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Ecological theatre on Gabriola

—managing the forests

by J.P. (Hamish) Kimmins

This article is about ecosystems and ecosystem management on the Gulf Islands, and because most of the Gulf Islands are, or were, forested, it is also about forestry ecosystems. I want to talk about such systems using the "theatre" as a metaphor. The paradigm of an "ecological theatre" is a powerful way of thinking about forested landscape ecosystems. A theatrical performance requires:

- a stage
- a play
- some actors.

The ecological stage of the paradigm is the physical environment of an ecosystem—the climate, bedrock, soils, topography, and hydrology—and the natural disturbances to that environment—fires, storms, floods, landslides, drought, and so on.

The ecological play is the sequence of biotic communities that successively occupy, and are replaced over time, following a disturbance that removed the pre-disturbance community. Accompanying this biotic community change are changes in soil conditions, soil organisms, and the above-ground animal community.

The ecological actors are the species of plants, animals, and microorganisms that make up the changing biotic community.

The need for conservation

The first question to be addressed in any consideration of ecosystem management is why do we need conservation? The simple, though incomplete, answer is because of the growth in human population.

Sustaining desired environmental values, maintaining services provided by the environment, and preserving the diverse biological products of millions of years of evolution—our genetic inheritance—all require that human relationships with the environment be founded on, and guided by, a conservation ethic. This is difficult to do if the population keeps on increasing. Globally, this has been true for much of the past century, and it is increasingly so on the Gulf Islands today.

Although the *rate* at which the global population is increasing has started to drop, human numbers continue to grow because this diminishing rate applies to an increasing number of people. By the end of this century, it is predicted that growth will add 3-4 billion to the present human population of about 6.3 billion. Even when population growth has ceased, the pressure posed by humans on the environment is expected to continue to escalate because of the rise in the standard of living and the per-capita consumption of resources by the developing world, which is where the majority of the world human population lives. Compounding the problems resulting from population growth is increasing urbanization with the result that many are becoming less aware of the environmental consequences of the choices they make, and many have less understanding of how ecosystems work.

The population of British Columbia has grown at a similar rate to that of the world

population, reflecting both growth in the net numbers born in BC and net immigration to the province. The population approximately doubled between 1970 and 2005, and is expected to add more than another million by 2030. As the BC population has increased, so has its median age, reflecting the ageing of past immigrants (the baby boom), smaller family size, and delay in the start of family formation. As the median age has increased, the proportion of the population younger than 18 years has decreased, and the proportion of the population over 65 has increased. These trends are expected to continue, as shown in the first table above.

BC population growth and trends

year	population (millions)	median age	young <18 %	middle aged %	elderly >65 %
1971	2.2	28	33	58	9
2004	4.2	39	20	66	14
2031	5.5	46	16	60	24

Gulf Islands population (based on School District)

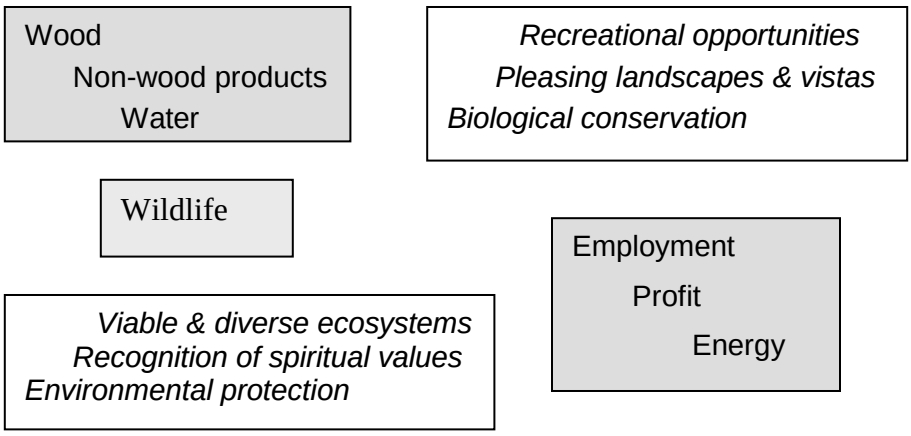
year	population (thousands)	relative %
1996	13.8	94
2004	14.7	100
2018	17.8	121
2031	19.8	134

The population of the Gulf Islands has increased more slowly than the world and BC populations, but if the present BC government projections, shown in the second table above, are correct, there will be a 34% increase in the next thirty years. Regulation of human density on the Gulf Islands (by control of lot size, dwellings per lot, and total island density) has limited, and will continue to limit, population growth to below the average for other coastal regions.

Gulf Island property values can be expected to continue to rise as the demand for properties for retirement by “baby boomers” from across Canada and elsewhere in the world continues to increase while the supply remains fixed or declines. This will pose social issues such as the exclusion of those with lower family income. The restriction on population growth will also limit some employment opportunities, limiting recruitment of young working families, although the construction of new homes and renovation of older homes by retirees will provide for a healthy home construction industry for some years to come.

In the face of projected population growth and the resultant pressure on water and island ecosystems, development of the Gulf Islands should be based on a conservation ethic, both environmental and social. The former should be based on ecological understanding of these ecosystems based on long-term experience and scientific knowledge, and not on belief systems about nature that lack such understanding. Among other things, this ethic should deal explicitly with the natural and historical disturbance ecology of the island and issues of groundwater consumption and fire control.

Social conservation must address the difficult issues associated with the inevitable change in demographic profile of the islands—referred to by some as



What people want from, and value in, their environment and its management

"gentrification"—that will be a consequence of population growth and migration and regulations with respect to environmental conservation, land use, and population density. We can expect the loss of many environmental values unless land use is founded on an appropriate environmental ethic based on knowledge and understanding. There will be a shift in social values as land values rise and the demographic profile changes in response.

The basis of an environmental ethic

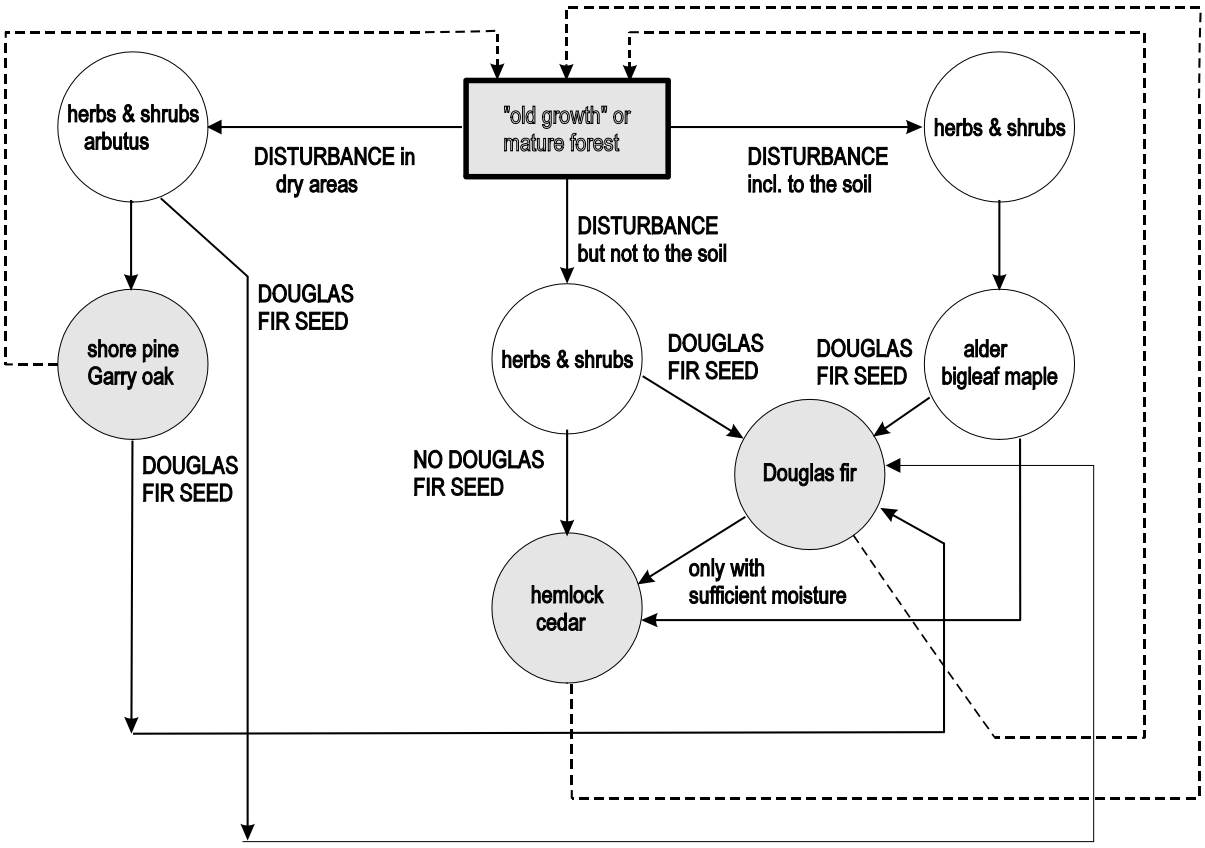
What would be the basis of an environmental ethic for Gabriola and the Gulf Islands? Fundamental questions that are raised here include:

- should the ethic be based only on the environment's tangible contribution to the welfare of human beings
- do only humans have rights and legitimate interests, or should we extend them to all sentient beings, or even to all non-sentient entities
- should it be anthropocentric, or might this be a potentially dangerously warped view of reality?

The question of what the relationship between humans and the natural environment should be has long been vigorously debated by environmental philosophers. There is no agreement on this topic. The so-called "deep ecologists" argue for the intrinsic value and inherent worth of the environment, while other environmental philosophical and theological viewpoints present a variety of alternative thoughts.

The advice of field-experienced ecologists is generally that such debates should ultimately be arbitrated by nature itself. "If in doubt, ask a tree", and "read the book of nature". For example, is it ethical for humans to alter forests from a climatically-adapted to a climatically maladapted condition that is likely to be more susceptible to the negative effects of climate change simply because it looks nicer in the short-run—a few decades (probably no)? Would it be ethical to allow wolves to kill an individual moose (yes); to kill an entire local moose population—uncommon, but it does happen (maybe); or to cause the extirpation of moose over large areas—very unlikely, but still possible under certain scenarios (probably no, but…)?

What values should be covered by an environmental ethic? Many of the values



An example of disturbance to "old growth" or mature forest (the box, top centre). Disturbance can be due to a variety of causes including weather extremes, fire, insects, disease, landslides, drought, floods, grazing by deer, and harvesting. "Recovery" proceeds through temporarily-stable *seral stages* (circles) and will eventually end in a *climax* stage (shaded circle). The process of change after disturbance is called *ecological succession*, and any particular sequence of community and ecosystem changes is a *sere*.

that would be acceptable to most people only appear to be uncontentious.

These might include that the environment be the result of good stewardship, that it be sustainable, and that it be natural. But then we have to ask:

by "good stewardship" do we mean:

- maintaining biodiversity; or
- supporting particular species,

by "sustainable" do we mean:

- an environment based on our current understanding of nature derived from the environmental sciences; or
- something that is constant,

and by "natural" do we mean:

- based on nature as we see it today
- nature as it has been perceived to be over the past few decades
- nature before European contact, when wolves and hunting kept the herbivore population low; or
- do we mean something that we would like nature to be—an anthropogenically-defined nature perhaps?

Other key questions in environmental ethics are over what time and spatial scales should the ethic be defined?

For timescales, should the ethic deal with current conditions only, with the variation over one or two decades, over centuries, or over the more evolutionary and geological time scales of millennia? For spatial scales, should we examine constancy *vs*. change at national, provincial, regional, or local landscapes? Is it reasonable to consider the question at the "my-back-yard" scale?

Good stewardship—biodiversity

Much of the debate on "good stewardship" has centred on the issue of conserving *biodiversity*. Discussions on biodiversity however often deal with only one of the several measures of biological diversity, namely, species richness—our inheritance from evolution. The focus has frequently been "no loss of species" on any scale, but, like all of the several other measures of biological diversity, at the local level, species richness changes naturally over time as a consequence of either natural disturbance or ecosystem development in the aftermath of disturbance. Good stewardship does not mean maintaining conditions and measures of nature unchanged, but rather supporting non-declining patterns of change that are appropriate for the ecosystems in question.

The diagram on the page opposite illustrates the dynamic nature of biodiversity and other values in disturbance-driven forests, with the example taken from our area. Each of the circles represents a "seral stage" of recovery following a disturbance to the "old growth" or mature forest (shown as a box).

Climax "old-growth" forests in southern British Columbia are often mixed stands dominated by hemlock and red cedar. Disturbance by fire or wind creates a sequence of plant communities, from post-disturbance herbs and shrubs, perhaps through a red-alder stage if there has been a lot of mineral soil exposed, or a Douglas-fir dominated community if the soil has not been physically disturbed and there is a source of Douglas-fir seeds. In the absence of sufficient soil disturbance and Douglas-fir seed, the area may regenerate directly back to hemlock and cedar. Any combination of these communities can occur, depending on circumstances.

On drier sites, the red-alder stage may not occur, and instead there may be an arbutus stage, in which case the climax may be shore pine in exposed areas; or Douglas fir; or if fires are frequent and severe, Garry oak on south-facing slopes.

Another example of the role of disturbance in ecosystems is an area probably familiar to most, even if they have never been there, the Carmanah Valley of Vancouver Island where there are magnificent stands of Sitka spruce. These spruce will only be recreated in the future if, periodically, the area is disturbed by flood, wind, landslide, or logging. Otherwise, the spruce will gradually be replaced by the climax species: hemlock, red cedar, and Pacific silver fir.

The omni-presence of disturbance and change in most Canadian forests raises the question of what is the difference between extirpation and extinction. As Aldo Leopold noted, the "first rule of intelligent tinkering is to keep all the parts". This famous saying by the grandfather of modern environmental ethics has been wrongly interpreted by many as saying that there should be no change in the species list in an ecosystem; that the loss of a species from a particular ecosystem means that you have lost one of the parts of that system and therefore it will no longer function normally. This "Swiss watch" analogy has been soundly rejected by

Above: Laminated root rot is a natural component of some ecosystems, but in overstocked stands it can develop into a serious problem.

Right: Heavy infestation of western hemlock by the plant parasite dwarf mistletoe. Stand-replacing disturbance that causes temporary extirpation of the hemlock is the major natural process by which this host-parasite relationship is kept in balance.

ecologists because nature is continually changing the species list at the local level as a result of natural disturbance and the ecosystem processes of successional development.

This apparent conflict is based on confusion between extirpation (the temporary loss of a species from a local ecosystem) and extinction (the total loss of a species from throughout its range). Extirpation is a normal and expected part of the dynamics of nature, and in many cases may be a necessary part of long-term stability for a species to avoid problems of disease, resource over-use, and predation.

Sustainability

For many values, long-term sustainability, including maintenance of biodiversity, requires change in all environmental measures at some temporal and spatial scale. This in turn requires the maintenance of appropriate ecosystem and biotic community disturbance regimes at appropriate frequencies and spatial scales and patterns.

A notion of sustainability based on our current understanding of nature derived from the environmental sciences, must include an understanding of the patterns and processes of nature, and the known or inferred range of change and variation in these patterns and processes. These values cannot be sustained in every local ecosystem all the time—sustainability involves areas large enough to account for the scale and frequency of disturbance, and it involves non-declining patterns of change over time periods that are characteristic of the ecosystems involved. An environmental ethic that does not address the issue of change is unlikely to be ethical, and land use regulations that ignore it are unlikely to be successful.

Natural

Ethics, like forestry, is concerned with the values and ecosystem services people desire. Human communities that vary in the values and services they need and desire will define environmental ethics differently. In societies that recognize the importance for of maintaining ecosystems within their

Alder thicket on a clear-cut in the centre of Gabriola. Alder trees replenish nitrogen in the soil and are characteristic of disturbed sites on the way to recovery, but to some, they "spoil the view".

historical, or "natural", range of variation, environmental ethics requires the maintenance of the supply of the variety of values, resources, and services associated with that natural range.

Adhering to a particular vision of what is "natural" may result in an effort to reproduce a snapshot—a single frame—of the on-going "movie" of nature; an attempt to "freeze-frame" what is a dynamic and ever changing and evolving system.

And if the vision is of a landscape that does not in fact exist in nature, we are imposing our values on nature; for example, by sustaining a continuous forest cover in all forests because it looks nice, or because it supports some particular animal species, irrespective of whether this conforms to the way nature actually works in the landscape being considered. This option denies the great temporal and spatial diversity of nature by attempting to impose and maintain a limited set of ecosystem conditions almost everywhere. It is a choice between basing ethics on natural patterns and rates of change generated by ecosystem disturbance and recovery processes *vs* attempting to achieve constancy and prevent change.

Forestry and environmental ethics

We can define forestry as:

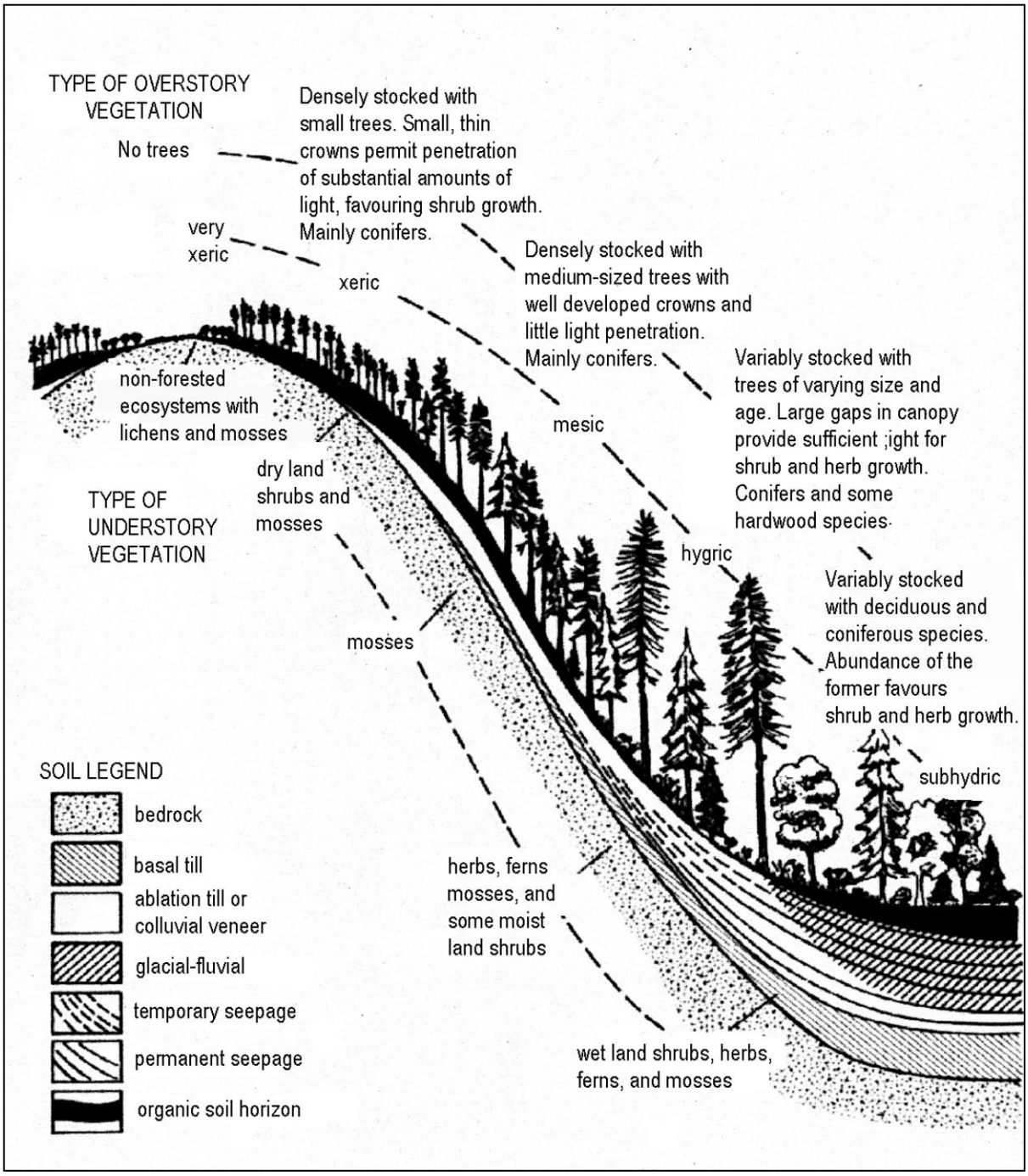
the art, practice, science, and business of managing forested landscapes to sustain an ecologically possible and socially desirable balance of values over appropriate spatial and time scales.

Forestry is first and foremost about people—their needs, values, desires, and concerns. Because these change over time, so will forestry—as it always has in response to social evolution. Change in forestry in response to social change is the first responsibility of the forestry profession.

The second responsibility is to resist suggested changes and to abandon current practices that are inconsistent with the ecology and sociology of the new set of values. Balancing the social and ecological components of such change will always be difficult because what is socially desirable may be incompatible with the ecological requirements of the desired set of values. It is also difficult because different groups in society have different values and desire different things from forested landscapes.

As forestry changes, we must decide what should be the guiding paradigm. There are many alternatives to chose from:

- ecosystem-based management
- ecosystem management
- adaptive management
- zonation
- variable retention
- natural range of variation



Geological components of the ecological stage and associated biotic communities on a hillside

- results-based *vs* regulation-based management; and
- monitoring and certification.

These are not all mutually exclusive; in fact, environmental ethics balanced with social ethics may require various combinations of these. However, all of these should in turn be based on the paradigm of ecological

theatre because this explicitly recognizes the key components of the environment and the management thereof.

The paradigm of ecological theatre

The ecological stage

The biotic potential of a local or landscape ecosystem is set by the physical factors that define the abiotic component of the ecosystem. The forest regions of Canada reflect the major climatic zones of our country. The major bands of different forest types reflect the major climatic belts that exist as a function of latitude, distance from oceans, and proximity to mountain ranges.

The biogeoclimatic zones of BC reflect a refinement of the climatic zonation provided by the national classification. The fourteen bioclimatic zones reflect major differences in precipitation and temperature. The zones are divided into bioclimatic subzones and variants on the basis of minor, but biologically significant, variations in temperature and precipitation, and into variants based on things like wind exposure, fire, and other physical factors.

Bedrock geology and surficial geology affect soil fertility, ecosystem productivity and resilience, slope stability, and susceptibility to erosion on slopes.

The ecological stage for the Gulf Islands is the Coastal Douglas-Fir (CDF) Zone, which has as some of its key features:

- a maritime, semi-Mediterranean (subtropical) climate—dry, warm summers; wet, mild winters
- Douglas fir, grand fir, arbutus, Garry oak, bigleaf maple in nutrient-rich soils
- disturbances: fire, root rot, drought.

Gabriola is located near the northern end of this zone, which features several genera and some species that extend all the way down into Mexico. Its climate is transitional to the drier parts of the adjacent cooler and wetter Coastal Western Hemlock (CWH) Zone. The wetter parts of the CWH have a temperate rainforest climate and vegetation, while the drier parts at lower elevation on eastern Vancouver Island are not rainforest, and have historically been dominated by infrequent, large, stand-replacing fires.

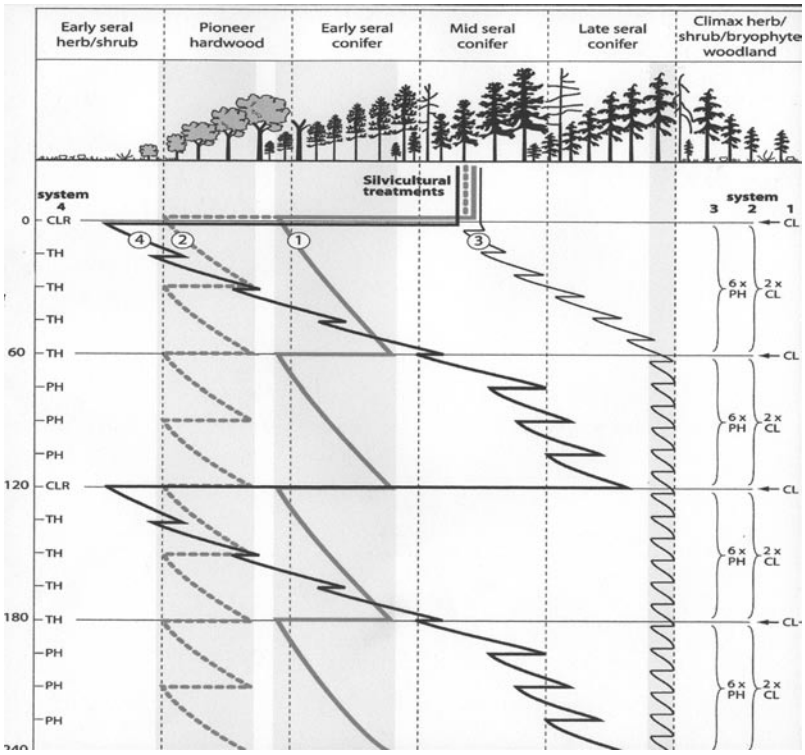
Fire has historically been a major part of the ecological stage of Gabriola. Its virtual elimination is resulting in major shifts in the ecology of the island. Clearcutting, both that done in the 1930s and more recently in the centre of Gabriola, has not duplicated the historical effects of fire, as it has removed the stands of large, thick-barked Douglas fir, which usually survive a forest fire. These are being replaced by a mix of species including grand fir, cedar, and hemlock; species that are usually destroyed in such fires. These species, which are physiologically maladapted to severe drought, will eventually be removed by drought thereby correcting the "errors" caused by fire control. Although there are sites at the north end of the island where drainage is poor or near-surface groundwater exists and stands of hemlock will survive, generally speaking, the lack of competition from the Douglas fir will result in an ecologically significant change in the future forests.

The ecological play

The ecological play is the sequence of biotic communities and ecosystem conditions (acts of the play) that result from ecosystem disturbance and post-disturbance development.

The top row of the diagram on the right shows a hypothetical play (a *sere*), with six acts (*seral stages*):

- early seral herb/shrub
- pioneer hardwood
- early seral conifer
- mid seral conifer
- late seral conifer
- climax herb/shrub/bryophyte (moss and liverwort) woodland.



Serial stages (acts) in a hypothetical sere (play).

Left to the biotic community itself (the plants), the play would proceed from left to right (*autogenic succession*), the final act, the *climax*, being a self-replacing community that is stable over at least several generations of the dominant plant species.

The lines below the top line on the diagram on the right show some of the possible ways that silviculture could change this hypothetical sere (play) by prolonging some "acts" and shortening others.

The diagram illustrates:

- (line 1) conventional silviculture (clearcutting and planting with no partial harvesting) maintaining an early seral conifer stage.
- (line 2) short-rotation even-age silviculture with repeated clearcutting maintaining a pioneer hardwood stage
- (line 3) a low disturbance, frequent entry, partial harvest system with natural regeneration or underplanting of shade-tolerant species maintaining a late seral conifer stage
- (line 4) a system that alternates moderate to severe harvest disturbance with periods of partial harvesting incorporating variable retention.

The scope of disturbance to change the play is not, as might be inferred from this particular diagram, confined to reverting to an earlier seral stage followed by a repeat of the autogenic succession. Disturbance by physical processes that are more or less independent of the biotic community (*allogenic*) or by a living organism (a pathogen or herbivore for example) (*biogenic*) may introduce entirely new acts. Retrogressive disturbance such as that caused by wind, fire, insects, disease, landslides, floods, exceptionally heavy snowfalls, and grazing may result in successions that are cyclical rather than linear as the result of such disturbance.

Other disturbances, particularly those used by forest managers, can hasten the move from left to right, or even eliminate some acts altogether. Forest management techniques that can accelerate succession or change the outcome, include thinning; small patch cutting; selective tree removal; planting or facilitating natural re-stocking; stand fertilization; manipulation of species composition; mulching; and control of fires, animals, drainage, and soil conditions. In general, these are low-to-moderately-severe, rather than moderately-severe-to-severe, disturbances.

Provision of the full range of ecosystem values and services requires that the full range of ecological "acts" occurs in the ecological "plays" across regions and landscapes large enough to account for the scale and frequency of past natural disturbance. When considering a small area like Gabriola Island, it may be difficult to ensure that all ecological conditions are represented on the island all the time. It is unlikely that this occurred prior to European contact, and it will be difficult to ensure that this occurs in the future.

Sustainability in disturbance-driven ecosystems and landscapes must often be assessed at much larger spatial scales than that of one island. This implies that from one decade or half century to the next, it would be reasonable to expect changes in the ecology of the island. This is not a threat to sustainability, as long as appropriate future disturbance regimes are applied, and that the processes of ecosystem recovery are permitted to operate—in other words, the "ecological story" is told in full.

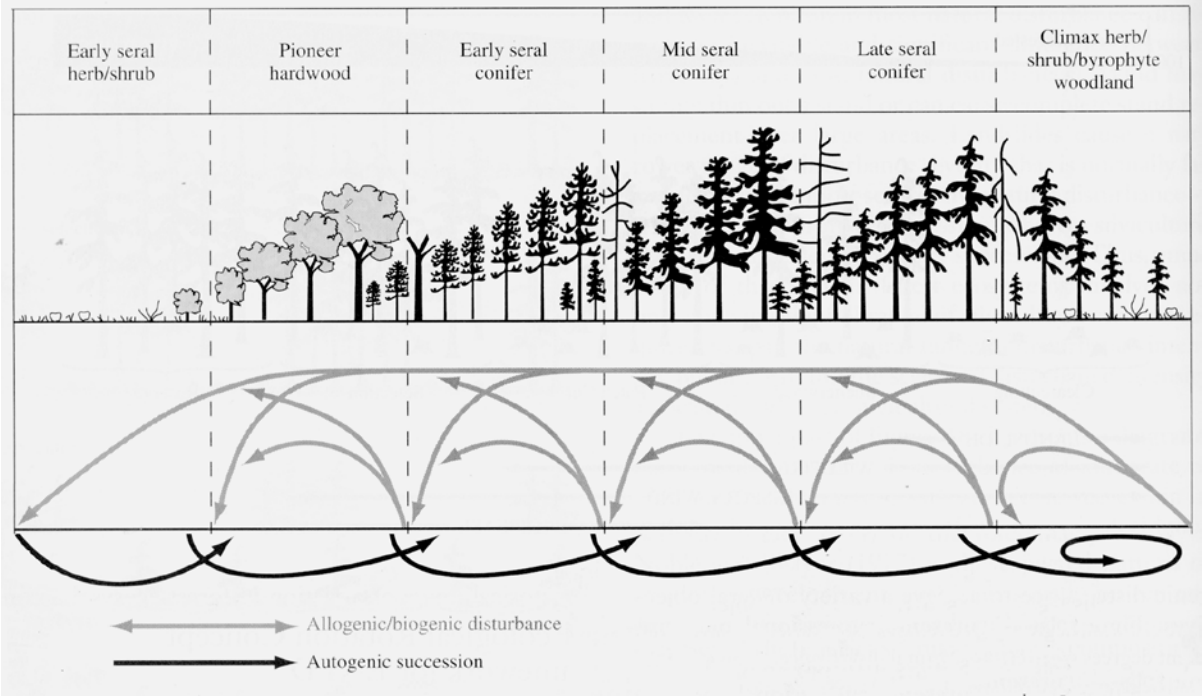
Because, for social reasons, it is not likely that this will be permitted to occur, we will have to revisit what is meant by the Islands Trust mandate "to preserve and protect". For example, the lack of fire and the increase in partial harvesting, were this to occur, would convert the "natural" Douglas-fir-dominated forest to a hemlock-red cedar-grand fir-dominated forest that is physiologically maladapted to our periodic summer droughts.

The ecological "actors"

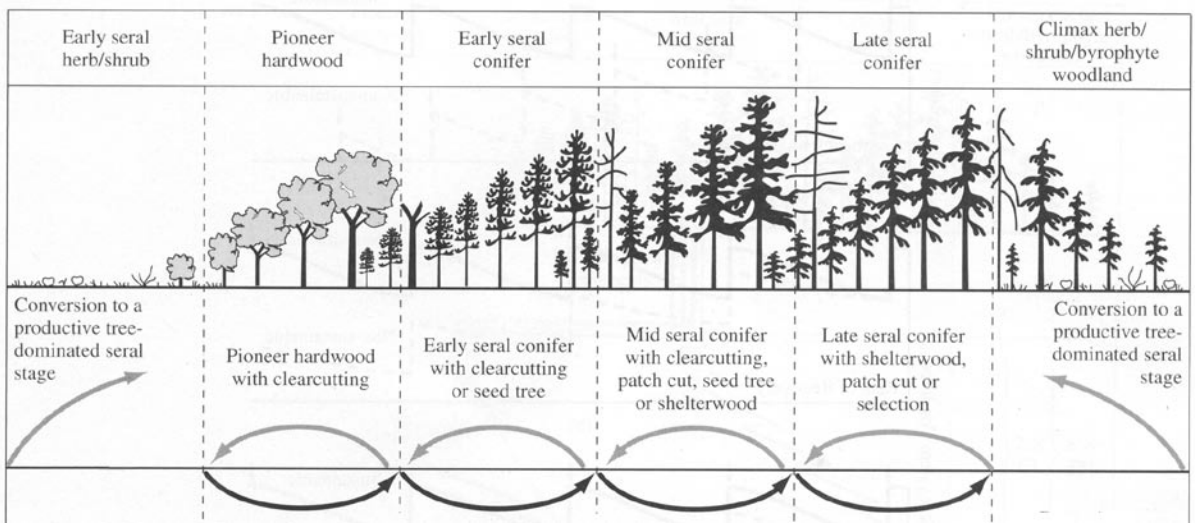
The ecological "actors" are the plants, animals, and microbes that occupy the different seral stages of post-disturbance ecosystem development. Like actors in a play, some species are only on "stage" for a single "act". Others may play an ecological role in several or all the acts of the play.

For ecological actors to be involved in the ecological play, they must be adapted to the range of physical conditions they will encounter—climate, soils, fires, and so on. They must also be able to compete with other species, and resist diseases, parasites, and predators.

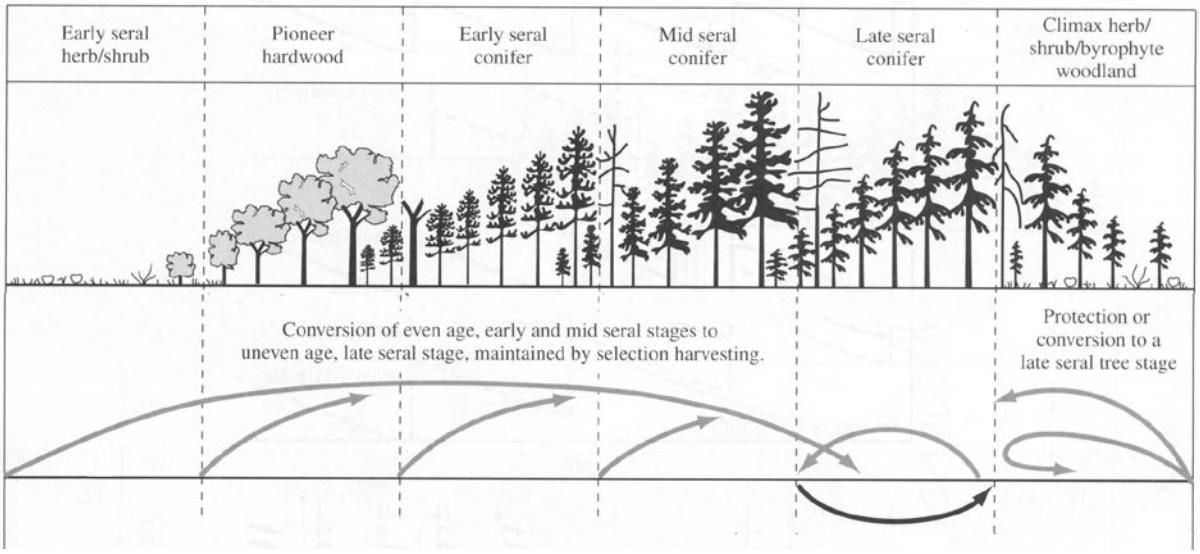
In many BC forest ecosystems, physical disturbance has favoured species that are adapted to the physical demands of the site or landscape. In many cases, it has also maintained a balance between hosts and their parasites and predators, and has reduced competition for limited site resources, for example, soil moisture. Maintaining an inappropriate disturbance regime on the Gulf Islands poses the risk of producing biotic communities that are maladapted to the physical and biotic conditions on the island. The problem is expected to be exacerbated by climate change, and possibly also by the drawdown of water tables by excessive water use. In other words, there is a significant risk that we are changing the ecological stage and producing the wrong ecological play.



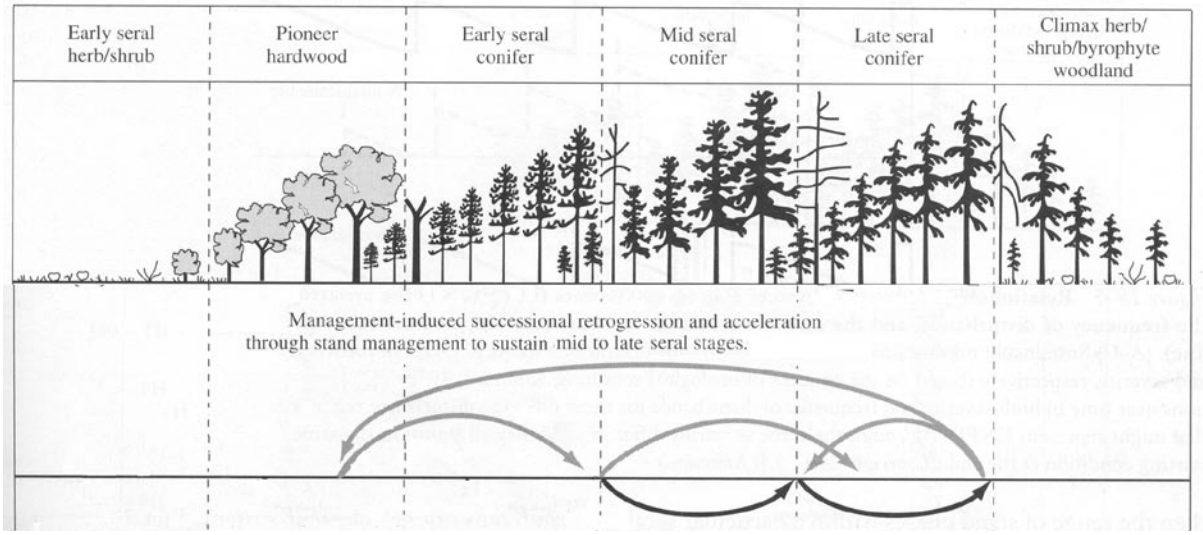
Succession by plants (*autogenic succession*) in this hypothetical sere (play) proceeds from seral stage to stage (acts) shown by the dark arrowed lines. Moderate to severe disturbance (*allogenic/biogenic*) of various kinds (not silviculture alone) may move the play back to an earlier act shown by the grey arrowed lines. Disturbance is natural to some ecosystems, so much so that removal of the disturbance would itself be a disturbance. The extirpation of wolves on the Gulf Islands, for example, has allowed deer to flourish to the detriment of some plant species and creatures that depend on them.



One of many possible management strategies would be the maintenance of a particular desired seral stage. The diagram illustrates maintaining either a pioneer hardwood, early conifer, mid conifer, or late conifer serial stage.



The acceleration of autogenic succession by selective harvesting combined with natural regeneration or underplanting could be used, as shown in the illustration, to create a late seral stand.



Yet another possible management strategy, this one aimed at maintaining a mid- to late seral sequence (play) using management-induced disturbance and accelerated recovery.

Young trees growing side-by-side in Drumbeg Park, Gabriola. *Left*, a Douglas fir with thick bark; *right*, a grand fir with thin bark and resin-filled blisters. In a "left-to-itself" environment, most grand-fir saplings in such a forest would be destroyed by fire before reaching maturity.

version of the Coastal Western Hemlock zone.

Soil variations, reflecting the underlying surficial and bedrock geology, add to the diversity of ecological stages defined by climate. Areas of clay-rich soils are poorly drained; the sandstone areas of the central part of the island are well drained, but nutritionally poor; and areas underlain by shale have soils where deciduous trees grow. Various depths of glacial till varying in texture and coarse fragment content from gravelly to silty provide variation in fertility and soil moisture, while the orientation of a slope affects many aspects of ecosystem function and species composition.

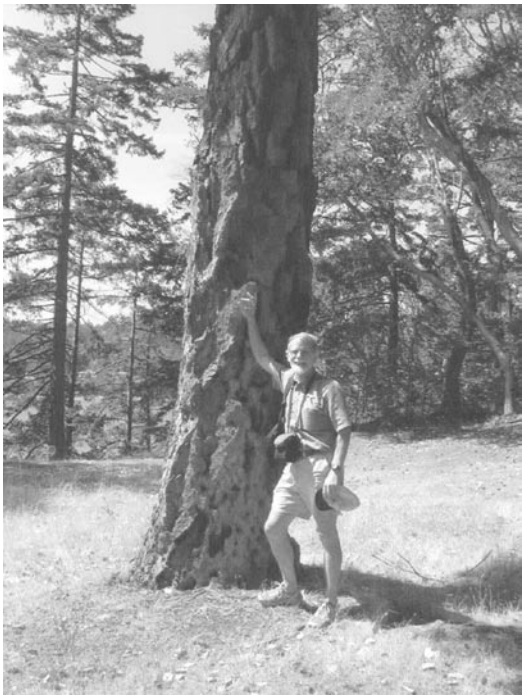
Using the metaphor of "ecological theatre" to develop an ethical land use policy

The first task in applying the metaphor of ecological theatre as a basis for land use planning is to undertake ecological site classification to identify the different ecological stages present on the island. While the major determinant of the stage is the regional climate, variations in aspect (the north end of the island *vs* the south end), proximity to the sea (interior *vs* coastal areas), and cold air drainage from Howe Sound and the high mountains on the mainland to the north, all modify the regional climate.

This cold air influences the northeastern parts of the island in late winter and spring much more than the southern areas. As a result, the south end of Gabriola is much more like a Coastal Douglas-fir zone, while the north end is more similar to an albeit dry

The second task is to define the desired future forest and patterns of change in forest conditions and values. Which acts of the ecological play do we want to see and enjoy? Do we all want all the ecological plays to be permanently in the last act—the climax vegetation, whatever that is? Or do we want as much of the ecological play of Gabriola Island represented as possible?

Integral to this task is understanding the relationship of the ecological play, or the range of alternative plays that could occur on our ecological stages, to disturbance regimes. What level of "protection" and "preservation" is compatible with the ecological play(s) that we want to have on the island? We need to identify the types, scales, severities, frequencies, and spatial



What a Douglas fir stand should look like. The thick bark enables such trees to survive fires. Note the absence of saplings; the tree is using all of the available soil moisture.

Variable retention silviculture seeks to mimic natural ecosystems by selecting such trees for retention as seed trees rather than selecting seed trees arbitrarily.

patterns of disturbance that will deliver the desired ecological play, and employ (involve) the desired ecological actors (species).

Once we have done this, we have to assess the social acceptability of our ecology-based choices. Many of these may be socially unacceptable. Then there has to be reconciliation between social and environmental considerations; a compromise between what environmentally-focused individuals and socially-focused individuals would like, and what is socially and ecologically possible.

Questions that need attention

In developing an environmental ethic, in deciding what constitutes sustainability and stewardship, and in applying these concepts in land use planning, there are several difficult questions that must be addressed. These include:

- at what spatial scale would one develop an environmental ethic? For the Gulf Islands as a geographical area? For Gabriola Island alone? For our individual properties?
- how do we balance the personal values we as individuals hold today against the overall ecology of Gabriola Island, the Gulf Islands, the Douglas-fir zone, the province, and Canada?
- who decides what the values are and how to define what is ethical?
- how do we accommodate the essential ecological element of disturbance, diversity, and change when most people want constancy, aesthetics, and minimal disturbance?

Spatial scale

On the question of spatial scale, certainly, the ethics of maintaining soil physical, biological, and fertility characteristics would seem to apply everywhere, yet there are examples where maintaining the habitat of certain rare plants requires soil conditions that, taken in isolation, might be judged to be unethical. The more this question is examined, the more one may conclude that diversity in soil conditions may be a desirable goal, as long as the landscape pattern of these conditions and their relationship to landscape ecosystem function is consistent with overall environmental goals, and so long as changes to soil conditions are not “permanent”, other than

Another example of the wrong play on the Gulf Islands (Cortes Island). The upper picture is in normal lighting, the lower one is as seen through a red filter. The darker vegetation is healthy green growth, but the lighter vegetation is dead or dying.

This maladapted forest was created by logging the tall Douglas firs that provided shade for the understory of hemlock and cedar. With the shade gone, the understory thrived, but only up until there was drought. Most of the remaining forest then died.

the loss of soil parent material (bedrock or till). Thus, the question of the spatial scale at which planning will be done is of great importance. This poses difficulties because of the fragmented private ownership of the landscape, and emphasizes the benefits of trying to keep some extensive areas in community control.

Personal values

What we may desire for our own properties could contribute to an overall landscape mosaic that is not optimal for the ecology of

the island if everyone wanted the same set of conditions. Fortunately, there is a great diversity in the values people want. Some want open farmland, some want closed, old forest. Others want a mosaic of tree stands and openings, particularly if the latter afford distant views. Yet others enjoy younger forests.

The fact that there is so much social diversity and that this is expressed in different land uses is one of the great attractions of the Gulf Islands. Because we cannot always anticipate future changes, it would be risky to do one thing over large portions of the island—whether this be imposed by local government regulation, or by private actions—even if this were to be within some regional or provincial plan.

Who decides

There is a great diversity in most communities in what people think is beautiful, desirable, sustainable, and even ethical. If diversity is good, as most people seem to think it is, this social diversity should be welcomed, and indeed it may result in maximizing the overall ecosystem diversity and biotic community diversity on Gabriola Island. If the entire community agreed on a single desired ecosystem condition and land use, the biological and ecological diversity of the island would decline. While this diversity makes local governance difficult and can be a divisive element in the human community, the chances are that it is very good for the island's ecology.

Leaving it be

How we accommodate the essential ecological element of disturbance, diversity, and change when most people want constancy, aesthetics, and minimal disturbance may be the most difficult issue.

If we wish to enjoy all the acts of all the ecological plays that are possible and desirable, we will have to find ways of sustaining the ecological consequences of past natural and human-caused disturbances that we generally do not want, and try to prevent. We need to find ways that are socially acceptable and which create sufficient ecosystem disturbance to emulate past natural events

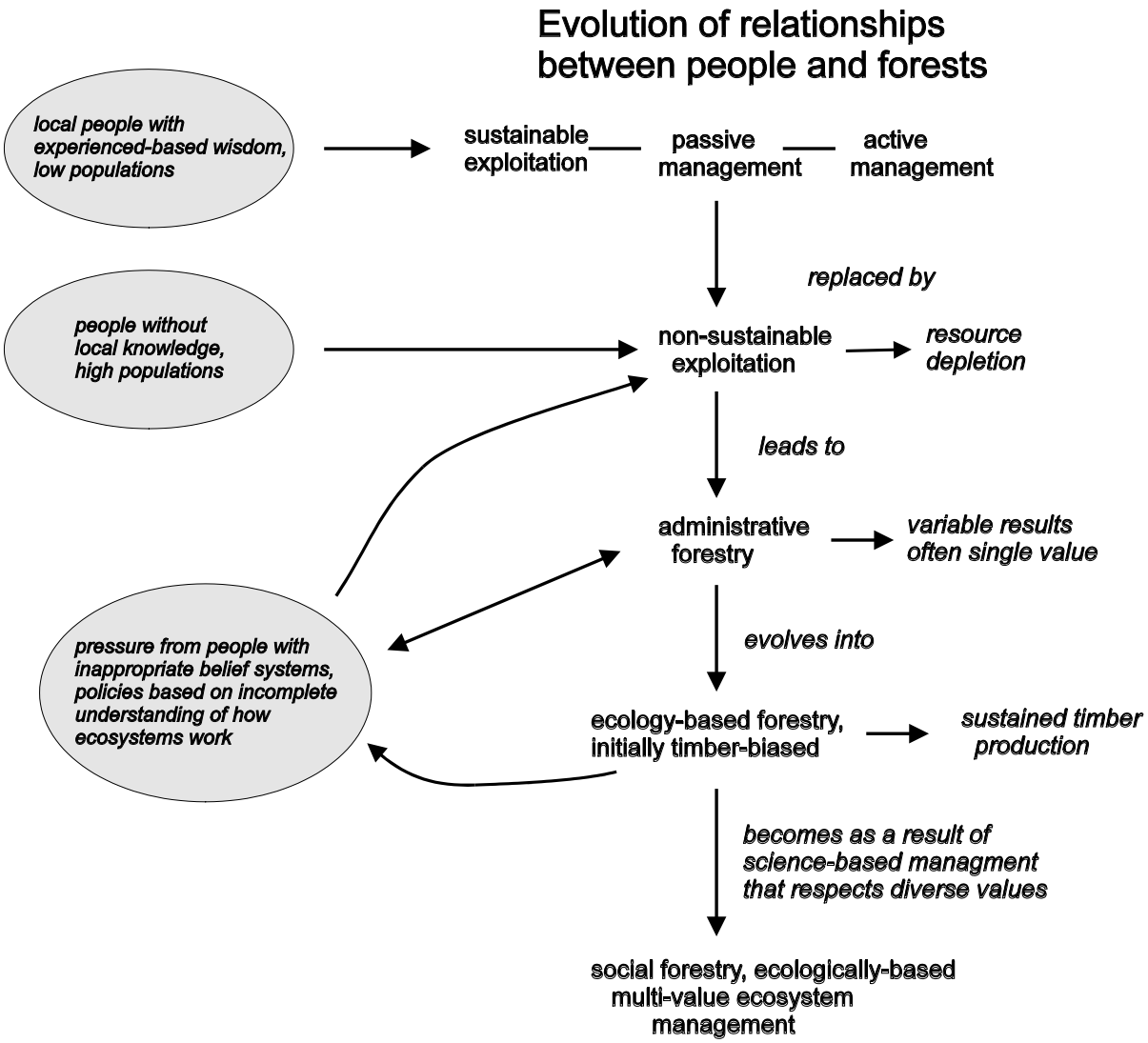
There are no easy answers, only complex questions. And we must deal with complexity if we are to achieve ethical land use and management—both socially and environmentally. As Albert Einstein said, answers and theories should be "as simple as possible, but no simpler". This echoes the wisdom of William of Occam in the 13th century; answers should be "as simple as possible, but as complex as necessary".

Closing note, and guidance from Aldo Leopold, author of *the Land Ethic*

Aldo Leopold, the modern grandfather of thought on conservation and environmental ethics, noted in his book, *A Sand County Almanac—with essays on conservation from Round River*:

- a thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise; but
- the evolution of a land ethic is an intellectual as well as emotional process. Conservation is paved with good intentions, which prove to be futile or even dangerous because they are devoid of critical understanding either of the land, or of economic land-use.

The first of these quotes has been widely reproduced, but often without any



understanding of what Leopold intended when he used the words: "integrity", "stability", and "beauty". Elsewhere in his writing, it is clear that he understood the dynamic and ever-changing character of ecosystems, and that ecological integrity refers to the maintenance of ecosystem processes, not the preservation of species lists, or any individual ecological condition unchanged.

By stability, he was referring to non-declining change at the local level and a shifting mosaic of local change of fairly constant overall character if evaluated at sufficiently large spatial scale.

By beauty, he was referring to the ecological "beauty" of ecosystem complexity, diversity, function, resilience, and, when considered at the appropriate temporal scale, continuity, rather than aesthetic beauty alone.

The history of forestry, as depicted above, shows continual change that has matched the changing social pressures and desires with respect to the management of forest ecosystems. This change has not always

been linear and logical. It has periodically been interrupted by periods of social unrest and by the development of pressure from groups espousing belief systems about nature that failed to reflect nature's diversity and the current understanding and experience of nature. Developers of ethical, sustainable land use and conservation practices for the Gulf Islands in general, and Gabriola in particular, would be wise to reflect on the dangers of ignoring the lessons of this history. ◊

Suggested readings

I have chosen not to reference in the text the concepts and ideas presented in this paper. They are from the following published material where you can find links to the literature from which the ideas were derived. These are all my own works, but each of them is a review of the relevant literature by a wide diversity of authors.

J.P. Kimmins, *Forest Ecology: A foundation for sustainable forest management and environmental ethics in forestry*, Third Edition. Upper Saddle River, NJ: Pearson/Prentice Hall, 2004.

H. Kimmins, *Balancing Act: Environmental issues in forestry*. Second Edition. Vancouver: UBC Press, 1979.

J.P. Kimmins, C. Welham, B. Seely, M. Meitner, R. Rempel, and T. Sullivan, *Science in Forestry. Why does it sometimes disappoint or even fail us?* Forestry Chronicle, 81, pp.723–34, 2005.

J.P. Kimmins, *Forest Ecology*, in S.B. Watts and L. Tolland (eds.), *Forestry Handbook for British Columbia*, Fifth Edition, pp.433–471. Vancouver BC: University of British Columbia Forestry Undergraduate Society.

J.P. Kimmins, *Forest Ecology*: *The study of the ecological (spatial), biological and temporal diversity of forest ecosystems*, in T.G. Northcote and G. F. Hartman (eds.), *Fishes and Forestry*, pp.19–43. Oxford: Worldwide Watershed Interactions and Management, 2004.

J.P. Kimmins, *Emulation of natural forest disturbance. What does this mean?* in A.H. Perrera, L.J. Buse, and M. Weber, (eds.), *Emulating Natural Forest Landscape Disturbances*: *Concepts and Application*, pp.8–28. New York: Columbia University Press, 2004.

H. Kimmins, *Sustainability: a focus on forestry and forestry*, in P.N. Nemetz (ed.), *Sustainable Resource Management: Reality or Illusion?* Journal of Business Administration and Policy Analysis, vol. 30–1, pp 303–338, 2003/4.

J.P. Kimmins, *Future shock in forestry. Where have we come from; where are we going; is there a right way to manage forests? Lessons from Thoreau, Leopold, Toffler, Botkin and Nature.* Forest Chronicle 78:263–271, 2002.

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