An Ecosystem Health Perspective relevant to Salt Spring Island's OCP review

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1. What constitutes Ecosystem Health on Salt Spring Island?

In a world in which everything is changing, the concept of "sustainability" may appear to be a paradox. Yet it has been a central feature of environmental and social planning, ever since the World Commission on Environment and Development released its report *Our Common Future* two decades ago (1). At that time, there was growing concern about a world coming out of balance—that population pressures, combined with powerful resource extractive and polluting technologies, would severely compromise global and regional environments. At the same time, it was accepted that economic development was essential if the basic needs (water, food, shelter, clothing, jobs) of the world's population were to be met. Thus the Commission had as its major objective the proposing of "long-term environmental strategies for achieving sustainable development" by the year 2000. Its key contribution was the notion of "sustainable development"— that is, "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The short prescription for achieving this has been described as "living off the interest without depleting the capital".

The mandate given to the Islands Trust is to "preserve and protect the trust area and its unique amenities and environment" (2). The Islands Trust Act (1974) was visionary – it recognized, a decade before the World Commission on Environment and Development was established, that growing urban population pressures in Southwestern British Columbia were beginning to threaten the unique environment and rural character of the Southern Gulf Islands, and that the Islands should accordingly be given special protection in efforts to prevent erosion of these unique features (3).

In order to "preserve and protect" our unique environment and its rural character, what is required is to maintain our ecosystems in a state of good health. Healthy ecosystems are those that maintain their full range of functions – that is, they maintain their organization (their capacity to sustain the biodiversity that is characteristic of this relatively dry "Mediterranean type" vegetation zone, typical of the islands of the Strait of Georgia and Haro Strait); they maintain their resilience, or capacity to rebound from periodic disturbance, such as wind storms, fire, and other natural perturbations; and they maintain their productivity, i.e. their capacity to transform solar energy into biomass, recycle nutrients, sequester contaminants. Furthermore, as humans are a part of ecosystems and not (as some technocrats would like us to believe) outside of them, healthy ecosystems are those that provide the necessities for supporting the human component of the ecosystem "without compromising the ability of future generations to meet their own needs". This means that ecosystems maintain their long-term capacity to provide for the basic necessities of life (food, water, shelter, clothing), while at the same time supporting the conditions for the social and cultural aspects of a rural lifestyle.

This implies that development must be aligned with the capacity of ecosystems to maintain their health. Thus, the notions of "densities", "density transfers", and "'build-out" that are commonly applied in the context of urban planning, and have been extended to rural areas such as the Islands Trust Area, are meaningless and potentially harmful unless they are solidly based on ecosystem health principles. For example, Salt Spring is

already experiencing ecosystem stress with its existing population, yet this population is little more than half of the build-out level enshrined in the current OCP. This clearly shows that these levels were projected without consideration for the capacity of the island to sustain such densities—a capacity that, furthermore, has likely been significantly reduced over the years by climate change effects. On face value, density transfers appear to be an attempt to reduce stress on more sensitive areas by concentrating development in the existing or planned villages. For example, greater densification of Ganges and Fulford and other settled areas through transferring densities from rural areas is seen as a means of protecting land, facilitating wise energy use, fostering opportunities for more pedestrian (and thus less vehicular) traffic, etc. However, without being themselves defined in terms of and limited by considerations of ecosystem health, density transfers could in the long run have paradoxical effects, whereby virtually the entire island could be turned into one large urban/suburban conglomeration. Manhattan was once a lush forested island! Further proposed density transfers within rural areas also need to be carefully examined. Protecting one valuable piece of rural property to the cost of degrading another valuable piece should be a non-sequitur in light of ecosystem health-based planning.

"Sustainability" is often represented as a three-legged (environmental, economic, and social) "stool", or, adding the cultural dimension, a four-legged stool. But this metaphor tends to be misleading. First, healthy full functioning ecosystems are the fundamental basis for supporting the social, cultural and economic aspects of our society—so they are primary to human well-being. They are not something to be "traded off", as too often is the case, for the enhancement of another dimension. If we lose the health of our ecosystems, we ultimately lose the very basis for sustaining our social, cultural, and human health. Second, the notion of a "stool" is a static one. The essence of sustainability of ecosystems, from a "humans-in" perspective, is the complex dynamic interactions between these elements. The world we live in is a dynamic system, in which cultural, social, economic, and environmental changes are all interconnected. Further, when we recognize that humans are part of their ecosystems, then the overall sustainability of the human enterprise comes to depend crucially on sustaining the health of ecosystems.

A concern for the health of ecosystems is vital not only when environments have already become damaged, but as importantly, before any such damage occurs. Just as a health check-up is an essential part of health maintenance for humans, it is also an essential part of health maintenance for ecosystems. Early detection of ecological dysfunction often enables corrective measures to restore full function. Waiting until the signs of degradation are obvious and apparent may also mean much more costly interventions to correct the situation; and in many cases, complete restoration of the ecosystem may not be possible, at least not on a human time-scale.

Although the OCP is a policy document that gives direction to the Land Use Bylaw (4), and although the OCP also allows restrictions on Development Permits in designated areas, these provisions have proved insufficient to ensure that the health of our island ecosystems is not compromised through development activities. For example,

while the Land Use Bylaw requires setbacks at least as great, and sometimes greater than, provincial regulations, and while the CRD is about to implement a septic monitoring program, the fact is that nutrient loads from septic fields, animals and other land disturbances have greatly compromised the health of our streams, lakes, bays, and harbors. Presently, at least two of our major watersheds, St. Mary Lake and Cusheon Lake, show clear evidence of compromised ecological function as a result of excessive nutrient loadings from human activities (e.g. leakage from septic fields, animal waste runoff, land disturbance). In St. Mary Lake, a major source of drinking water, algal blooms have become chronic, with an increasing incidence of toxic blooms (5). Not only is this a potential threat to maintaining the health of people who draw upon the lake for potable water or use the lake for recreational purposes, but also, such conditions severely compromise the health of the lake itself and the health of the non-human life forms – which are also to be protected as part of our unique natural heritage.

2. What indicators are needed in order to assess the health of Salt Spring's watersheds, harbors, forests, agricultural lands?

Before addressing this question, a note of caution about ecological indicators: namely, that there is a seemingly unending list of potential indicators of environmental conditions. Too often, indicators are selected on pragmatic grounds (what data are available "off the shelf") rather then on the basis of what is really important in tracking the health and sustainability of our ecosystems and their functions. Further, the traditional classification of "environment" in terms of air, water, and land results in a fragmented approach which ignores the substantial and significant interactions between all components of the ecosystem. Finally, assessing the health of ecosystems, and discovering evidence of compromised ecosystem function, begs the further question of "why"? In order to address this, it is essential that SOE (State of Environment) reports include as an integral part data on status and trends for human activities which are know sources of stress on the ecosystems in which they take place.

Recognizing these shortcomings in much of the early efforts to report on the state of the environment, in 1974 Statistics Canada took the initiative to develop a statistical system for reporting on the status and trends of Canadian ecosystems. It was under this initiative that the Stress-Response Environmental Statistical System (SRESS) was developed (6). SRESS was predicated on an understanding of the behavior and functions of whole ecosystems (at scales ranging from local to sub-global), from a "humans-in" perspective.

By the late 1970s, Statistics Canada had emerged as a world leader in national SOE reporting. Its first publication in this field, entitled: *Towards a comprehensive framework for environmental statistics: A stress-response approach* (6) became the template for the work of environmental statistical bureaus around the world. It was immediately adopted by the Environmental Secretariat of the Organization for Economic Cooperation and Development (OECD) and the UN Statistical Bureau, and it is known today as the "Pressure-State-Response" system (7). In this framework, which is based on ecosystem and watershed mapping, "pressure" refers to the constellation of human activities that place stress on ecosystems; "state"' refers to the condition of ecosystems as a

consequence of pressure from human activity; and "response" relates to the policies and other actions that are taken to mitigate environmental damage -- e.g. through regulations, laws, moral suasion, monetary and fiscal policy, etc.

Internationally, SRESS is the foundation in a great many international organizations and countries for their reports on the environment: e.g., it is central to the report on the state of the environment recently released by the European Environmental Agency (as is the related notion of ecosystem health), the work of the OECD and other agencies, as well as to a large number of country-level reports (including Canada's national SOE report) and provincial and state reports. Based on the SRESS framework, Statistics Canada, in partnership with Environment Canada, produced Canada's first national State of the Environment Report (8a). Statistics Canada's publication, *Human Activity and the Environment* (8b) which was first released in the same year as the SOE report for Canada, has been updated and revised every 5 years. Canada's SOE report was also, as mandated by Parliament, produced every 5 years, up to 1996.

Validating indicators of ecosystem health has been an ongoing active area of research for nearly three decades (6, 9-12). Although ecosystems differ greatly from one another in terms of dominant vegetation, species diversity, climate, geology, and land uses, tracking trends in a small number of parameters often suffices to indicate whether or not ecosystem health is being compromised. There are two major classes of indicators: those of ecosystem dysfunction (that is, those indicators characteristic of ecosystem pathology) and those of proper ecosystem function (that is, those indicators characteristic of ecosystem health). The two sets of indicators are to some degree two sides of the same coin.

Indicators of Ecosystem Dysfunction (The Ecosystem Distress Syndrome):

Early work on the behavior of ecosystems under stress revealed that ecosystem responses to stress from human activity (anthropogenic stress) showed highly similar patterns (13). Subsequent investigations confirmed the presence of ecosystem distress syndrome in a wide variety of natural systems as a result of cumulative anthropogenic stress. For example, a comparison of the response of the Great Lakes, the Baltic Sea, and the Desert Grasslands in the Southwest of the USA to anthropogenic stress showed a highly similar pattern: reduced species diversity, increased disease prevalence, reduced species population regulation, increased presence of short-lived species, reduced presence of longer-lived species, increased dominance by invasive species, and a shift from larger to smaller dominant life forms (14). Further, stress on terrestrial ecosystems results in nutrient leaching, loss of soil fertility, increased erosion, and declines in plant productivity. These impacts inevitably increase nutrients in the drainage, thus resulting in eutrophication of streams, rivers, lakes, and coastal waters.

Some of these changes have been noted for SSI ecosystems. Among the best documented are Cusheon Lake and St. Mary Lake. As well, there is an obvious build-up of algal mats in the inner Ganges Harbor in the summer months. Consider, for example, the changes that have taken place in St. Mary Lake and Cusheon Lake, two of the three major

watersheds on the island. In both cases there is evidence of increased eutrophication (that is, increased levels of phosphorus), signaling a marked deterioration in the health of these vital ecosystems, which are central to the watersheds that many SSI residents depend upon. With eutrophication comes the increased likelihood of blue-green algae (which thrive in phosphorus-enriched waters) and toxic algal blooms, which can pose a public health risk. Although an in-depth study of these watersheds would be needed to confirm the transformations occurring in them, the evidence from many other studies shows that eutrophication inevitably results in changes that run throughout the whole ecosystem, reducing species diversity, changing the composition of the biotic community to favor short-lived, often invasive, opportunistic species, at the expense of long-lived native fauna and flora.

Indicators of Healthy Ecosystems:

Healthy ecosystems are characterized by integrated biotic communities which maintain organization (e.g. species diversity, biotic community structure, complex food webs), productivity (both primary and secondary), and system resilience (the capacity of the ecosystem to recover from disturbance or stress) (10, 14 -15). Of these measures, in principle the most useful is system resilience – for when the capacity of a system to recover from disturbance begins to falter, this signals the early stage of ecosystem degradation. Unfortunately, owing to the complex dynamic of ecosystems, and the difficulty of establishing "norms" for recovery times for specific perturbations, this kind of data is very difficult to obtain (16).

Measures of organization are relatively easier, but nonetheless require systematic surveys. In simple terms, one needs to identify the relative abundance of the major species that comprise the biotic community of the ecosystem within taxa (e.g. birds, fish, mammals, fungi) for ecosystems that are not significantly impacted by human activity. This establishes the "healthy condition" for species composition. Under stress, one sees a loss of diversity and the shift in composition to favor the smaller, more opportunistic species. Looking at data on SSI forests for avian species, and comparing this with historical data, would likely reveal a loss of diversity, the loss of interior-forest birds, and the increase in abundance of introduced species. It would be interesting to examine the Christmas bird counts done on SSI from this perspective, as one measure of the degree to which our forest ecosystems have become degraded. One might also look at the shifts in species composition and age-class distribution of trees over time, to assess the degree to which our forest ecosystems are breaking down, becoming less diverse, and consequently less integrated.

Productivity, technically defined as the amount of organic carbon produced per square meter, is easy to measure in principle, but in practice it is almost always determined by indirect methods, many of which bear only a loose association with productivity. Often, an estimate of plant biomass is used as a surrogate for primary productivity. For example, on SSI one could assess, from aerial photographs and nowadays remote sensing, the changes in tree cover, perhaps even subdivided by categories, such as "old growth" , "young forests", "tree farms", etc. With increased development on the island, the health

of our forests has undoubtedly been in decline: one striking indicator is that Salt Spring has lost almost all of its old growth forests, with their full range of ecological functions (diversity of fauna and flora, water retention, etc.). While one might argue that young forests that replace old growth may also be "healthy", the former are not substitutes for the latter. A "forest" is not just "trees". Young trees provide less cover, less capacity to retain water, less habitat for biodiversity, etc. Further, the loss of diversity of tree age classes makes forest ecosystems more vulnerable to disease outbreaks.

Bringing it Home to Salt Spring Island:

In 2003, The Islands Trust released a series of reports for each major island in the Trust Area, under the banner *Sustaining the Islands: Measuring Our Progress Report* (17). This may well be the start of an ongoing process to establish the degree to which the IT mandate of "preserve and protect" is being met. However, this report appears to be based more on a compilation of readily available data for the major islands, than on a comprehensive approach to state of the environment reporting. For example, there is no overarching ecosystem framework as the basis of reporting. Rather, selected "facts" about the island seem to be assembled on an ad hoc basis. The six chosen "environmental indicators" are:

1. Percentage of Land Base with Protected Status (including proportion of sensitive ecosystems in protected areas).
2. Percentages of Groundwater Observation Wells with Declining Water Levels
3. Tree Cover
4. Kilometers of protected streams
5. Shellfish harvesting closures
6. Trends in Kilometers of Public Roads per Hectare and per Capita.

Of these six indicators, only one, the trends in shellfish harvesting closures, may be taken as a surrogate for one aspect of the health of our marine ecosystems. It is interesting to note that in 1999 Salt Spring Island LTA had 604 ha of shoreline closed to shellfish harvesting due to contamination, compared to 1059.6 ha in the whole Trust Area. Thus our island has the distinction of having more than 50% of total closures. Further, between 1996 and 1999 the total Trust Area closed to shellfish harvesting increased by 12%. However, by itself, this indicator is insufficient to evaluate the health of these systems. It would need to be supplemented by a range of other indicators pertaining to trends in species diversity (shellfish, fish, birds, sea mammals, eel grass and other vegetation, etc.). Also needed are indicators of nutrients and contaminants in water, in sediments, trends in seasonal algal blooms, surveys of nears-shore fish and wildlife habitat, etc.

The use of tree cover does not by itself tell us much about the health of our forest ecosystems. We know that it has been quite a while since "In its pristine state every island in the Trust Area was blanketed with a dense forest of evergreens interspersed here and there with small prairie-like openings – delightful bits of parkland in the midst of the brooding forest. Stands of mature Douglas fir, balsam, and Western red cedar towered sixty meters in the air, so close together that a squirrel could travel completely across any

island, leaping from branch to branch high in the air, without once coming to ground" (3). Tree cover by itself tells us very little about the state (and health) of our forests today. More relevant would be remote sensing surveys, supplemented by on-the-ground checking that would provide us with on-going updates on the conditions in our forests, particularly the size of continuous patches, the extent of old growth, etc.

The percentage of land base with protected status, by itself, gives no indication of its current state of health. Indeed, in some reports it was suggested that a large amount of protected land had already been highly disturbed at the time of establishment of protection by the Islands Trust. It would be extremely useful to know, within the classes of "protected land base", what condition the land is in. Similarly, when it comes to the kilometers of protected streams, we need to know what is meant by protected. Is it the entire watershed through which the stream passes, or is it merely a few meters of riparian vegetation along the stream? Further, stream health if influenced by many factors, including activities upstream in unprotected areas. Finally, streams are also influenced by deposition from air—particulates, acidic precipitation, toxic substances, etc. The "protected status" per se obviously does not offer full protection.

We also learn from *Measuring Our Progress* that the length of public roads on Salt Spring increased from 314 to 333 km between 1996 and 2002. But what does this mean for the progress towards the "preserve and protect" mandate? Building a public road on a steep slope, or through an old growth forest, or by compromising a stream, or to the expense of productive farmland, all have very different implications—and negative ones at that—for maintaining island health.

Perhaps one of the most fundamental flaws of this exercise, from an ecosystem health perspective, is the missed opportunity to develop economic indicators (see the following section) on activities that relate to and often are the cause of degradation of ecosystems. The economic profile chosen for the report is confined largely to information about income distributions, costs of living, diversity of sources of income, etc. None of this by itself speaks to the growing pressures that development is placing on our island's fragile ecosystems through land disturbances, permits to build in sensitive watersheds, the purposeful or accidental introduction of exotic species, and commercial logging and tree cutting by private property owners, including on steep slopes, to the cost of the health of our ecosystems.

The CRD Round Table on the Environment (RTE) released its first State of the Environment Indicators Report in 2006 (18). The report is an important step forward for the Roundtable to assess whether its goals are being met. The specific objectives of the roundtable are to:

1. Maintain and restore the integrity of the natural environment in the Capital Region
2. Emphasize sustainability in regional strategies that address land use and transportation planning

3. Work towards a diverse and sustainable region through an enhanced understanding and application of new technology, modified practices and green infrastructure
4. Implement the principles of environmental stewardship and sustainability in everyday decisions
5. Develop the appropriate indicators to report on the state of the environment.

These are laudable goals, and they require an ecosystem-based framework that integrates the role of human activity in altering the functions of the ecosystems they impact. The CRD report is designed to address the question of whether the integrity of the environment in the Capital Region is being maintained or restored. So inherently the RTE is embracing ecosystem-level concepts in the design of their report, and in its selection of 3 of their 13 indicators of "the integrity of the natural environment" (i.e. "healthy watersheds", "sensitive ecosystems", "biodiversity"). However, there is no indication that there are data to support the chosen indicators. Rather, the report's conclusions appear to rest on tenuous inferences. With respect to biodiversity, for example, no surveys of biodiversity components of the ecosystems of the CRD are given; rather, it is simply stated: "Biodiversity has been protected through the addition of parks and protected areas, although some ecosystems are threatened by continued land development". With respect to healthy watersheds we learn: "Three major watersheds in Greater Victoria have greater than 30% total impervious surface and healthy functioning condition is at risk. Work is underway on the assessment of the ecological health of Greater Victoria." (18). Again the conclusion (although likely correct) is not backed by appropriate indicators or data bearing on the health of watersheds.

To carry out the mandate of the CRD, a more integrated conceptual framework is required: one that carefully justifies the choices of indicators, based on sound science and policy relevance. A number of major programs are already in place across Canada with the objective of long-term monitoring of the health of a large variety of ecosystems, from the Bay of Fundy to the Strait of Georgia; from northern rivers to the Great Lakes; from forests to prairies (19). The possibilities for obtaining sound data on which to assess the degree to which our ecosystems are being sustained are no longer theoretical, and much could be gained by designing a monitoring plan for the CRD area (with Salt Spring Island as a pilot study) based on an extensive review of frameworks and methodologies now in place elsewhere in Canada for the purpose of assessing the health of regional ecosystems.

Two general comments on these initiatives:

1: The vision for sustainability—namely, preservation and protection of trust area ecosystems, a rate of development and human activity compatible with maintaining the integrity of Trust Area ecosystems, nurturing island character, local economies and livelihoods, and supporting healthy communities—is laudable. Healthy ecosystems are those which maintain their full functions (the preserve and protect aspect), allow for sustainable livelihoods in such a manner as not to degrade ecosystem functions (the rate

of development and local economies/livelihoods aspect), and nurture cultural and social diversity and healthy communities (the island character and health aspects).

2: The indicators to "measure progress" or to carry out the goals are, however, woefully inadequate. They comprise for the most part isolated "facts" (e.g. education, income levels, age distribution, labor force by industry, crime rate, road systems, changes in water tables, "protection status", shellfish harvesting closures, vegetation cover, etc.) None of these, with the exception of trends in shellfish harvesting closures, bear directly on the health of our island ecosystems.

Assessing ecosystem health requires refocusing on the central indicators of the full (or proper) ecosystem functioning: indicators of resilience, organization, and vitality; or alternatively, measures of ecosystem dysfunction (i.e. the ecosystem distress syndrome) and/or key indicators of ecosystem distress.

Towards an Implementation Plan for Monitoring the Health of Salt Spring Ecosystems:

An ecosystem/watershed based framework for indicators of the health of Salt Spring ecosystems is essential if we are to ensure the sustainability of our island. The first step in implementing a systematic program for monitoring the health of our island ecosystems is to establish an integrated framework, comprising the following aspects: (i) the state of health of our ecosystems and watersheds per se; (ii) stresses from human activities which threaten or compromise ecosystem functions, as well as opportunities for human activities to enhance ecosystem functions (rehabilitation and protection of ecosystems); and (iii) effectiveness of governance systems to manage for ecosystem health.

Within this framework, specific indicators could be selected. For example, for the ecological dimensions one might examine the trends in invasive species, endemic species, forest cover (by species and age class), pest loads (in both agro- and forest ecosystems), biodiversity, nutrient concentrations (in soils and water), soil fertility and crop yields (adjusted for fertilizer subsidies), contaminants in soils, sediments, water, and air, water tables, stream run-off, etc. Indicators would not, however, be restricted to only the ecological dimensions (as per the examples above), but would also cover the socio-economic, cultural, human health and governance dimensions. (20)

The second step would be identifying existing data sets that may serve as a proxy for the selected indicators. This would require a review of existing information on major Salt Spring Island watersheds (and ecosystems) and identifying the data gaps. Such a study would build upon already well established large-scale monitoring programs for monitoring and assessing the health of Canadian ecosystems (19).

The third step would be ongoing monitoring of the health of our forests, lakes, streams, bays, harbors, and coastal areas, as well as of the human-health, socio-economic, governance and cultural dimensions. This step would be the most demanding part of the program. Trends in a comprehensive suite of indicators for the health of island ecosystems would form the basis for decision-making by both planners and developers,

serving as a sound basis for determining the kinds of development compatible with maintaining the health of our watersheds and ecosystems.

3. Human Activities as Threats and Opportunities for the Health of Our Island's Ecosystems

With climate change and its dire implications for human futures now making the headlines around the globe, there is a unique window of opportunity for engaging our citizens to consider more carefully how dependent our well-being is on the proper functioning of ecosystems – particularly in this unique and magnificent landscape in which we live. Conversely, we need to be more keenly aware of the potential negative outcomes for our personal, social, and economic well-being if we do not take decisive measures to reverse the environmental damage already sustained.

Much of that damage, at the global level (i.e. reduction in the protective stratospheric ozone layer, build-up of atmospheric greenhouse gasses), is directly linked to human activities (e.g. release of CFC's; burning of fossil fuels). Even more directly, research on the process of ecosystem breakdown has tied the cumulative impacts of human activities to the loss of ecosystem functions. Sometimes ecosystem-wide damage is caused by a single activity, as in Sudbury Ontario, where the release of sulphur dioxide (SO_2) and metals emissions from nickel smelting operations has resulted in regional wipe-out of terrestrial ecosystems (i.e. surrounding boreal forests) and greatly compromised the lakes in the region through acid precipitation. More often, it is a complex of human activities acting over long time scales that ultimately takes ecosystems to and beyond the "tipping point". This is surely the case in the Lower Great Lakes and the Baltic Sea (10, 14), where harbors, bays, near-shore ecosystems, and whole basins have been dramatically transformed owing to the interactive impacts of the following:

a) Over-harvesting (commercial fisheries)
b) Introduction of exotic species (some accidentally, and some intentionally)
c) Shoreline restructuring (building of harbors, marinas, dredging for shipping, draining wetlands for farming)
d) Pollution (both nutrient enrichment from urban, industrial, and agricultural activities, and influx of toxic chemicals, mainly from industrial plants, but also from household disposal)
e) Extreme "natural events" such as drought, floods (driven by intense storm events such as experienced on Salt Spring over the past two winter seasons), heat or cold surges, etc. Increasingly, these so-called "natural events" are in fact driven by human influences – e.g. global warming which destabilizes weather patterns; deforestation which increases runoff and flooding, and consequent water-logging in low-lying areas.

In reporting on the SOE, it is possible to make at least qualitative and often quantitative linkages between human activities and environmental change. For example, with respect to the toxic algal blooms in St. Mary Lake and the increasing eutrophication of Cusheon Lake, it is clear that it is inorganic phosphorus from septic fields, agriculture, and land disturbances in the watershed that hastens the natural eutrophication processes in lakes

and streams, resulting in more frequent algal blooms, sometimes toxic. Toxic algal blooms can also occur in the absence of human influences. Historically, it is known that indigenous peoples avoided shellfish at certain times of year and in certain areas, and the logs of early mariners such as Cook and Vancouver recorded an association between "discolored water" and poisonous shellfish.. However, the increasing frequency of such outbreaks is strongly linked to anthropogenic sources of phosphorus (for freshwater) and nitrogen (the limiting nutrient in fueling algal blooms in marine systems).

With respect to Salt Spring Island, a study of the impacts of our activities on the health of our ecosystems will likely reveal the following sources of stress:

a. **Land-use Change (physical restructuring of watersheds from development, diversion of streams into culverts, drawing down water tables, construction of roads, utility corridors, etc.).**
b. **Release of Waste Residuals (pollution): to air – particulates from burning, emissions from ferries, nearby pulp mills (i.e. Crofton), idling cars, and traffic; to freshwater and marine waters – runoff from septic fields and agriculture, waste disposal from boats into harbors, oil pollution from boats and float planes, etc.**
c. **Over-harvesting – particularly of old growth forests (little left on SSI) – and unsustainable harvesting practices (clear-cut logging, logging on steep slopes), resulting in massive soil erosion, and little likelihood of rapid forest recovery.**
d. **Introduction of invasive species (such as broom and others).**
e. **Extreme weather events, attributable in part to global warming: storms, droughts, increasing weather instability and unpredictability.**

Recognizing that these activities have had a deleterious impact on the health of our ecosystems provides us with an opportunity to redress the situation. Reduction of stress on ecosystems that are already damaged, and prevention of stress on those that are not, offer the best hope for maintaining or recovering healthy ecosystems. While technological solutions and reliance on human competence to properly manage the technology can be helpful, and in some cases essential (e.g. chlorination of biologically contaminated drinking water), they are at best "stop-gap" measures, and they are never foolproof, as the tragic case of Walkerton revealed. Far better than crisis management and technological "fixes" are forward-thinking preventive strategies to ensure the health of the ecosystems that are the very foundation for our health and well-being. Specific recommendations are given in Section 5.

4. What are the potential effects of degraded ecosystems on public health, maintenance of livelihoods, cultural values – in short on the sustainability of life on this island as we know it?

Public Health: It is often said that healthy ecosystems are essential for healthy communities. An increasing number of diseases have been related to ecological

imbalances. Sometimes these imbalances compromise our food supply, and thus encourage a shift of diet to less healthy and nutritious foodstuffs. Other imbalances increase the risk of contact with pathogens. In the case of Walkerton, Ontario, while the proximate cause of the outbreak of *Escherichia coli* O157:H7—a potentially deadly strain of *E-coli* bacteria—was human failure to properly manage the treatment plant, the root cause was ecological degradation in the watershed. There are a number of other potential public health issues which stem from ecological imbalances and might in the future threaten the health of our communities in the Gulf Islands. These include outbreaks of vector-borne disease such as Hanta Virus, Lyme disease, Malaria, and Dengue Fever – all of which are enhanced by ecological imbalances.

Livelihoods: The potential for earning an adequate living on SSI is significantly related to ecosystem health issues. For example, according to the 2001 Census analysis, tourism accounted for about 18% of the jobs on Salt Spring (although only 8% of incomes). Tourists are undoubtedly attracted to this island owing to the splendor of its natural settings and ecosystems. If the health of our ecosystems continues to erode, if "boil water advisories" proliferate, if toxic algal blooms in our major recreational lakes become chronic (as they may already be), then tourists and seasonal visitors may go elsewhere, and this would deal a blow to sustainable livelihoods. Loss of agro-ecosystems owing to the conversion of productive agricultural land to development threatens rural livelihoods as well as food security. The degradation of near-shore waters negatively impacts shellfish harvesting and other fisheries.

Further, development and greatly increased costs of housing are restructuring the social fabric of our community, by shifting demographic patterns on Salt Spring. Local craftspeople and artisans, those who have largely been responsible for the special character of the island, are increasingly unable to afford to stay. Vital sectors, such as health-care providers and other service providers, are increasingly finding it difficult to recruit the staff they need to carry on their functions, owing to the prohibitive cost of housing. Thus "development" threatens to reduce the vitality and diversity within our community. Such changes might result in a less tightly knit, involved, and caring community and in a reduced willingness to take responsibility for the health of our ecosystems. A transformation of this nature would pose further risks to maintaining the health of our ecosystems (including the human health and well-being component).

Cultural Values: The unique character of the Gulf Islands includes importantly our heritage of rural lifestyles integrated within our ecosystems, as well as the long history of First Nations' occupation of the islands. Landscape degradation due to unrestrained development and resource exploitation not only affects ecosystems per se, but it also undercuts the integration of people in the landscape, and often obliterates the historic traces that this integration has left on the landscape—from First Nations' middens and sacred sites to historic farmhouses and other rural heritage places. Shifts in cultural values threaten to move the islands, and particularly Salt Spring, increasingly away from a strongly felt sense of place and widespread awareness of the integration of people and their environment. The loss of cultural diversity due to the demographic changes mentioned above is likely to contribute to a loss of societal vitality and resilience, which

in turn could contribute to loss of ecosystem health. Conversely, the degradation of ecosystem health is a contributing factor in the social factors that are leading to loss of cultural diversity. The interconnectedness of cultural and biological diversity is a phenomenon increasingly recognized at both global and local scales (21). Biological and cultural diversity are mutually supportive, and the erosion of one often precipitates or contributes to the erosion of the other. These dynamics play out also in the microcosm that is Salt Spring Island.

5. Recommendations

1. That the Islands Trust "preserve and protect" mandate be directed first and foremost towards preserving and protecting the health of Salt Spring's ecosystems. The OCP should be amended to reflect the primacy of this goal.

2. That the OCP be amended with respect to the level of "build-out". The existing figure is not grounded in a solid understanding of what is sustainable in terms of maintaining proper ecosystem functions. If, with the current island population at half the "build-out", we are already experiencing problems associated with damaged ecosystems, then we are already at or past "build-out" for maintaining healthy ecosystems.

3. That there should be a hold on further development that may compromise the health of Salt Spring ecosystems until such ecosystem health issues are addressed and resolved. While a hold is likely to be opposed by many property owners, it could be essential for the sustainability of the island. This follows logically from the need to reassess the limits to "build-out" on Salt Spring Island in light of current understandings. In those watersheds where scientific assessment reveals a state of failing health, no further development should be permitted until those health issues are resolved. It would be foolhardy and socially irresponsible to allow continued development (even where the only permission required is a CRD building permit) in watersheds already found to be dysfunctional as a result of existing pressures from human activity. When it comes to reaching the "tipping point", many straws can and do "break the camel's back". Downgrading existing acreage as to the number of house sites allowed in sensitive watersheds may be essential to prevent further declines in the health of the watershed, or to maintain watershed health.

4. That the planning tools for land-use be reformulated and additional tools be brought into play so as to put land-use planning on a sound ecological and social basis, recognizing the importance of healthy watersheds and healthy ecosystems in order to maintain or enhance the quality of life on SSI. The planning tools should be based on the principle of "Do No Harm" to the health of our ecosystems. In restructuring the tools – such as development permits – aggregated and cumulative impacts of human activities must be taken into account. Granting permits on a "one by one" basis misses the collective impact on the health of our ecosystems. One 4,000 sq. ft. home by itself may have a small

or negligible impact on an entire watershed, while 100 or 1000 such homes may irrevocably compromise the health of the watershed.

5. That a scientific assessment of the health of SSI watersheds be carried out – to establish the current state of health of local ecosystems and the relationships between existing land-use practices and other human activities and the state of health of the ecosystems. Ecosystem health assessments need to be updated periodically, and this activity could be community-based, drawing upon the wide variety of skill sets of community members. Involving students (middle and high-school) in field-based learning about issues of ecosystem health on SSI would be one effective means of raising public awareness of the issues and potential solutions without undue financial burden.

6. That emphasis be placed on educational programs for all age groups to gain understanding of the importance of healthy ecosystems on SSI for maintaining quality of life. The education should be oriented towards practical steps (beyond well-known activities such as recycling). The educational objective might directly be linked to recommendation 3, above. Special educational sessions or "short courses" might be offered to our island's health providers (doctors, dentists, Nurses, public health officials, etc.), focusing on the linkages between the state of the environment and human health risks.

7. That particular attention be given not only to the rights but as well to the responsibilities of island residents to minimize their ecological footprint. Particularly damaging to SSI ecosystems are any and all of the following activities: deforestation of land for the view; compromising the islands wetlands, creeks, and streams; degrading the shoreline habitat, through steep access paths and staircases, and construction of platforms onto the beach; burning of leaves, compromising both air quality for humans, and also having potential damaging impacts on sensitive ecosystems through fumigation; etc.

8. That where the means (tools) to achieve healthy ecosystems exceed Island Trust mandates, a campaign for social responsibility be vigorously pursued to ease pressures, and the provincial authorities be lobbied to address the needs.

9. That attention be given to encouraging island-wide dialogue on the critical issues of restoring health to the ecosystems of SSI, through a combination of strengthening the Trust, education, and moral suasion.

10. That future assessments of the health of SSI employ a four-fold strategy: Mapping (on an ecosystem /or watershed basis), Monitoring (for critical aspects of both ecosystem responses to stress, and human activities that cause stress on ecosystems), Modeling (the relationships between the multiple stresses and ecosystem breakdown), and finally Management: taking all into account and devising policies that safeguard our healthy island ecosystems, while restoring damaged ecosystems.

References and Footnotes:

1. World Commission on Environment and Development 1987.

2. Island Trust Act, 1974.

3. Sweet, A. F. 1988. *Islands in Trust*. Oolichan Books, Lantzville,. BC

4. The Land Use Bylaw sets forth the regulations governing subdivision potential, zoning, setbacks and permitted uses for all land and shoreline areas of Salt Spring.

5. Mazumder, Presentation to SSI Water Council, SSI 2006

6. Rapport D.J. & Friend, A. M. 1979. *Towards a Comprehensive Framework for Environmental Statistics: A Stress-Response Approach*. Statistics Canada 11-510, Ottawa. 87 pp.

7. Rapport, D.J. and Singh, A. 2006. An EcoHealth approach to State of Environment Reporting, *Ecological Indicators* 6, 409-428.

8a. Bird, P.M. & Rapport, D.J. *State of the Environment Report for Canada*. 1986. Canadian Government Publishing Centre, Ottawa. 264 pp

8b. Statistics Canada: Human Activities and the Environment (first edition 1986, and every 5 years thereafter).

9. Rapport, D.J. 1983. The stress-response environmental statistical system and its applicability to the Laurentian Lower Great Lakes. *Statistical Journal of the United Nations ECE* 1: 377-405.

10. Rapport, D.J. 1989. What constitutes ecosystem health? *Perspectives in Biology & Medicine*
33: 120-132.

11. McKenzie, D.H., Hyatt, E.D. & J.V. McDonald (eds), 1992 *Ecological Indicators*. Vols 1 and 2. Elsevier.

12. Rapport, D.J, Lasley, W., Rolston, D.E., Nielsen, N.O., Qualset, C. O., and Damania, A.B. (eds). 2003. *Managing for Healthy Ecosystems*. CRC Press. 1456pp.

13. Rapport, D.J., Regier, H.A. & Hutchinson, T.C. 1985. Ecosystem behaviour under stress. *The American Naturalist* 125: 617-640.

14. Rapport, D.J. and Whitford, W. 1999. How ecosystems respond to stress: Common properties of arid and aquatic systems. *BioScience* 49(3): 193-203.

15. Mageau, M.T., Costanza, R. and Ulanowicz, R.E. 1995. The development and initial testing of a quantitative assessment of ecosystem health. Ecosystem Health 1 (4) 201-213.

16. Whitford, W, Rapport, D.J. and deSoyza, A., 1999. Using resistance and resilience measurement for "fitness" tests in ecosystem health. *Journal of Environmental Management* 57, 21-29

17. Islands Trust, 2003. Sustaining the Islands: Measuring Our Progress Report.(www.islandstrust.bc.ca)

18. CRD 2006. Report on the Environment: Environmental Priorities and Indicators. (www.crd.bc.ca/rte/report/indicatr.htm)

19. Rapport, D.J. 2003. Ecosystem health and ecological integrity; foundations for sustainable futures. In: B. Mitchell, ed. *Resource and Environmental Management in Canada: Addressing Conflict and Uncertainty*. 3rd Edition. Oxford University Press, pp 24-53.

20 The World Bank 2006. Measuring Coral Reef Ecosystem Health: Integrating Societal Dimensions (# 36623 September 2006).

21. Maffi, L. (ed.) 2001. *On Biocultural Diversity: Linking Language, Knowledge, and the Environment*. Washington, DC: Smithsonian Institution Press.

Bionotes:

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