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Gap analysis in conservation planning for cultural & less culturally modified landscapes: Prospects for northern Garry oak ecosystems in British Columbia

Gap analysis in biodiversity conservation planning has been largely based on notions of natural ecosystems unmodified by human beings. However, landscapes that have been partially created by aboriginal societies are increasingly recognized in North America and in other parts of the world. There have been few protocols for describing both cultural and less human-modified associations and other ecosystem sub-classifications. This `gap' in theory and method has direct implications for gap analysis in biodiversity conservation planning. This discussion reviews what is known about the evolution of northern Garry oak ecosystems south-western British Columbia. The history of classification of northern Garry oak ecosystems is reviewed along with evidence of prehistoric human impacts. At various points in the last 5,000 years, some complexes of species became largely associated with cultural modification – at least in certain areas and climatic and social periods. Since Europeans began to engage in these ecosystems in 1792, a series of land use changes have further transformed these ecosystems whether they were relatively natural or culturally modified. Today, many of the protected portions of these landscapes are the subjects of ecosystem restoration programmes involving control of invasive species, reintroduction of burning, and maintenance of the full range of successional conditions. Significant gaps remain in the network of protected examples of northern Garry ecosystems – including for the culturally modified portions. This discussion explores the implications of three so far under-utilized bodies of theory and practice for setting priorities for new acquisition of land for more complete and secure protection of the biological diversity of northern Garry oak ecosystems in south-western British Columbia: biodiversity conservation for culturally modified landscapes; rapid biodiversity appraisal, and gap analysis. We explore methods for setting priorities for identifying gaps in biodiversity conservation that span the range of relatively natural to the heavily cultural modified.

keywords:
Northern Garry oak ecosystems; culturally modified ecosystems; aboriginal impacts; biodiversity conservation planning, Rapid Biodiversity Appraisal (RBA); gap analysis

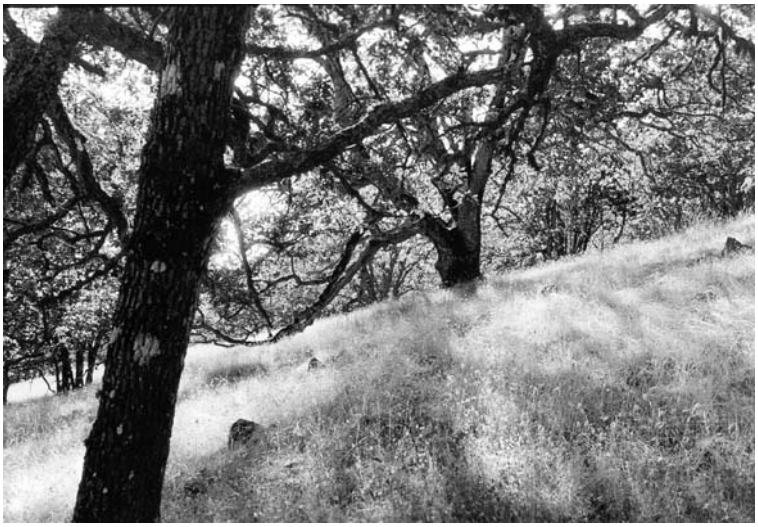

figure 1. Garry oak meadow, Mount Maxwell, 6 1979, photograph by Ingram
This site has a well-established history of aboriginal modification extending into the early 20th Century, was acquired by the Nature Conservancy in 2001 and has recently been made part of an expanded ecological reserve.

INTRODUCTION

The 1992 anthem, If I Had a Million Dollars by The Barenaked Ladies, mentions various things that people can do on receiving large sums of money. However, the song did not mention purchasing land and related rights for the protection of critical habitat, a set of activities that has accelerated over the last decade. Today, agencies, organisations and individuals are increasingly making decisions, over short periods with time constraints, involving large sums of money for acquisition and protection of what are thought to be parcels of land with the most important, vulnerable, under-represented habitat and associated elements of biological diversity. Such priorities for expanding systems of habitat protection represent a cumulative response to the monitoring of the effectiveness of current programmes biological conservation for particular ecosystems. While there are often years of reports and recommendations for landscapes, sites and properties most warranting protection and acquisition, the actual arrival of funds can be abrupt, disruptive and involve additional priorities.

Northern Garry oak ecosystems in Canada (figure 1) have been one of three bioregions that have been subjects of ecosystem recovery initiatives that since 2003 have been increasingly linked to work under the *Species At Risk Act* (SARA). While protection, management and restoration of habitat modified by aboriginal land use practices comprise a growing, but poorly resolved, set of concerns for biological conservation, little of this movement has had an impact on the conservation strategies for northern Garry oak ecosystems. For many areas of our country, where aboriginal population densities have probably always been low, culturally modified landscapes can best be understood in terms of a small number of relationships with particular species along with practices such as burning. But in this example from the Strait of Georgia, an area sometimes referred to as the Salish Sea, there were more site-specific impacts

associated with year-round and seasonal aboriginal settlements and intensive forms of plant harvesting that involved some characteristics of agriculture. This somewhat anomalous example for Western Canada has more similarities with aboriginal cultures in central and southern North America as well as with many island dwelling societies in the Pacific Rim. In exploring the needs and prospects for better acknowledgement and accounting of culturally modified ecosystems and respective sites in "systematic conservation planning" (Margules & Pressey 2000) for protection of local biodiversity, we argue that the best way to begin is with the mission of this conference: expanding the means for monitoring the effectiveness of biological conservation. Exploring the relevance of the gradients spanning pre-colonial culturally modified sites and less humanly modified areas is the focus of this discussion.

While many culturally modified sites have been inadvertently conserved within the boundaries of protected and managed areas, other sites have been effectively disqualified from consideration for their obvious signs of human activity. The ideological and legal conflicts of the 1980s and 1990s have been largely resolved in favour of viewing Canadian landscapes as at least partly the results of aboriginal stewardship, a host of `gaps' remain in linking concerns for biodiversity conservation with preservation and restoration of certain aboriginal landscapes. For example, the implications of the confluence of better documentation of culturally modified landscapes, expanding aboriginal legal prospects around lands and resources, and the *2003 Species At Risk Act* have only begun to be explored.

With expectations increasing for the best use of public and private funds for biodiversity conservation, methods to better integrate both information and set priorities through more transparent and workable methods are worthwhile. We begin to explore the implications of three so far under-utilized bodies of theory and practice for setting priorities for new acquisition of land for more complete and secure protection of the biological diversity of northern Garry oak ecosystems in south-western British Columbia:

1. biodiversity conservation for culturally modified landscapes (in the context of broader programmes focused on more pristine habitats);
2. rapid biodiversity appraisal; and
3. gap analysis.

This discussion progresses through five parts. First we outline the most important natural and social factors that have been at work in northern Garry oak landscapes and reflect on the current status of processes and elements of these ecosystems. We explore the difficulties of reconciling the imperatives to preserve the more pristine of the remaining landscapes of Garry oak ecosystems while, at the same, working to protect culturally modified sites to the extent of reintroducing traditional practices. Secondly, we explore contemporary theories of culturally modified landscapes and ecosystems along with some goals for protection and restoration. Thirdly, we explore the relevance of Rapid Biodiversity Appraisal (RBA) for a set of ecosystems that in Canada only exist in relatively small pockets in a corner of Canada (but which are far more widespread and diverse in the USA). The fourth section of this paper explores the relevance of gap analysis for biodiversity conservation planning with a focus ways to expand these

approaches to gradients of past and in some cases re-established cultural practices. We conclude this paper with an exploration of when and how to link these approaches to more effectively and credibly identify gaps in current biological conservation for northern Garry oak ecosystems so as to better know what parcels of land to acquire for when government agencies and nongovernmental organizations have another `million dollars'.

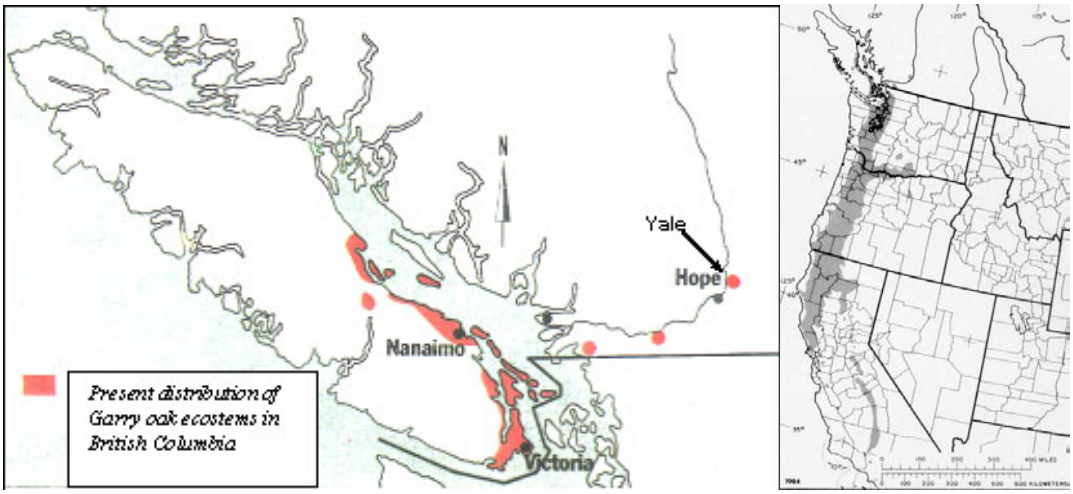

figure 2. (left) present distribution of Garry oak ecosystems in British Columbia (Erickson 1996)
figure 3. (right) the global distribution of Garry oak ecosystems

NORTHERN GARRY OAK ECOSYSTEMS: COMPONENTS, PROCESSES & STATUS

Variations on the Garry oak – Douglas fir savannah-woodland-forest ecosystem configuration extend south to California with the northern margins on some of the drier islands and mountain faces and valley bottoms in the extreme south-west of Canada (figure 2). In comparison to its total range (figure 3), the northern margins of Garry oak ecosystems of Canada are relatively low in species numbers. However within Western Canada, these ecosystems support some of the highest levels of species richness, especially in conjunction with marine and shore areas. These oak ecosystems, at 49 degrees latitude, also represent one of the more polar margins of such Mediterranean-like, summer drought woodlands. Here, as in much of the world, temperate maritime sites, with mild climates and summer water stress, are dominated by oaks and other drought-resistant perennials with adjacent, better-watered sites often supporting coniferous species.

The northern margins of Garry oak-dominated ecosystems can involve a range of canopy formations from grassland with very few trees to savannah to woodland. This far north, there are only three strata: herbaceous, shrub, and canopy trees. In contrast to some of the more mesic Garry oak habitats further south, the vine layer is nearly nonexistent with little or no poison oak. Instead, the under-story layer of Garry oak savannah and woodland dominated by a few shrubs, mosses and forbs. This third group often includes species of tubers and roots adapted to rapid activity in late winter and spring followed by

dormancy in the long, cool summer drought. Because the climate is so influenced by the 'Pacific High' the extent of the summer drought are highly variable between years. These abrupt fluctuations between years in the extent of summer water-stress and respective conditions for fire have varying impacts across the landscape in conjunction with aspect and soil conditions biomass partially determining where savannah, woodland or coniferous forest dominates and for how long.

A number of structural aspects of northern Garry oak ecosystems make elements of associated biodiversity more vulnerable than others – both in nature and through the impacts of land use. Ecosystems that are temperate and with summer drought are often termed fire-climax because some regular combustion is inevitable in drier and warmer years. Some species are better adapted to the summer drought and subsequent water deficit than others. Other species are more resilient to fire than others. A second characteristic of temperate, sub-humid summer drought ecosystems is that fire-resistant trees (with thick bark) tend to dominate. Of these ecosystems, northern Garry oak ecosystems are exceptional in the low diversity of tree species which in turn comprise such an exceptional portion of the biomass. Whereas California has scores of such fire-resistant tree species and shrubs, the major fire-resistant species this far north are the older specimens of Garry oaks and Douglas fir. A third characteristic of these ecosystems is that of long-standing dead wood. When trees die, they tend to take on new ecological roles as snags -- often for decades and sometimes in spite of fires. Garry oak and Douglas fir mosaics provide a diverse set of niches and habitats for a host of species associated with both the grazing (live plant) and the detritus (dead) food webs – if standing and fallen biomass is not removed. A fourth characteristic of cool, mild, fire-climax summer drought ecosystems is the crucial role of combustion in releasing nutrients trapped in biomass. Fire episodes embody one of the only processes for periodic and rapid release and redistribution of nutrients. And fire this far north has been one of the only forces that have countered the colonization of Douglas fir forest after a set of wetter years with less water-deficit in the summer.

In contrast to much of the larger areas of Garry oak woodland and Douglas fir forest mosaics at higher elevations in north-western California (Kuchler 1977) and southern Oregon, the mosaics even partially dominated by oaks around the Puget Sound (Kruckeberg 1991: 284 – 304) and Strait of Georgia are relatively small and highly fragmented spatial units. Today's northern Garry oak ecosystems, north of Olympia, Washington, are less than 10,000 years old although many of the constituting species, including this dominant tree species, probably occurred in parts of the region in warmer periods for millions of years.

NORTHERN GARRY OAK ECOSYSTEMS AS CULTURALLY MODIFIED LANDSCAPES

Human beings have been present and have generated impacts on the formation of the ecosystems of the Georgia Basin area since the end of the last glacial period – with a possibility of some earlier presence from marine-based cultures from around the North

Pacific. Subsequently, cultural developments and various waves of human migrations transformed ecosystems around the Strait of Georgia. Perhaps one of the best clues to the shifting increasingly cultural nature of northern Garry oak ecosystems, especially on Vancouver Island and the Gulf Islands, comes from pollen records (Pellat et al. 2001). After the melting of the last ice cap, 11,000 to 9,000 BP, the climate warmed quickly. There was rapid colonization by pioneer vegetation species such as Lodgepole pine and aspen (which today persists in small pockets including adjacent to Garry oak and Douglas fir). The suit of species that constitute the ecosystems today dominated by Douglas fir and Garry oak re-colonized the Gulf Island from the south. Throughout the glacial period, there remained Garry oak populations in lower elevations of Oregon and California. Sources of species of today's northern Garry oak ecosystems were mountain ranges that were not glaciated and with considerable environmental heterogeneity that provide genetic adaptations for the cooler, northern conditions. The Klamath Mountains in south-western Oregon and the Trinity Range in far north-western California have extensive complexes of ecosystems where Garry oak and Douglas fir often dominate. At the same time, species more associated with the plains and foothills of the arid West also colonized drier areas including the Gulf Islands.

By 7,500 BP, ecosystems dominated by Garry oak were established in the Georgia Basin and expanded in a climate than was warmer than that of today. It probably took other species, associated with the mosaics of Garry oak and Douglas fir, additional hundreds and thousands of years to colonize as far north and west as the Strait of Georgia. Garry oak has perhaps the heaviest seed of any species in the region and yet became established on islands that may well have been in isolation in the millennia after the last glacial retreat. That Garry oak is one of the few dominant trees in the region that also reproduces clonally has unexplored implications. Soon after Garry oak became established in its current northern margins, there was a cooling phase between 7,040 and 5,750 years BP and Douglas fir and Western hemlock increased. Curiously, the presence of Garry oak does not appear to have declined as the climate cooled further 5,750 – 3,800 BP. Some new force intensified at 3,800 – 1,050 BP. Oak appears to have increased as the climate cooled while fire, whether natural or aboriginal, increased markedly.

At various points in the last 5,000 years, some complexes of species and genotypes became largely associated with cultural modification – at least in certain areas and in specific climatic and social periods. In recent centuries, communities speaking Salish languages extended from central British Columbia south well into Oregon. While including a diversity of practices and technologies, Salish food production in the Gulf Islands centred on salmon fishing and the gathering of root crops, such as camas, *Camassia* spp., and wild onions, *Allium* spp., along with scores of other species. All of these root foods tended to thrive best in meadows particularly the sunnier sites that often have supported Garry oak. The Douglas fir forest was much lower in food plants though did provide some berries and were used for hunting. Salish tuber culture has some similarities to other island and coastal societies around the Pacific Rim. We have plenty

of historical and cultural confirmations of extensive digging and burning in northern island Garry oak ecosystems.

The landscape changes that were figured in the pollen analyses suggest the emergence of a culture of heavy use of Garry oak meadows combined with burning. This would have been consistent with the societies all through the range of Garry oak ecosystems where, for example, in Mendocino, these trees were carefully managed and owned. Acorns, including of Garry oak, were a major source of protein (Chestnut 1902: 343). Coast Salish cultures at the northern margins of Garry oak ecosystems may well have represented a cultural fusion where root crop digging and burning and fishing cultures met. But most of the time in recent centuries, salmon would have been a more readily available source of protein. Nancy Turner (1975: 81) gives the best description of what little reliance there was on acorns in the twentieth century – after over a century and half of population decline (Harris 1997). Significantly, Turner's report on the reliance on acorns for food was from Central Saanich where the streams had limited runs of salmon with respective habitat particularly vulnerable in warmer and drier periods.

Other than assuming that aboriginal population levels in the Strait of Georgia were much higher before the 1790s (Harris 1997) we have a very cursory knowledge of land use and impacts. Given that other Salish groups were actively engaged in planting and managing oak trees for food production much of today's remaining oak savannah the cultural knowledge from Central Saanich, that does not seem to have been recorded to the same extent for other Straits Salish communities (not that these questions have or could be posed uniformly) suggests the remnants of a proto-agricultural landscape produced by digging, burning and gathering. Most likely, the extent of gathering, digging, and burning may well have varied greatly with more impact before the nineteenth century.

In initially exploring the types of culturally modified forms of northern Garry oak ecosystems, some obvious practices, impacts and forms become apparent:

1. **sites of regular or seasonal habitation** with accumulated detritus and distinctive soils such as associated with shell middens;
2. **sites of regular digging and burning accessible to settlements and shore transport** which would have involved various kinds of savannah (figure 4) and even on more hydric sites;
3. **small islands where certain species were either absent or introduced** such as where packs of the now extinct, long-haired dogs were placed and, for example, where browsing would have been curtailed;
4. **sites with specific ecological conditions attracting specific harvesting, management and plants for useful species** as might be the case with nettle, *Urtica dioica*, which was important material for the making of cord or the 'Indian celery', *Lomatium naudicale*, a tonic and ceremonial plant today so often associated with aboriginal sites (figure 5);
5. **steep south and south-west facing slopes above where there was regular burning** that would have been transformed by the upward movement of the heat of burning; and

6. **sites with particular spiritual and ceremonial significance** which may have been modified by intensive but infrequent human presence.

Since Europeans began to engage in these ecosystems in 1792, a series of land use changes have further transformed these ecosystems whether they were relatively natural or culturally modified. However, many aboriginal communities in collaboration with scientists, ethnographers and historians often have enough data to map out the six categories of culturally modified sites listed above. Today, many of the protected portions of these landscapes are the subjects of ecosystem restoration programmes involving control of invasive species, reintroduction of burning, and maintenance of the full range of successional conditions. While many of the culturally modified sites listed above have been transformed, such maps of confirmed or probable cultural modification would guide restoration and ongoing management – especially where aboriginal communities were re-engaging with their landscapes outside of the boundaries of Indian Reserves. Since such sites may be crucial for the protection, survival and restoration of some species at risk, we will be able to increasingly blend a set of priorities for acquisition of additional habitat and its management and restoration for both biodiversity conservation and re-establishment of aboriginal land use practices.

After a century and a half of modern settlement and specifically suppression of burning, introduction of invasive species, agriculture and urbanization, the areas with Garry oak ecosystems that remain in Canada have shrunk by well over half if not three quarters.[1] Few large intact landscape units with Garry oak ecosystems have been included in protected areas and perhaps only a score of currently unprotected sites are available for expanded conservation and restoration programmes.[2] However, many tiny fragments of mosaics of Garry oak ecosystems remain available for some kind of conservation acquisition or covenant combined with restoration. The question looms large as to whether or not the goals of many such restoration endeavours should be to go back to some postulated natural state or to have cultural practices re-introduced. Similarly, the management of the numerous Indian Reserves that contain Garry oak ecosystems is a topic of growing interest to respective communities – as are possibilities of re-introducing traditional practices.

There is a growing body of thought on the costs of ignoring aboriginal impacts in the formation (and maintenance) of North American landscapes. William Cronon's 1995 essay (Cronon 1995), "The Trouble with Wilderness; or, Getting Back to the Wrong Nature," consolidated the sense of unease about ecosystem conservation and restoration that ignored aboriginal impacts. In his recent essay on the restoration priorities of the United States National Park Service, Dennis Martinez argued that the agency has a history of actively creating "wilderness" at the expense of the human cultures that were a part of cultural landscapes (Martinez 2003). Today, nature conservationists have theoretical space for divergent scientific perspectives which can (and should) be debated and can be combined with intercultural dialogues (Pritchard 2003: 256). But as with the pressures around management of Yellowstone National Park, setting practical management goals can be daunting. In the case of northern Garry oak ecosystems,

assertion of aboriginal priorities for the maintenance, management and cultural restoration of some of the still unprotected sites might provide an additional pillar to a protected area network. Indeed, some of the most distinct, diverse, and enigmatic Garry oak sites are on Indian Reserves where aboriginal leaders fought hard for ownership of and access to such places a century and a half ago. But as the title of this paper suggests, rather than a binary aboriginal and 'natural' division in these landscapes between less altered and more modified sites, there is more of a soft gradient of past impacts. The recent work on Chittenden Meadow, in the upper valley of south-western British Columbia, just north of some historic Garry oak meadows (now inundated by a dam), highlights the need for interdisciplinary case studies where the nature of aboriginal impacts, and the level of cultural modification if any, remains debatable and enigmatic (Lepofsky et al. 2003).


figure 4 (left). This is a well-documented 'field' with camas and *Lomatium nudicaule* habitat, adjacent to a historic village site and was used well into the second half of the 19th Century. Today, this is on the north side of Beacon Hill Park in central Victoria. photograph by Ingram, 22 April, 2004
figure 5 (right). *Lomatium nudicaule* adjacent to the Belly Rising Up site, Tsawout Nation, Central Saanich

RAPID BIODIVERSITY APPRAISAL (RBA) FOR NORTHERN GARRY OAK ECOSYSTEMS

RBA, initially labelled Rapid Rural Appraisal, was developed out of a host of methods in international development work to focus on the most important information that can lead to decision-making to alleviate health and related economic problems. Abbreviated research frameworks were developed containing relatively small numbers of biophysical and social data categories (typically under 100). Rapid Biodiversity Appraisal was first developed for relatively large areas, such as the Amazon Basin, with hundreds and thousands of poorly documented ecosystems and species, and where expanding land use activities threatened the continued existence of a host of biological resources. Methods were adapted from broader bodies of knowledge for ecological impact assessment and related use of indicator species (Faith and Walker 1996, Lambeck 1997, Carignan and Villard 2002). The core of RBA for conservation planning has been the question of which ecosystems and respective sites are most important for maintaining

local biological diversity and are most vulnerable to disappearance and extinction. Unfortunately, a hundred or two or three hundred pieces of data may not always be enough to answer this so central question in conservation planning. With RBA, there has also been a link to vegetation mapping and specifically to work on more precise spatial identification and descriptions of critical habitat.[3]

RBA was developed for large, biologically rich regions with relatively poor people and with conservation planning programmes that could not keep up with the needs for more information on species, ecosystems and land use – induced habitat change. To argue RBA's relevance for a small area (around the Strait of Georgia) with relatively wealthy people and extensive planning frameworks is ironic – and 'a bit of a stretch'. And RBA's relevance to conservation of biodiversity associated with culturally modified ecosystems remains poorly explored. But in going back to the question of 'if I had a million dollars', the current level of information exchange, discussion and decision-making has not recognized aboriginal landscapes – even where extensive legal exercises have generated millions of dollars of research. And after all the fine field work on Garry oak ecosystems and over a decade of legal linkages between indigenous communities and biodiversity conservation (Colchester 1994) extending to the *Convention on Biological Diversity* of which Canada is a party, there have been few discussions and no formats for describing and classifying indications of aboriginal modification in northern Garry oak ecosystems.

If we go back to the rapid appraisal movement as a response to social impoverishment, RBA for culturally modified Garry oak ecosystems could be viewed as part of a strategy to confront the chronic underdevelopment of aboriginal communities which has been further compounded by loss of knowledge of and links to traditional sites. A more sardonic perspective might suggest that it is biologists who are under-developed. So before we might be able to quickly spend that million or ten million dollars for acquiring new habitat for protection, it is prudent and necessary, to begin to ask researchers to answer ten or twenty questions related to assessing sites and broader landscapes for signs of possible aboriginal modification. Such work would create a bridge to questions being explored by archaeologists, ethnographers, historians and heritage conservationists.

THE RELEVANCE OF GAP ANALYSIS TO CONSERVATION OF CULTURALLY MODIFIED AND LESS MODIFIED NORTHERN GARRY OAK ECOSYSTEMS

The concept of "gap analysis" (Scott et al. 1990), much of which has been developed and applied to adjacent parts of the USA, has had a huge impact on conservation planning for biodiversity and related habitat[4]. To a large degree, today's work in assessment and monitoring of landscapes for biodiversity conservation planning is largely within the gap analysis paradigm (Stoms 2000).

So far, gap analysis in biodiversity conservation planning has been largely based on notions of natural ecosystems unmodified by human beings. Given that landscapes

partially created by aboriginal societies are increasingly recognized in North America and in other parts of the world, this is a good time to consider such ecosystems within broader gap analysis frameworks. Because of the diversity of ecosystem structures, species complexes, successional conditions and respective theoretical approaches, there have been few protocols for describing both cultural and less human-modified associations and other ecosystem sub-classifications. In turn, this 'gap' in theory and methods has had direct implications for priorities for the sites selected for acquisition and additional protection in biodiversity conservation planning exercises. And some culturally modified sites could provide critical habitat for some species and respective assemblages.

Typically, gap analysis involves development of a set of layers on elements of biological diversity and broader environmental relationships (classifications of ecosystems, associations, species, physical gradients, land use patterns, trends). Certainly, a layer related to aboriginal history could be integrated into such an exercise for northern Garry oak ecosystems. The obstacle, until recently, was that the impacts of aboriginal communities and practices were often viewed by biologists as difficult to confirm or classify and were even often considered deleterious to biodiversity rather than a distinct set of factors that could be maintained as part of an overall conservation strategy. To a large degree, this problem has passed as biologists have increasing employed relevant methods from the fields of archaeology, ethnography, and environmental history. However, with all the social data available, only small, site specific conservation planning exercises have ever been used in British Columbia.

figure 6. aerial photograph of the south-western face of Mount Maxwell and the north-western shore of Burgoyne Bay, Salt Spring Island, 22 May, 2001

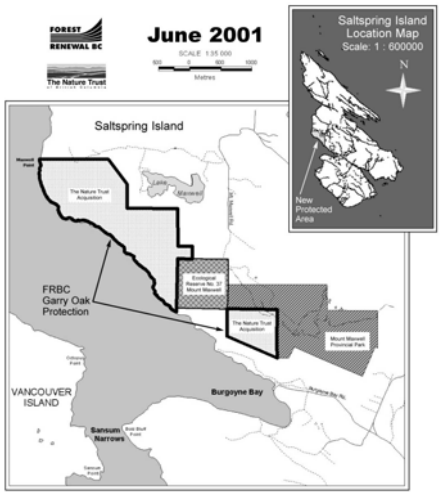

figure 7 (left). informal schematics of some biodiversity conservation priorities from the 1980s (Ingram)
figure 8 (right). The outcome of a conservation planning exercise involving federal and provincial agencies and Nature Trust that did not involve the acquisition of all of the culturally modified and documented archaeological sites.

PROSPECTS FOR BETTER ACKNOWLEGEMENT OF CULTURALLY MODIFIED PORTIONS OF NORTHERN GARRY OAK ECOSYSTEMS: CRITERIA, FORMATS & INFORMATION

This discussion embodies a simple, three-part solution for more comprehensive conservation planning for northern Garry oak ecosystems. First, biologists and conservation planners can focus on the information for identification of these culturally modified sites and portions of landscapes. Secondly, these culturally modified areas can be mapped and related to other Garry oak ecosystem classification systems currently being explored and applied. Thirdly, gaps in categories and viable areas can be identified through setting more precise conservation goals for such habitat units combined with an analysis of what is already in today's protected areas.

The following are some of the most important sources of information for identifying culturally modified Garry oak ecosystems inside and outside of protected areas:

1. analysis of presence of species associated with specific aboriginal practices, identification of indicator species, and identification of sites where those species exist today (or have existed);
2. archaeological data;
3. thorough reviews of current books in press and historical titles;
4. analysis of language and dialects especially for local aboriginal communities;
5. review of oral histories;
6. historical maps;
7. photographs (aerial and landscape over the last century and a half);

8. mapping landscape features related to attractiveness or convenience for aboriginal land use;
9. records of actual individual persons, events and sites;
10. incidental information from descriptions of parcels and sites such as from surveyor notebooks;
11. land management policy and historical files;
12. journals and personal letters;
13. newspaper articles and announcements; and
14. interdisciplinary assessments specifically focused on historic aboriginal land use (White 1999).

figure 9 (both photographs). Garry oak ecosystems, Belly Rising Up, Tsawout Nation (Indian Reserve), photograph by Ingram 22 June, 2004.

CONCLUSIONS:
BETTER LINKING KNOWLEDGE OF CULTURALLY MODIFIED LANDSCAPES TO MONITORING THE EFFECTIVENESS OF BIOLOGICAL CONSERVATION

If biologists and conservation planners in south-western British Columbia do not embark on new initiatives in acknowledging and monitoring the culturally modified aspects of Garry oak ecosystems, we risk two problems that could obstruct biodiversity conservation in the region. With an overwhelming body of ethnographic and historical information that confirms the existence of these culturally modification ecosystems, to further ignore or neglect the nature of these sites undermines credibility of researchers. Secondly, further ignoring the cultural modification of ecosystems would set in motion adversarial relationships and new, well-founded legal challenges by First Nations. Conservation planners and restorationists have yet to work with aboriginal governments begin to support the protection of culturally modified Garry oak ecosystems on Indian Reserve lands (figure 9).

In grappling with this complex set of questions spanning natural and social sciences, we have proposed a perhaps overly simplistic solution: better description and classification of cultural modified Garry oak ecosystems, an adapted RBA framework

with a small number of data fields to better identify such sites for further study and possible conservation, and creation of additional layers of spatial data on such landscapes within geographic information systems and related gap analysis frameworks. As crude as these proposals are, they would provide something of a credible basis for considering culturally modified Garry oak ecosystems the next time there is a million dollars for habitat acquisition and restoration.

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NOTES

[1] The best source of information on status for Garry oak ecosystems in Canada is the web site of the Garry Oak Ecosystems Recovery Team: http://www.goert.ca/ .

[2] Ingram, G. B. 2001. Analysis of the January 2001 *Catalogue of Site Records* of the Georgia Basin Ecosystem Partnership for locations of interest for conservation planning under the terms of the Garry Oak Ecosystems Recovery Strategy. on file, GOERT, Victoria & Ingram, G. B. 2002. Some information needed for making a list of priority areas with currently unprotected Garry oak ecosystems warranting immediate protection -- Discussion paper for the Conservation Planning & Site Protection Recovery Action Group of GOERT, on file, GOERT.

[3] The Sensitive Ecosystems Program of the BC Ministry of Sustainable Development could identify some culturally modified sites, http://srmwww.gov.bc.ca/sei/ , and the BC Terrestrial Ecosystem Mapping programme (TEM) does include archaeological data but has not involved any sort of indicator species of cultural modification.

[4] The publications of the University of Idaho Gap Analysis Program provide some of the best introductions to the topics of the field: http://www.gap.uidaho.edu/ .