 1996).

Diamantis (1999) distinguishes four (4) distinct categories of sustainability indicators which are to be accounted for in any indicator set: (i) indicators of environmental pressure (measure human impact on the environment); (ii) indicators of environmental conditions (correspond to the quality and quantity of natural resources and the state of the environment); (iii) response indicators (assess society's response and concern for the environment); and, (iv) policy performance indicators (indicate overall contribution to reduce the negative environmental impacts). If all four (4) distinct categories are represented it is more likely that a comprehensive indicator set has been developed and as a result monitoring will be more reflective of regional sustainability.

In order to most effectively choose indicators they should be evaluated against a set of agreed criteria to assess their significance. An excellent set of criteria developed by Mitchell (1996) are as follows. Indicators must: (i) be relevant and defensible; (ii) be sensitive to change across space; (iii) be sensitive to change over time; (iv) be supported

by data; (v) be understandable; (vi) be measurable; (vii) be sensible; and, (viii) identify targets and trends. If relevant indicators are not supported by existing data it is reasonable to expect the an effort be made to gather the data required; however, Tanzil & Beloff (2006) suggest that indicators should be cost-effective in terms of data collection.

3.0 CLAYOQUOT BIOSPHERE RESERVE REGION

The Clayoquot Biosphere Reserve Region is situated in the coastal temperate rainforest on the west coast of Vancouver Island within the Alberni-Clayoquot Regional District. It has been described as one of the most complicated political ecosystems in the world, having experienced heated clashes between environmental advocates and forest companies (Pacific Estuary Conservation Program [PECP] n.d.). Sources of conflict between these groups included protection of visual aesthetics, tourism and industrial forestry (PECP n.d.). In lieu of a culmination of protests in 1993, which resulted in the greatest mass arrest in Canadian history, the majority of Clayoquot Sound was designated as a UNESCO Biosphere Reserve. This designation was granted with the aim of promoting conservation and sustainable living within the reserve, as well as, recognizing its unique and irreplaceable intrinsic values (PECP n.d.). This designation has acted also to subdue, although not eradicate, clashes between the conflicting groups since.

The Clayoquot Sound Biosphere Reserve covers approximately 350,000ha and is comprised of a vast number of ecosystems (Dobell & Bunton 2001). These ecosystems include nine unlogged watersheds (Dobell & Bunton 2001). The predominant natural

vegetation is old growth forest made up of continuous and uneven canopies (Clayoquot Sound Scientific Panel 1995) which cover 93% of the land base (Dobell & Bunton 2001). The region is characterized by heavy precipitation and strong winds associated with winter storms (Clayoquot Sound Scientific Panel 1995). These predominant weather systems cause the regions shallow surficial materials to be prone to erosion and landslides, debris slides, debris flows and rock falls, all contributing to natural disturbance within the landscape (Clayoquot Sound Scientific Panel 1995). In addition, shifting stream channels contribute to natural forest disturbances (Clayoquot Sound Scientific Panel 1995)

The fauna are strongly influenced by water and forest characteristics (Clayoquot Sound Scientific Panel 1995). The freshwater systems of the sound serve as critical spawning areas for salmon populations, while the narrow ocean passages are rich in marine life. Also, a wealth of marine diversity can be found in the region's mudflats, beaches and estuaries (Dobell & Bunton 2001), which provide wintering grounds and migratory stopover areas for a large number of waterfowl and shorebirds (Dobell & Bunton 2001). Key wildlife species of the region are the Roosevelt elk, black bear, wolf, orca, grey whale, salmon, migrating waterfowl, shorebird and marbled murrelet (National Round Table on the Environment and the Economy [NTREE] n.d.).

The population is comprised of roughly 5000 people, with over half being of First Nations heritage (Dobell & Bunton 2001). It has a variant level of population growth, typical of small communities, where trends show that in any given year population

growth is no more likely to be positive than negative (Statistics Canada 2002). The economy depends heavily on timber, tourism, fisheries and aquaculture (NTREE n.d.). In addition, more recently mining has become an important industry (NTREE n.d.). However, changing market conditions, declining fish stocks, environmental concerns and corporate decisions have seriously affected the social and economic structure of this region (NTREE n.d.). For example, the Ministry of Forests centralized in the 1980's and closed their office in Tofino (NTREE n.d.). Also, downturns in the fishing and forestry industries have had significant and direct affects on the Nuu-chah-nulth settlements, along with a dramatic impact on non-Aboriginal communities (NTREE n.d.). Resultantly, unemployment has remained chronically high (NTREE n.d.).

4.0 INDICATORS OF SUSTAINABILITY FOR THE CLAYOQUOT BIOSPHERE RESERVE REGION

Given this background, the following indicators were felt to be appropriate. They are broken into two (2) categories: (i) socio-economic indicators and (ii) environmental indicators. Individual indicators are to be presented in the following fashion: (i) what does this indicator tell us; (ii) why is it important in relation to sustainability; (iii) what data will be used; and, (iv) what information is currently available on the status and/or trends of these indicators. Each indicator was chosen using the criteria outlined by Mitchell (1996). However, not all indicators are supported by existing data and therefore, this criterion is not always fulfilled. Indicators are not listed in order of their importance. Indicators have not been assigned a weight in order to determine their influence on

sustainability. If weighting is desired, it should be determined through a process of community consultation.

4.1 SOCIO-ECONOMIC INDICATORS

4.1.1 Employment Rate

Employment rate is an effective measure of economic capacity (Fraser Basin Council 2000) where employment rate is defined as the number of persons employed in a week (Sunday – Saturday) as a percentage of the total population 15 years of age or over (Statistics Canada 2002). The importance of employment is evident within the sustainability objectives outlined in the introduction (Mitchell 2002). It is correlated most specifically to two (2) objectives: sustainability should promote the revival of growth; and, sustainability should aim to meet the essential needs for jobs (Mitchell 2002).

Employment rate as an indicator effectively represents both the social and economic aspects of sustainability (Tanzil & Beloff 2006). This quality facilitates more systematic and multidisciplinary communication and thinking and, ultimately, it provides a more holistic and realistic indicator of regional sustainability (Tanzil & Beloff 2006). In the economic realm, employment rate is reflective of income. This corresponds to the level of opportunity for economic sustainability for the residents of the Clayoquot Biosphere Reserve Region. In the social realm, employment is indicative to any social divides within the community where certain groups achieve higher levels of employment than others. This inequality occurs presently and may prevent those who are at a disadvantage from considering the needs of future generations. This, thereby, negatively affects the

overall sustainability of the community. In addition, Spangenberg (2004) argues that employment rate is a headline indicator for social sustainability at the community level. He reasons that employment rate is an indicator of social sustainability as entitlement to benefits; like old age pension, is based on earlier participation in the work force. In addition, Spangenberg (2004) claims that the social contacts made in the work place are essential to individual well-being and are thus reflective on overall social sustainability.

Data on employment rate will be taken from Statistics Canada's Community Profiles. These profiles are updated every five years in accordance with the nation-wide census. Data are available for the Clayoquot Biosphere Reserve Region for the 1996, 2001 and 2006 populations. Although, the most recent data was collected in 2006, it has not yet been synthesized and made available to the general public. For the purposes of this indicator, an effort should be made to obtain data more often than it is collected presently in order to address the problem of accessing current data.

4.1.2 Income

Income is a measure of the health of the economy. It can be defined as the average income level of the Clayoquot Biosphere Reserve Region residents (Koehler & Hecht 2006); whereas, the economy can be defined as a subsystem dominated by the transformation of matter and energy to serve human purposes (Koehler & Hecht 2006). Income, as a metric, provides insight to the capability of an individual to meet their needs and care for others (Fraser Basin Council 2000). Once an individual has met their own needs they can begin to think about the needs of future generations (Brundtland 1987). It

is also reflective of resources available to promote new sustainable and less energy intensive technologies. Thus, income aids in building a community's financial capacity to address the challenge of sustainability and to react to the present opportunity for future planning. It is recognized that a challenge with income data is its inability to indicate distributional inequalities (Spangenberg 2004). This shortcoming should be considered when reviewing all income data.

Data on income will be taken from Statistics Canada's Community Profiles. These profiles are updated every five years in accordance with the nation-wide census. Data are available for the Clayoquot Biosphere Reserve Region for the 1996, 2001 and 2006 populations. For the purposes of this indicator, an effort should be made to obtain data more often than it is collected presently in order to address the problem of accessing current data.

4.1.3 Education

Education is identified as a core element to social sustainability (Spangenberg 2004). It is a component of what Tanzil and Beloff (2006) term 'human capital development'. Human capital, as defined by the National Round Table on the Environment and the Economy [NTREE] (n.d.), as the relationships, networks and norms that facilitate collective action. It includes social cohesion and is a main proponent of quality of life measures (NTREE n.d.). Human capital is instrumental in creating a productive work environment and is therefore central to a flourishing economy (Tanzil & Beloff 2006). It is reflective of the community's capacity to understand and contribute meaningfully to

sustainability (Fraser Basin Council 2000) and provides a foundation for community management.

For the purposes of this paper, education will be measured as the percent of the population who have received a high school graduation certificate. The data will be broken down into the following age categories: 20-34; 35-44; and, 45- 64. This measure and its component categories were chosen to coincide with the data available within the Statistics Canada Alberni-Clayoquot Community Profile. This profile is updated every five years in accordance with the nation-wide census. Data are available for the Clayoquot Biosphere Reserve Region for the 1996, 2001 and 2006 populations. Although, the most recent data was collected in 2006, it has not yet been synthesized and made available to the general public. For the purposes of this indicator, an effort should be made to obtain data more often than it is collected presently in order to address the problem of accessing current data.

4.1.4 Aboriginal Community Capacity

Individuals of First Nations heritage make up over half the population of the Clayoquot Biosphere Reserve Region (NTREE n.d.). There are five (5) First Nations groups in the region: the Ahousaht, Hesquiaht, Tla-o-qui-aht, Toquat and Ucluelet (NTREE n.d.). It is therefore essential that the sustainability of the First Nations communities play a principal role when developing indicators of sustainability for the region. In addition, as highlighted earlier, community engagement is especially important for those who have

traditionally been disenfranchised from mainstream decision-making processes. Thus, it is important that First Nations people have a strong presence in community workshops.

The metric proposed to address First Nations sustainability is a measure of Aboriginal community capacity. Community capacity can be defined as the degree to which a community can develop, implement and sustain actions which allow it to exert greater control over its physical, social, economic and cultural environments (Taylor 2003). This metric provides insight to the long-term health, functioning and overall quality of life for the community (Sustainable Seattle 1998). Community capacity, as outlined by Frank and Smith (1999), is often considered to include the following components: resident participation; a combination of skills, knowledge and abilities; overall wellness and community health; an ability to identify and access opportunities; motivation and ability to carry out initiatives; presence of infrastructure, supportive institutions and physical resources; leadership and the structures needed for participation; economic and financial resources; and, enabling policies and systems.

Aboriginal community capacity within the Clayoquot Biosphere Reserve Region will be measured with use of four (4) indicators: (i) accessible housing - to be measured by the proportion of homes which are crowded, where crowding is measured by the number rooms versus the total number of house residents (there should be as many rooms as the number of residents minus one (1)); (ii) employment rate - to be measured as the number of persons employed in a week (Sunday – Saturday) as a percentage of the total population 15 years of age or over (Statistics Canada 2002); (iii) proportion of the

population who understand their primary Aboriginal language – measured as a percentage of the total population over eighteen (18) months in age; and, (iv) proportion of the population employed who hold management positions – to be measured as a percentage of the population employed. Weighting of these indicators is to be determined through community consultation. These metrics are not currently measured and made available to the public for the Clayoquot Biosphere Reserve Region First Nations communities; however, similar monitoring does take place for other Aboriginal communities through Statistics Canada and relevant data is available online in the Aboriginal Peoples Survey.

4.1.5 Population Growth

With a growing population comes the need for greater access to resources in order to satisfy overall community needs. This can have significant and negative effects on the sustainability of a region. Mitchell (2002) argues that ensuring a sustainable level of population is therefore one of the key seven objectives to sustainability. Accordingly, population growth will act as an indicator of sustainability for the Clayoquot Biosphere Reserve Region.

Data on population growth will be taken from Statistics Canada's Community Profiles. These profiles are updated every five years in accordance with the nation-wide census. Data are available for the Clayoquot Biosphere Reserve Region for the 1996, 2001 and 2006 populations. Although, the most recent data was collected in 2006, it has not yet been synthesized and made available to the general public. For the purposes of this

indicator, an effort should be made to obtain data more often than it is collected presently in order to address the problem of accessing current data.

In addition to examining the fluctuations in the population of permanent residents of the region, the influence of seasonal populations (tourist and workforce populations) in the Clayoquot Biosphere Reserve Region should be considered as well since they contribute to increasing pressures on available resources in the region. As a consequence, a tourism indicator has been created and is to be examined next.

4.1.6 Tourism

While tourism brings many economic benefits to a region, it also contributes to environmental degradation and can have negative social and cultural impacts (Choi & Sirakaya 2006). These impacts are thought to stem from unplanned growth, which is characteristic of the tourism industry, and which has caused increased concern for the preservation of natural resources, human well-being and the long-term economic viability of communities (Choi & Sirakaya 2006). In effect, the report of the Clayoquot Sound Scientific Panel (1995) identifies the need to monitor the impacts of tourism.

An increased awareness of the impacts of tourism has caused many decision-makers to search out alternative tourism planning and management strategies in order to generate a more sustainable industry. Ultimately, tourism should function as a tool for its own long-term survival to enhance the profitability of the industry. Furthermore, it should act to

sustain the resource base of tourism enterprises, which in turn will generate a greater tourism demand (Diamantis 1999).

The metric proposed to deal with the sustainability of tourism is the proportion of certified ecotourism establishments compared to the total number of tourism establishments. Ecotourism, for the purposes of this paper, shall be defined as economically viable, culturally appropriate, nature-based tourism activities that promote education, interpretation, environmental protection and conservation, and involvement of local communities and indigenous peoples (Vodden & Kueks 2003). Ecotourism was selected as, theoretically, it functions to sustain the resource base and to enhance the profitability of the region. While all tourism operations should be striving to lessen their social and environmental impacts, ecotourism certification provides acknowledgement to those operations which have successfully pursued these objectives. Ecotourism certification, although not yet conventional in tourism establishments of the Clayoquot Biosphere Reserve Region, and indeed world wide, is desired to verify the legitimacy of the label and avoid its misuse. Using models developed elsewhere, like Ecotourism Australia's Eco-tick Certification (ecotourism.org.au), a certification program should be created for the Clayoquot Biosphere Reserve Region. Certification provides tourists with honest insight into the sustainable operation of ecotourism businesses as well as a metric through which to measure sustainability of the tourism industry. Therefore, with the development of a certification process, data for the metric would become available. Data on this indicator should be compiled on an annual basis.

4.1.7 Volunteerism / Philanthropy

Philanthropy, private action for the public good, is indicative of the capacity of a community to identify public problems and to develop strategies for addressing them (Brown & Ferris 2007). Social capital, community networks and the norms of trust and reciprocity that encourage collective action, play an important role in facilitating philanthropic behaviour from individuals in a community (Brown & Ferris 2007). This philanthropic behaviour in turn provides benefit to society at large (Brown & Ferris p2007). One metric of philanthropy is the rate of community volunteerism, where volunteering is defined as any unpaid work done to benefit individuals who are not family, friends or colleagues (Brown & Ferris 2007). The act of volunteering instils a sense of collective civic identity, which is an important component of good citizenship, and is beneficial to the entire community (Bekkers 2007). Volunteering also provides individual benefits such as growth in social skills, development of new friendships and connection with community networks (Bekkers 2007). While the benefits of volunteering are subjective, it is unquestionable that volunteering offers invaluable aid to the functioning of non-governmental organizations (NGO's) which unequivocally contribute to overall community well-being. With overall community well-being and collective civic identity there is greater community sustainability.

For the purposes of this metric, volunteerism will act as an indictor to social capital and is to be measured as the percentage of the population who partake in volunteering for the local NGO's in the Clayoquot Biosphere Reserve Region. NGO's were chosen as it is arguable that their functioning is more reliant on volunteer service than public sector

agencies. While this data may not as of yet be compiled to form one statistic, details on the number of regional volunteers is available from local NGO's and the statistic can be compiled using existing data. Data on this indicator should be compiled on an annual basis.

4.1.8 Affordable and Attainable Housing

Affordable and attainable housing, where affordability is defined as the cost of adequate housing that does not exceed 30% of household income, is a key component to a sustainable community where there are inevitably a variety of incomes (Sustainable Seattle 1998). Lack of affordable housing can contribute to a number of social stresses, including homelessness, and directly affects the quality and stability of neighbourhoods (Sustainable Seattle 1998).

The Clayoquot Biosphere Reserve is no exception to housing issues. In fact, the Tofino Housing Corporation (2006) stresses that attainable housing has become increasingly difficult to secure for local residents and seasonal employees. The majority of households are paying more than 30% of their pre-tax income for shelter, a rate well-above above that suggested by the Canadian Mortgage and Housing Corporation. Effectively, permanent and seasonal residents are often necessitated to look to the neighbouring communities of Ucluelet and Port Alberni for housing alternatives (Tofino Housing Corporation 2006). This trend increases fuel consumption and vehicle miles travelled (Sustainable Seattle 1998) not to mention it causes social disruption. Others, faced with a

lack of affordable or attainable housing, opt to live in sub-standard or crowded conditions (Tofino Housing Corporation 2006).

Not only is Tofino experiencing challenges with attainable housing, but it is also recognized that all Nuu-chah-nulth communities have been experiencing chronic housing shortages (Clayoquot Sound UNESCO Biosphere Reserve 1999). The population of these communities is significantly younger than surrounding areas and is growing at a much faster rate, placing greater demand on attainable housing (Clayoquot Sound UNESCO Biosphere Reserve 1999).

Thus, both affordable housing and attainable housing are to act as an indicator of social sustainability for the Clayoquot Biosphere Reserve Region. Affordable housing is to be measured as the proportion of households in the Clayoquot Biosphere Reserve Region which spend greater than 30% of their combined income for shelter. The less affordable housing, the more negative the consequence. Additionally, attainable housing will be measured by regional housing vacancy rates. The lower the vacancy rate, the more negative the consequence. Indicator weighting of affordability and attainability will be determined through community consultation. Data for this indicator is not yet publicly available for the Clayoquot Biosphere Reserve Region and an initiative should be undertaken to develop it.

4.2 ENVIRONMENTAL INDICATORS

4.2.1 Water Use

Water acts as a link between the land, air and marine environment (Ministry of Environment 1993) and sustains the Clayoquot Biosphere Reserve Region's enviable natural ecosystems. Its quality is important to the conservation and enhancement of the resource base (Mitchell 2002). Overuse of such a valuable resource puts more than humans at risk as water has numerous and often competing users. These users include: agriculture, industry, waste disposal, domestic use and habitat for aquatic organisms (BC Ministry of Environment, Lands and Parks [MELP] 2000). In addition, water availability is essential to the health of riparian ecosystems, which play a critical role within the Clayoquot Biosphere Reserve Region (Clayoquot Sound Scientific Panel 1995).

It is hard to comprehend that the Clayoquot Biosphere Reserve Region, an area which receives 3305.9 mm of precipitation annually (Environment Canada 2004), experiences water shortages. However, the period of greatest precipitation occurs from November through March, where the region receives greater than 300mm of precipitation per month (Environment Canada 2004). Contrastingly, the period of greatest water use is throughout the summer months where there is a sharp rise in the regions population due to the influx of tourists and seasonal workers. Indeed, during recent years, Tofino and surrounding areas have experienced critical water deficiencies (West Coast Vancouver Island Aquatic Management Board n.d.). Holte (n.d.) suggests these shortages are not a new phenomenon, but have occurred intermittently since 1958. These shortages result in the implementation of water restrictions, which are detrimental to the local community and

businesses. In addition, these shortages are denying the surrounding environment and wildlife of a much demanded and essential resource.

The number of water restrictions is indicative of the intensity of regional water use, pressures on water supply and the intensity of water management that is required to maintain a water supply and thus, the number days under water restrictions acts as an effective indicator to the sustainability (annually and for future generations) of water use in the region. This metric is tracked by the municipalities within the Clayoquot Biosphere Reserve Region. Pre-existing data regarding this indicator is available and, for the purposes of analysis should be compiled on an annual basis (i.e. the number of water restriction days per year) to provide insight to the sustainability of regional water use.

4.2.2 Forest Health

The forests of the Clayoquot Biosphere Reserve Region play a chief role in the vitality of overall ecosystem function in the region. Despite its history of industrial logging Clayoquot Sound still maintains large tracts of intact forests (NTREE n.d.), which provide valuable habitat for a number of species (Environment Canada 2006). In addition to its provision of habitat, forest cover is important to water resources within the Clayoquot Biosphere Reserve Region. Forest cover strongly influences the total annual runoff of water and the timing of the peak rate of storm runoff (Clayoquot Sound Scientific Panel 1995). It also plays an important role in its input of coarse woody debris to the hydroriparian ecosystem, which helps form the structure of stream channels (Clayoquot Sound Scientific Panel 1995) and the presence of the forests root systems

maintain natural pathways and regimes of sub-surface water flow essential to the function of the hydrologic system (Clayoquot Sound Scientific Panel 1995). Furthermore, these root systems provide a measure of slope stability to steep slopes (Clayoquot Sound Scientific Panel 1995).

It becomes apparent that the health of the forests in the Clayoquot Biosphere Reserve Region is critical to its ecological functioning and that sustainable harvest and use of the forest is essential. It was primarily for this reason that the Clayoquot Sound Scientific Panel was established in 1993 with the goal of developing world-class sustainable forestry standards. These standards were to take into whole consideration the interconnectedness of the system and carefully plan the rate and distribution of harvest in the region (Clayoquot Sound Scientific Panel 1995).

Using insight provided by the Clayoquot Sound Scientific Panel (1995) and the Fraser Basin Council (2000), an appropriate metric to measure forest health in the region is the percentage of harvest, which is Forest Stewardship Council (FSC) certified, in conjunction with the proportion of second-growth harvest compared to old-growth harvest. FSC certification was chosen, as it is currently demands the most stringent environmental compliance when compared to other certification systems. Particularly in its demand for a Chain-of-Custody, which ensures that there is compliance with FSC certification throughout the products creation, from its raw material harvest, to processing, manufacturing, distribution and printing. Data for FSC certification can be obtained from the Forest Stewardship Council of Canada. Data for the proportion of

second-growth harvest to old-growth forest could be obtained through an agreement with forestry operators of the Clayoquot Biosphere Reserve Region.

4.2.3 Trends in Shellfish Closure

At the time of the Clayoquot Sound Biosphere Reserve's nomination eight (8) years ago, sewage contamination was recognized as having degraded the marine environment (Clayoquot Sound UNESCO Biosphere Reserve 1999). Although a number of liquid waste management plans have since entered into the first stages of development (District of Tofino 2003) none have yet been successfully implemented. While it is encouraging that liquid waste management plans are in the initial stages of development, there have been no interim actions to relieve the stress on the marine environment that is caused by liquid waste discharge. Meanwhile, the method of liquid waste management continues to be the collection of liquid waste through gravity pipes, pump stations, pressure force mains and gravity mains; its passage through grinders; and discharge, without any further treatment, into ocean outfalls (District of Tofino 2003). Toxins within the wastewater, in addition to a number of bacteria and viruses, are thereby released crudely into the natural marine environment. These pollutants can become concentrated in shellfish through a process known as bioaccumulation (Waldichuk 1974). Toxins concentrated in the affected shellfish biomagnify, becoming more concentrated as they proceed up the food chain. Thus, bioaccumulation is harmful not only to the affected shellfish, but also to all species which consume these shellfish. This process can have economic consequences for coastal communities when marine resources become no longer marketable due to high toxicity levels (Waldichuk 1974). Overall, for the long-term health and sustainability of

coastal resources and communities it is important to implement innovative sewage treatment design and management.

In the meantime, monitoring the marine environment and the trends in shellfish closures can act as an effective metric to the effects of community wastewater. The metric will be calculated as the number of days annually where shellfish harvest is closed due to liquid waste related viruses and bacteria, like Escherichia coli. Data regarding shellfish closures for the Clayoquot Biosphere Reserve Region can be obtained from the Department of Fisheries and Oceans.

4.2.4 Stressors of Protected Areas

Despite legislation and policies to the contrary, many protected areas do not fulfil their management objectives due to internal and external stressors (BC Ministry of Environment [MOE] 2006). Internal stressors are those which take place within the boundaries of a protected area and may involve roads, visitor services, recreational use, exotic species, and resource exploitation (MOE 2006). External stressors are those which take place outside the boundaries and may include roads, urban development, forestry, mining, agriculture, fishing, pollution and aquaculture (MOE 2006). External stressors bordering a protected area can result in its isolation and effectively produce a protected island within a larger, inhospitable matrix (MOE 2006). The effect of these external stressors is variant depending on the type of activity, its level of intensity and its proximity to the protected area (MOE 2006).

While 33% of the Clayoquot Biosphere Reserve Region is designated as protected areas (BC Ministry of Sustainable Resource Management 1996), it is important to evaluate the effectiveness of these areas in their role of conservation of the environment and provision of viable wildlife habitat. Without effective protected areas, the sustainability of the regions' wildlife communities and natural amenities will be seriously compromised. Thus, it is imperative that the existing protected areas be effective in their intentions to conserve and sustain wildlife communities and natural and cultural features. Disconcertingly, in their 2000 report, the Panel on Ecological Integrity of Canada's National Parks judged the ecological integrity of Pacific Rim National Park to be severely impaired, rating it third worst in the nation (NTREE n.d.). The Panel made specific mention of the park size and configuration, in combination with intensely proximal logging pressures, high backcountry use, substantial recreational fishing pressures and inadequate park management resources (NTREE n.d.). This is of particular issue as Pacific Rim National Park makes up a sizable portion of the Clayoquot Biosphere Reserve Regions core protected area.

In light of these challenges, the following three (3) metrics for the sustainability of the protected areas within the Clayoquot Biosphere Reserve Region are proposed: (i) the number and classification (primary, secondary, tertiary) of transportation corridors bisecting the protected area, (ii) the proximity of commercial resource extraction to protected area borders; and, (iii) annual park visitation. Annual park visitation is to be calculated using data from the sale of day passes from parking meters and from campgrounds regarding the number of park campers. These metrics could be analyzed

using Geographic Information System (GIS) Technologies which would apply a weighting to each indicator. The following combination would assign a higher level of stress to the protected area: (i) a greater number of roads which bisect the protected areas; (ii) a higher road classification; (iii) a closer proximity of resource extraction to protected areas boundaries; and, (iv) a higher annual park visitation. No such public data exists currently and would therefore need to be made available for the purposes of this indicator. GIS Technologies were chosen due to their capability of creating quantitative output, which is more easily compared over time; however, a challenge with GIS technologies is determining the appropriate weighting distributions of the indicators to be measured. Therefore, weighting distribution for this indicator should be determined through discussion with a panel of informed scientists and the interested public.

4.2.5 Changes in the Conservation Status of Red-listed Species

The status of red-listed species is important to sustainability, where red-listed species are those which have been legally designated as Endangered or Threatened under the *Wildlife Act*, are extirpated, or are candidates for such a designation (BC Ministry of Sustainable Resource Management 2002). In theory, a change in the conservation status of threatened and endangered vertebrates provides a benchmark to the extent and severity of human impacts between taxa and over time (Possingham *et al.* 2002). It is therefore important that few species are red-listed as a diversity of species and their complex interactions are vital to the maintenance of ecosystem function (MELP 2000). Overall, healthy ecosystem function lends to long-term economic and social well-being for surrounding communities and thereby, lends to sustainability (MELP 2000).

Some argue that ecosystem function, and correspondingly ecosystem sustainability, could be better measured by the health of benthic macro-invertebrates (Sharpe *et al.* 2004) or by the number of habitats at risk, versus the status of red-listed species; however, given the scale of the Clayoquot Biosphere Reserve Region, these metrics would not be as effective or economic as monitoring the status of red-listed species. Due to the specificity of environmental conditions associated with the health of benthic macro-invertebrate communities, the majority of fluvial systems within the Clayoquot Biosphere Reserve Region would require monitoring in order for the health of benthic macro-invertebrates to act as a representative indicator of regional sustainability. There are simply too many fluvial systems to measure such an intricate indicator efficiently. On the other hand, monitoring habitats at risk would be inefficient due to the large habitat units that occur across the Clayoquot landscape. There are too few habitat categories to gain a sense of sustainability. The status of red-listed species certainly provides a more manageable and distinct list of candidates of which to measure ecosystem function.

Information regarding red-listed species is available from the Conservation Data Centre (CDC) which published its first red-list in 1992 (MOE 2006). Monitoring for all red-listed species in the Clayoquot Biosphere Reserve Region has not yet been undertaken and thus, not all species have data available yet to monitor trends. Thorough data does exist for some red-listed species of the region, however, and trends can already be established.

4.2.6 Solid Waste Production

As solid waste becomes more widely recognized as a resource, it is important to appropriate the required efforts towards harnessing its potential. While there are many new and innovative opportunities for waste diversion and solid waste resource potential, there are also a number of widely socially acceptable measures of waste diversion which are still under-practiced in the communities within the Clayoquot Biosphere Reserve Region. For example; regional recycling is lower than the provincial average, at 16% recycled versus 32% recycled respectively (Gartner Lee Limited 2007). In addition, there is a substantial amount of leachate produced annually due to high rainfall in the region, where leachate is a liquid that forms from the percolation or rainwater and groundwater through landfilled refuse (Gartner Lee Limited 2007). At the West Coast Landfill, which serves the Clayoquot Biosphere Reserve Region, leachate is collected and sprayed on adjacent forest lands (Gartner Lee Limited 2007). As Inanc et al. (2007) describe, leachate can contain a number of heavy metals including copper, lead, boron, zinc, manganese and iron and at lower concentrations aluminum, arsenic, molybdenum and vanadium. By spraying leachate on the forests, the West Coast Landfill is potentially introducing heavy metals and contaminants directly into the environment. As Gordon et al. (1989) suggest, forest soil ecosystems which are shallow to bedrock, as found in the Clayoquot Biosphere Reserve Region, should be avoided when practicing leachate spray irrigation. Thus, spray irrigation may not be the best method of leachate disposal. In addition, there is no landfill gas management at the West Coast Landfill, which causes the direct loss of a beneficial, economic resource (Recycling Council of BC & Ministry of Environment, Land and Air Protection [RCBC & MELAP] 2004). Landfills which

harvest waste gas for energy can often produce so much energy as to sustain their operations and make profit by selling back to the grid. For example, the Capital Regional District's Hartland Landfill harvests waste gas for energy, producing enough power to meet the needs of at least 1,600 homes annually (BC Hydro 2005). While the West Coast Landfill could use many additions as noted above, many First Nations communities of the region do not even have formal waste disposal facilities, or often, they rely on unmanaged, open landfills (Gartner Lee Limited 2007). Thus, in terms of sustainability in waste management there is much to do in the Clayoquot Biosphere Reserve Region.

Tourism within the region also presents an interesting dynamic to the topic of solid waste management. As Georges (2006) points out, small island states, or isolated communities cannot continue to absorb excessive quantities of waste generated by a material intensive, throughput economy, which epitomizes the mass tourism industry. Waste monitoring may provide some insight to the impact of tourism on waste production for the region.

Many of the issues addressed above stem primarily from an underlying need to build community interest and awareness surrounding solid waste management. Often through interest and awareness comes change. Thus, an initial indicator of sustainability in waste management is the amount of domestic waste generated per capita annually. This metric would effectively act as both a measure of solid waste management and community awareness. Data are available for the Alberni-Clayoquot Regional District regarding waste production per capita through the Ministry of Environment's Environmental Protection Division. This body of government is responsible for producing BC's

Municipal Waste Tracking Reports. Pre-existing data are available for this indicator and trends can be established.

4.2.7 Riparian Areas Integrity

In their report, the Clayoquot Sound Scientific Panel (1995) identified one of the main objectives for monitoring in the region was watershed and coastal integrity, which includes riparian areas health. As Mitchell (2002) indicates, conservation and enhancement of the resource base, in this case riparian areas, is vitally important to the sustainability of a region.

Forest riparian areas are transitional lands which merge aquatic and upland forest ecosystems (MELP 2000). They act as a link between water bodies and the terrestrial environment, alpine areas and estuaries (Clayoquot Sound Scientific Panel 1995). Riparian areas function to stabilize stream banks, regulate stream temperatures and filter potentially harmful debris and pollutants (MELP 2000). Large woody debris provides structural stability, complexity and nutrients to aquatic ecosystems (MELP 2000). Riparian areas are even influenced by ephemeral (seasonal) streams which give support by providing increased moisture (Clayoquot Sound Scientific Panel 1995).

According to the Clayoquot Sound Scientific Panel (1995), riparian areas are the "skeleton and circulation system of the ecological landscape" (p. 13). They contain the most diverse flora in a watershed (Clayoquot Sound Scientific Panel 1995) and provide many opportunities for wildlife nesting, hiding, feeding, roosting (MELP 2000). They are

used often as migration corridors (MELP 2000). Of the 287 forest dwelling vertebrates of British Columbia, 88% rely on riparian habitat for basic needs (MELP 2000). Therefore, monitoring the integrity of riparian ecosystems can act as a proxy to the health of a great proportion of the forest dwelling vertebrates.

In the Clayoquot Biosphere Reserve Region, riparian areas have been historically affected by logging, road building and development activities which alter stream morphology, hydrology and shading (Clayoquot Sound Scientific Panel 1995). Maintenance of natural paths and regimes of subsurface water flow have been disrupted, affecting both plant and animal biodiversity (Clayoquot Sound Scientific Panel 1995). Thus, forestry and development activities need to ensure the retention of sufficient vegetation cover and natural drainage patterns to maintain soil stability, the natural stream discharge regime and habitat of stream-dwelling organisms (Clayoquot Sound Scientific Panel 1995).

To effectively monitor the health of riparian areas, regulations should be developed for the Clayoquot Biosphere Reserve Region. The development of this regulation is not within the authority of the Clayoquot Biosphere Trust. Regulation would need to be instituted through the provincial level of government. Riparian areas regulations could be developed similar to the existing regulations which apply to Eastern Vancouver Island that were created by the Ministry of Environment. Initially, an inventory addressing the integrity of riparian areas in the region should be developed. This inventory should be set-up so that annual or bi-annual monitoring can continue to take place according to the

guidelines developed for the region. In addition, any proposed forestry activities or development should be required to go through a rigorous riparian assessment. This assessment should be implemented by a third party.

5.0 CONCLUSION

Conceptually, indicators of sustainability have been recognized as core to any broad based sustainability strategy. The inherent nature of indicators, whether they are social, economic, cultural or environmental, requires that they be subject to stakeholder engagement in order to gain the benefits of local knowledge. Therefore, the indicators identified for the Clayoquot Biosphere Reserve Region are suitable from a theoretical perspective, but for practical application it is essential to ascertain that there is community and stakeholder involvement in the indicator development process. Without community support and involvement, monitoring and effectiveness cannot be achieved.

In addition, in order to ensure their effectiveness, these indicators must maintain a balance between local relevance and global issues. While choosing indicators of local relevance is important, the overall global connection cannot be lost or it will result in a tragedy of the commons.

Overall, this paper has identified fifteen (15) manageable, balanced and relevant indicators to the region of study. In addition to identifying indicators relevant to the region of study, a number of global indicators have been included. All indicators chosen

have been based on a review of literature. Indicators should now be taken into an arena of public discussion and community consultation in order for them to assume full effectiveness.

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