Fish and Wildlife in a Changing Climate: Options for Future Management Practices.

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FORREX
Supporting Sustainable Natural Resource Management Decisions

What Paradigm Needs Shifting Anyway?

We now have, at planetary scale, overwhelming evidence that the magnitude of human appropriation of ecosystem benefits is having enormously destructive effects. Our strategy as a species appears to be to expand our populations and their consumption of natural capital to the limits of space, energy, food, water and materials. Our cultures and our civilizations have repeatedly boomed and crashed as limits have been breached, as cumulative ecological footprints have exhausted the resources on which they ultimately depended for continuity or run headlong into one of the earth's periodic climate fluctuations. As the first decade of the twenty first century nears its end, we are desperately trying to resuscitate a system of continuous growth in consumption and worrying about how we are to feed 9 billion people at socially defensible levels of equity. No species population, human or otherwise, that adopts such a long term strategy has ever been able to escape limits. A species with long term continuity must at some juncture be molded by the functional necessity of engaging in a balance between growth and decay that stops short of killing the host system, being contained within a co-evolved and multifaceted ecology. As a result they have become integral partners in complex ecosystems, adapting to the fluctuations of a fickle supply of natural capital, or, failing the effort, they have become marginal or extinct.

Our current industrial civilization operates on the assumption that there are no limits to growth of population and consumption that cannot be overcome through technological innovation and the influences of an impersonal market. The paradigm in which we are now embedded depends on continuous growth, continuous accumulation and concentration of wealth, continuous export of environmental disbenefits, and continuous substitution of energy sources and materials for those that have been rendered in short supply. Dissonant facts are accumulating that challenge that governing paradigm, ones that are now familiar to all of us, thought still disingenuously denied by some. Dangerous climate change is under way. Positive feedbacks to global warming have been engendered. Biophysical consequences are threatening shortages of water and food. Forests are declining. Biodiversity is diminishing.

Oceanic fish stocks are declining. Sea level is rising. Industrial poisons are ubiquitous. Wealth and consumption are vastly inequitable. Fossil energy sources are finite and their use is contributory to climate change. The cumulative challenges to our current paradigm suggest that another must rise to take its place. A future paradigm might well operate on the assumption that our present civilization must accommodate itself to real and periodically fluctuating limits to growth and that population and consumption must be scaled to lie within the sustained carrying capacity of the earth. We would then depend on a steady state economy, recycling of materials, carbon neutral energy supplies and stable populations with equitably distributed wealth, all flexibly managed with sufficient buffers to enable us to adapt to biophysical changes truly beyond human intervention. That's all!

Of course, our new paradigm might well be one of runaway climate change, collapse of agriculture, mass starvation, violent conflict, ruined oceans, eroded soils, mass extinctions, human depopulation and collapse of industrial civilization. It would be nice to avoid that one!

What are the imperatives if we desire a benign future rather than a catastrophic one? Bring CO2 in the atmosphere into the range of 300-350ppm to forestall uncontrollable positive feedback. Manage terrestrial and aquatic ecosystems to arrest the loss of biodiversity. Bring human population and consumption into balance with the carrying capacity of our natural capital. Distribute the ecologically sustainable economic wealth of the planet equitably. A modest agenda, indeed!

British Columbia: Two Great Waves of Change

There are two great waves of change sweeping across the province of British Columbia that challenge our ability to forestall losses of biodiversity and, in particular, individual species at risk. The first if these, of course, is climate change. Progressive warming of the earth's climate is evident in BC with elevated winter temperatures, retreat of glaciers, changes in hydrology of streams, changes in animal behaviour, incidence of catastrophic wildfire and the release of

forest pests whose populations were in the past limited by extreme winter conditions.

Arguments about the precise balance among contributing forcings, or the regional variability of the many historically active climatic factors that are influenced by global heating, do not need to be fully decided to recognize that significant changes are taking place that will affect the ecology of the province.

The second great wave is the progressive expansion of the human ecological footprint on the land. Forest harvesting-mineral extraction-fossil and renewable energy development; expanding habitation and motorized or resort based recreation, among many others, all demand an increasing allocation of land and natural resources to intensive human use. Accompanying all of these are land conversions: roads, seismic lines, pipelines, transmission corridors, flooding, vegetation removal, habitat fragmentation, fencing, ecosystem simplification, invasions by foreign species, chemicals, noise and expanding consumption of species and ecosystem services. Beyond land conversions is the continuing alienation of crown land to private ownership or resource tenures where the potential for ecosystematic impacts may lie beyond effective public scrutiny or timely influence. This human appetite of ours is being credited with an unprecedented rate of global extinctions. The two great waves are the context in which the province is expected to confront the conservation of species at risk in particular, conservation of biodiversity in general and ecosystem based management as an approach to the appropriation of natural capital.

In British Columbia, however, we are still mesmerized by the cornucopia of natural capital resources that we found as recently-arrived colonial administrators and quickly locked into the perpetual growth paradigm. Our resource management agencies are still based on the premise that their fundamental role is to be the agents of asset distribution and the collectors of taxes from the beneficiaries of tenure arrangements. Tacked on to this basic role definition is an accumulation of land and environmental management requirements, acquired over decades, silo-specific, and extraordinarily difficult to integrate in practice.

At best they represent efforts to keep the natural capital cornucopia's individual resources in production for the continued benefit of tenure holders and the public purse. At worst they conspire to prevent the imposition of voluntary or mandatory limits on our economic aspirations.

Our land units are still organized around resource extraction zones. This is reflected in our resource management language, even to the extent that we still characterize the complexity of forests as "Timber Supply Areas" though they are also the source of carbon sequestration, potable water, edible plants, community viewscapes, cultural context, wilderness experiences, public recreation, guide-outfitting, trapping, mineral and energy extraction, and the critical habitat of a host of threatened species. As we have become aware of the toll this approach has taken on the biophysical systems of the planet, we are now trying to answer the wages of our industrial appetite by layering yet more tenures of natural capital assets over the provincial landscape. Independent power and biofuel tenures are examples of this model of asset management, based in practice on distributing rate-of-return benefits to investors for whom maintenance of the underlying ecosystems is a cost of doing business that has to be balanced against the interests of shareholders for acceptable profits. We intend to save the province from overuse of resources by allocating even more of them to new aspirants. Even where we have established tenures with the potential for stewardship as a defining characteristic, such as community forests, we are still administering them primarily as timber supply units.

There are two specific areas where the outdated paradigm of land management into which we have fallen challenges our ability to solve widely recognized problems: first is the increasing numbers of species at risk and second is the cumulative impact of increasing resource use. To deal with the assault on biodiversity we need to address the properly functioning condition of all of our natural ecosystems rather than to focus on single elements. To deal with our burgeoning cumulative impact on natural capital we need to address how we manage our use of the land, not just to whom access to one of its exploitable elements is tenured. Prospects for any positive outcomes from adopting either of these strategies are completely dependent on us having the wit to reverse carbon

build up in the atmosphere and to reduce our collective footprint. In the context of the juggernaut of climate change, we must try to become integral partners in complex ecosystems, lest we in due course become extinct! In effect we will either voluntarily adopt a paradigm more suitable to a limited earth or be forced to do so by events.

Given such a modest agenda for the planet and the province, what could be contributed by British Columbia in the process of mitigation and the necessary effort to adapt to changes already in train?

Hitting the Complexity Wall

In the short term the province is undertaking to recover or prevent continuing decline of populations of species that are sufficiently visible and charismatic to the public, notably Mountain Caribou. Like all other species, Mt. Caribou are enmeshed in an extremely complex web of biophysical relationships within their habitat. These include climatic conditions, snow depths, thermal cover, food supply, calving nutrition, parasites, predators, competing ungulates, escape terrain, movement corridors and human intrusion. We are being asked to consider how to manipulate parts of this complex web to make it more favourable to a single species. It is very unlikely that this can be done successfully on a single species basis because with each Caribou enhancing intervention we disturb some other biophysical feature that influences the well-being of many other species. If we kill wolves to reduce mortality of Caribou the reduction of wolves also affects deer, moose and elk populations, which in turn affects vegetation patterns, which in turn affects bird populations, which in turn affects insect and rodent populations and so on. If we develop individualized recovery actions for a growing list of threatened species at the same time, on the same landscape we risk a rapidly approaching gridlock of counterproductive and competing prescriptions – biophysical, socioeconomic or indeed, even moral chaos.

Approaching the consequences of the two great waves of change on an individual species basis is an expensive folly, at best a public relations exercise, destined for ephemeral gains or technical failure. Recovery and sustained maintenance of individual species will require a holistic approach at a sufficiently large scale to maintain the properly functioning condition of the ecological webs of life on which all species depend.

We are very unlikely to be capable of tinkering effectively with the life conditions of popular species that naturally interact with numbers of other socially visible species – (Caribou, Wolf, Bear, Cougar, Deer, Elk, Moose) let alone with the many others whose ecological characteristics remain un-researched. In this situation we are like the young Harry Potter, wielding spells for which we do not know the full consequences and do not know how to reverse the effects if we get unintended results.

Dealing with the Human Footprint

The only long term strategy within human grasp that is consistent with ecological reality is to ameliorate the consequences of the two great waves of change, by limiting human influence on climate change and by limiting the impact of the human ecological footprint. Influencing climate change materially is beyond the scope of actions that can be taken solely within British Columbia. We can make a contribution, but we cannot reverse global trends alone. What is within our local grasp is our own human footprint and it is there that our efforts to conserve ecosystem functions, biodiversity and individual species can be profitably focused.

Achieving a human footprint of low environmental consequence is our major challenge. What has to be conserved is the properly functioning condition of the ecosystems of the province that are the biophysical habitat of our stock of species and our only legitimate source of ecological services. We are currently supplementing our own stocks, because we are rich enough to do so, by importing from elsewhere, (our phantom footprint, as it is known) but in the long term this is both unlikely to be sustained and will certainly be morally indefensible.

If we continue the current trend of progressively and permanently altering the vast majority of our landscapes and focus only on heroic efforts to recover a few charismatic species, we will be on a never-ending retreat slope of declining biodiversity.

What would it take to reverse this trend?

A Grand Strategy

There are both conservation and management practice elements in a footprint limiting strategy. As a conservative first step, we must identify and locate our diverse stock of ecosystem types and ensure that we target an ecologically representative and functionally effective extent of them for active conservation in their natural state. Within those ecosystem types and areas that our economy must continue to exploit for natural resources we need to ensure that our habitat altering intrusions are as limited in extent and of as short duration as possible, leaving exploited land fallow long enough for ecological succession to recover natural function – even if that will be different in a future climatic regime. Natural resource technology and management must progress to lighten impacts of our systems of extraction and must progress to mimic or restore natural conditions. In a process of ecosystem based management, natural resource development is designed to maintain the properly functioning condition of the exploited ecosystems – retrieving the interest on natural capital but leaving that capital resilient enough to recover. Ecological capital is not only the physical attributes of the land and the species inhabiting it, but also the co-evolved web of relationships that binds them together. Of course, in the end, this means accepting limits, accepting that perpetual growth in material consumption is a pathology that must be abandoned. It also means stopping well short of limits, leaving a buffer of capacity as a hedge against the climate changes that are already evident, the changes that appear now to be inevitable and the unpredictable changes that a volatile planet may still deliver.

Strategic Details

T o effect this strategy, we must act with sufficient restraint to limit our continuous intervention in all areas of landscape. Land restoration, fallowing, access prohibition, hunting restriction, habitation boundary limitation – all decidedly unpopular or expensive in our North American society – must be given consideration.

As a matter of strategy we must consider how heroic efforts on behalf of individual species fit into the larger ecosystem conservation picture. Social or legal imperatives will occasionally make it necessary to expend major efforts to prevent a single species from being extirpated or rendered extinct. Sometimes this will mean attempting to reverse the flow of circumstances that are happening at the scale of the great waves of change. Some species will not be conserved by the efforts to reserve representative ecosystems from exploitation or to soften the impact of combinations of industrial, habitation, transport and recreational use. We have to be able to choose when and how to make the significant investments and to take the web-disturbing risks on behalf of individual species, in effect making the social judgment to intervene on behalf of a single species where our landscape scale investments have proved insufficient. Sometimes we will find ourselves trapped into killing Golden Eagles to save a breeding population of marmots!

There are at least three components to such a choice: which species to address, popular will to make the expenditure and to endure the land use limitations, and the scientific knowledge that would make interventions in the web of life technically feasible in specific locations.

Which species should we address? Suggestions range from those with a popular following evidenced by environmental group campaigns to those that have keystone ecological functions with major influence on the viability of many other species, to indicator species that are particularly sensitive to ecological change, to those whose range is exclusive to the province, to those for which the province has significant core populations of regional, national or continental importance, to those which have a reasonable prospect of recovery to self-replicating

condition or simply those that are demonstrably in decline. Choosing which combination of characteristics to employ is a political/technical matter of great complexity.

What science is required to assist decision-making? Making an investment in single species recovery has to have a strategic rationale that makes ecological and evolutionary sense, a rationale that can withstand the predictable repugnance for the potentially necessary triage decisions and that can stand above the ebb and flow of popular campaigns. Scientifically determined ecological importance, feasibility of successful intervention in the light of habitat conditions and efficacy of particular action programs are the bedrock. Socio-economic costs and benefits, as the political dimension, can only be estimated if the scientific dimension is in place.

What cost is supportable? The cost of individual species recovery operations has to be justified by the ecological importance of the species, the technical potential for meaningful results and the popular will to bear the socioeconomic consequences of proposed actions. This political judgment needs to be informed by the overall strategy for ecosystem based conservation and the state of its implementation. Making significant investments in the recovery of individual species in the absence of the larger ecosystem based strategy is likely to be wasted effort of very short term value. The principle involved in making a species specific investment is that it should enhance and complement the province's effort to take care of its whole environment rather than stand alone as a gesture to popular pressures or response to narrow legal requirements.

What land use restrictions are supportable? British Columbia is already employing land use practice codes and restrictions to address the land footprint. Forestry clear-cut sizes, retention harvest systems, reforestation provenance requirements, road deactivation, inter-sector resource road rationalization, land use plans, mine reclamation, riparian zone practices, environmental assessments, pesticide regulation, wildlife habitat areas and protected areas are among the examples. These and other similar devices are proliferating but need to be coordinated and enhanced to better provide for ecological representation and to

better reflect the concept of maintaining the properly functioning condition of all exploited ecosystems. We are still satisfying ourselves with the convenient fiction that we can zone the landscape into a small proportion of protected areas and a large proportion of single use dominated areas, where commercial exploitation can take precedence over sustaining ecological balance as though the differing land classes are not functionally connected and interdependent. Effective coordination will require that we alter our land management paradigm of "asset allocation to silo based interests" to one of "holistic asset management for perpetual ecosystem health".

This is not a superficial change, but one that substitutes a culture of perpetual growth in consumption with a culture of steady state balance, a form of human commerce for which we will have to invent a new language and new indicators of societal success. We will have to deploy our land managers to real places and make them primarily managers of ecosystem sustainability rather than managers of extraction.

Implications for our Mountain Caribou Recovery Effort

What are the implications for a species like Mountain Caribou? Heroic efforts to maintain or enhance populations of Mountain Caribou are subject to the strategic criteria. Will our current system of protected areas, habitat reserves and landscape management efforts maintain sufficient intact ecosystems to permit survival of representative viable self-sustaining populations?

Are Caribou of ecological importance throughout their current range? Do all their existing populations have a scientifically substantiated potential of viable recovery in the light of progressive climate change and its related northward habitat drift?

Do we have the landscape assessment and management tools in place to deal with the impacts of the human footprint in all areas of current population? Can we intervene successfully in their habitat and population dynamics without an endless circular retreat before the impacts on other species engaged in their ecological web?

If we bear the costs of heroic efforts on behalf of Caribou populations will this forestall similar efforts for other worthy or ecologically important species? For which populations can we make a sufficiently compelling case for the investment – all, some or none?

Do we have the mechanisms in place for consultation with the public that can effectively blend popular values with the intervention activities justified by science? In the end, do we have the strategic rationale sufficiently articulated to enable difficult political decisions to be made about levels of investment or triage?

Our current Caribou Recovery Strategy deserves much credit for trying to make this difficult equation work in practice.

Single Species Gridlock

Asking government to make investment decisions, one at a time, on a continuing array of threatened species, Spotted Owls yesterday, Caribou today, Murrelets the day after, Goshawks next week, Grizzlies next month and Yellow-breasted Chat next year is a recipe for paralysis of will and gridlock on the ground. When we are done with the high profile species that have effective advocates we will then have to deal with the common ones whose range and populations are declining, Black Bears today, Mountain Goats tomorrow, Herons the next day…ad infinitum – and this is just for the large and visible wildlife. Imagine the complexity if we move on to mycorrhizal fungi, rare medicinal plants or decomposition bacteria in the soil!

First let's make sure that our sustaining ecosystems are on board the ark, then we can mop up with the species that spilled out of them on the way up the gang plank!

"A future paradigm might well operate on the assumption that our present civilization must accommodate itself to real and periodically fluctuating limits to growth and that population and consumption must be scaled to lie within the sustained carrying capacity of the earth."

What would it take to begin this transformation in British Columbia?

Design Criteria for a model

"Manage the cumulative human footprint on the provincial landscape to preserve the properly functioning condition of our ecosystems and maintain our biodiversity while earning a living through the development of natural capital assets and appropriation of ecosystem services within the sustained carrying capacity of our environment."

Landscape Management Units

Using existing landscape units as a base for establishing ecologically and socio-geographically defined land and water units within which the appropriation of ecosystem benefits and natural capital is to be managed sustainably. Embed communities within the units where geographically appropriate

Complete Inventory and Monitoring

Within each unit establish an ongoing inventory and monitoring program to characterize and quantify the stock of natural capital assets, the complement of existing land and resource uses, potentially developable assets, operating ecological processes, existing biodiversity and the nature and pace of climate change effects to provide an accurate picture of the state of the unit. Publish periodic state of the unit reports.

Land Use Plans

Renew public land use plans, attaching them to the landscape unit level, with ongoing engagement processes to keep the plans relevant and capable of reflecting changing socio-economic and ecological conditions. Engage embedded communities in the ongoing stewardship functions as part of their civic responsibilities.

Resident Managers

Site resource managers in the unit, charging them with becoming intimately familiar with all aspects of the biota, ecological conditions, human uses and emerging demands on natural capital

Properly Functioning Condition

Charge the resident managers with developing an understanding of the "properly functioning condition" of the ecosystems of their units and the array of forces that may be occurring from human or other causes that may be altering that condition

Carrying Capacity and Development Demand

Charge the managers of the units with balancing existing and newly emerging demands for human appropriation of assets from the unit with their studied estimates of the unit's carrying capacity for the total cumulative human demand

Employ the Full Array of Land Management Tools

Enable resident land managers to employ the full array of management tools, including reserves, practice regimes, and management of access, habitat, fire, pest and pathogen controls necessary to sustain the integrity of the unit and its overall productivity of ecological services and to maintain a buffer capacity to guard against destabilizing change

Recovery Programs

Design ecosystem and species restoration and recovery programs to fit within the particular conditions of land units or groups of land units

Unitary Authority

Attach the managers to a unitary authority that has the mandate to approve or disapprove human demands on the unit based on the state of the unit, the degree to which carrying capacity is loaded and any material threats to conserving properly functioning condition of the unit's ecosystems

Empower the authority to link the management of adjacent units to achieve objectives for conservation of the ecological integrity and balanced human use of the larger landscape or to achieve particular restoration or recovery programs