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Habitat, visual and recreational values and the planning of extractive development and protected areas: A tale of three islands

abstract

In planning for the conservation of biological diversity, the theories of fragmentation, gap dynamics, minimum area for habitat, and edge can provide a basis for more site-specific land use decision-making and subsequent monitoring. But identification of the full range of possibilites and associated trade-offs for integration of habitat values with those related to wildland recreation and visual amenities is still problematic. These three island examples are notable in the high proportion of remaining "primary" rainforest, distinctive island cultures and pressures for both development of logging and mining and conservation of wildland amenities. Biological, recreational and visual values are envisioned as being considered early in comprehensive planning and rough land use scenarios involving conservation and limited extraction are identified. Subsequent trade-off analysis could be used interactively with simulation of successional mosaics over a district in order to allow for a form of adaptive landscape management. Such an approach could afford more flexibility for higher impact land use and better margins of security and satisfaction for conservation.

Biological diversity and wildland visual and recreational amenities: Changing perceptions, conceptualization and valuation

What does this emerging science of landscape ecology have to do with the efforts to conserve biological diversity and how can these imperatives be combined with those for protected of recreational, heritage and visual resources? Studies of ecological aspects of horizontal space over time should tell us a great deal about how to conserve habitat and concepts such as fragmentation (Harris 1985), gaps, edges (Hansen et al. 1988), successional mosaics and membranes and are proving key to the design of effective parks and other kinds of protected areas. Why is a process-oriented (Forman 1982) perspective with an emphasis on successional mosaics key to the preservation of biological diversity?

But what are the limitations to the current landscape ecology paradigm? How did it emerge and how must it be transformed to account for the vulnerable elements of landscape diversity? More importantly for the areas discussed in this paper, how can landscape ecology provide a framework for prioritizing from a range of vulnerable attributes within a region in a manner that can lead to site-specific decision-making? Does landscape ecology as a science provide any firmer basis for integration of concerns for habitat and biological diversity into design and planning frameworks for "wilderness" (Nash 1973) areas which deal with more qualitative attributes such as visual and

recreational resources?

These questions are discussed for three examples:

1. Burnaby Island, Skwa-ikungwa-i, Haida Gwaii (Queen Charlotte Islands), British Columbia, Canada;
2. Siberut Island, Mentawai Islands, Sumatera Barat, Indonesia; and
3. Fergusson Island, D'Entrecasteaux Islands, Milne Bay Province, Papua New Guinea.

These islands were chosen as part of a review of the conservation requirements of the world's remaining off-shore islands with large tracts of primary rainforest and pressures for logging or mining (Ingram 1989).

These areas represent unique island ecosystems with high degree of endemism, large tracts of primary rainforest and distinctive and relatively indigenous cultures. These islands are all worthy of relatively high levels of conservation for resource and conservation and subsequent monitoring. Given the biological, wildland recreational and visual values little new extractive resource activities should take place. But this distracts the discussion of the spatial and management requirements for conservation of these amenities. And more importantly, purely preservationist responses obscure the fact that a range of conservation and development styles are available and these options can be derived from explorations of the requirements for the spatial aspects of conservation and their implications land use-related trade-offs.

The research in this paper is not yet conclusive nor can these examples lay the basis for more general assumptions without many more years of research. But this is the case with many areas where the need for comprehensive planning and management efforts are recognized but where only piecemeal opportunities for research have been available. Burnaby Island is now part of Canada's South Moresby / Gwaii Haanas National Park Reserve but will require a careful management plan before the preservation of the area's biological diversity can be assured. On Siberut Island, Indonesia there have been some conservation delineations but little management. While biosphere reserve status has been attained, more area and management of its buffer areas is badly needed. And Fergusson Island, Papua New Guinea only has a small community-managed conservation area which needs to be expanded, linked and supported.

In all three cases, the attention to and interpretation of principles of landscape ecology and conservation biology (Balser et al. 1981) will prove to be central determinants in the effectiveness of protected areas for maintenance of the full sets of "local biological diversity" (Ingram 1989) on each island. Such networks of protected areas comprise archipelagoes of relatively pristine habitat surrounded by more disturbed areas which will probably include industrial logging, mining, agriculture, traditional gathering and hunting, roads and facilities for wildland recreation. The nature of these gaps may tell us a great deal about the effectiveness of the reserves themselves (Janzen 1983).

Historically, all three of these types of wildland amenities, biodiversity, recreational values and visuals have been considered intangible. Now they are becoming the more tangible foci of social concerns. However, the valuation and indeed the perception of valuation varies markedly between traditional communities at the local level and affluent "eco-tourists" who have come from a

great distance. And management of the dynamic between local and international perspectives becomes central in clarification of priority sites.

A dwindling global resource: Marine islands with large tracts of primary rainforest

In the next two decades, nearly all of the primary rainforest on the Earth's islands are scheduled for cutting by logging concessions or will be cleared for agriculture and tourist facilities. There is currently a tremendous economic incentive to loglowland rainforest. Most of this timber is exported to affluent industrialized countries such as Japan.

Islands have often been attractive for logging because of the relative ease of marine transport to metropolitan centres. But export-oriented logging is capital-intensive and because of the higher costs in establishment of operations on islands, there are pressures to maximize the short-term extraction of timber in order to generate profit. The pressures for competitive returns has usually required undermining indigenous patterns of land tenure and control of resources and has been the greatest obstacle to rainforest conservation. In a number of areas, world-wide, supplies of old-growth have dwindled to the point where it will soon be unprofitable to operate saw mills for big logs and there is pressure to quickly liquidate remaining stands.

As with other types of island settings such urbanizing islands, those with heavy pressures for tourism (Coccassis 1987) or with unsustainable development patterns (Council of Europe 1987), more informed and coordinated planning responses are necessary. Most of the world's remaining islands with large tracts of rainforest are in the Pacific Rim.

Island biota are particularly vulnerable to disappearance through land use-related disturbance. The relative smallness of the size of communities, habitat units and populations often magnifies the severity of perturbations. Island species are often already pre-disposed to disappearance from disruption of their insular ecosystems.

Designation of relatively undisturbed forest sites is necessary in order for local populations to withstand onslaughts of logging in the district (Norse et al. 1986). Both islands and moist forest are under-represented in the biosphere reserves and other international networks though they could provide relatively secure sites for long-term monitoring and control of disturbances.

In recent decades, islands have often functioned as laboratories for debates about development and ecological impacts. Terrestrial and terrestrial/marine systems are sufficiently discrete to make obvious the linkages between: capital; political power; control of land and resources; irreversible loss of biological resources; and subsequent damage to local communities. Island environments have come to be backdrops for some of the more painful examples of "maldeveloppement" (Sachs 1984).

But how exactly do conservation of biological, recreational and visual amenities contribute to more ecologically cognizant and "sustainable" development? Conservation of areas attractive to wildland recreation and visual amenities allow for a wider ranger of development options but often require the pre-emption of some possibilities for extractive development. Maintenance of minimum levels of local biological diversity allows for a few options for continued exploitation of traditional resources, expanded industrial harvesting and long-term prospects for biotechnology. But again the

distribution of benefits and costs of conservation vary markedly between the globe-trotting "biosphere people"and the local "ecosystem people" (Dasmann 1975) - and this translates into different aesthetic compromises, use priorities and margins of security for conservation.

Biological diversity

The concept of biological diversity (Wilson 1985 and 1998) has emerged over the last two decades in response to the loss of natural habitat and associated heritable diversity. A number of concerns as related to economics (Ehrlich and Mooney 1983) and ethics (Callicott 1986, Ehrenfield 1988) coalesced to respond to this process of biotic impoverishment at both global and local levels. There are three inter-related systems of heritable diversity: intra-specific variation within and between populations of species (Ingram 1990), species and communities. Programmes for the conservation of biological diversity must, in the long-term, deal with all three levels though short-term emphases are often on sensitive species and ecosystem types.

While the conservation of biological diversity is related to efforts for the maintenance of ecosystem functions and biological productivity, there are some distinctly different technical priorities. A robust and highly productive set of ecosystems can still lose vulnerable elements of local biological diversity. And the various motives for conservation of biodiversity suggest the need for a host of signifiers and indicators. Three sets that will be used in this discussion are:

1. species **representative** of communities, food webs, and successional phases;
2. species that are **vulnerable** due to being endemic, rare, K - selected (Pianka 1970), inherently sensitive to change or sensitive to certain human activities or technologies; and
3. species that are currently harvested or have the potential for being **exploited** such as through traditional subsistence, industrial extraction, and as potential genetic resources. Many other kinds of signs of certain assemblages of organisms and their conservation over space, some of which hopefully being less species-oriented, should be developed in the coming years.

From the standpoint of species numbers and area, as well as overall biological productivity, these complex interfaces of terrestrial and marine ecosystems suggest that within their respective regions these islands are some of the more diverse points in the biosphere. This is certainly the case with the remaining islands with relatively pristine rainforests and coral reefs. But these highly diverse areas are particularly problematic for the setting of conservation objectives because virtually any change in the environment could push the status of a sparsely-distributed, endemic or sensitive species close to the brink of extirpation or extinction.

Another indicator of biological diversity is the range of structural forms of vegetation across a district: the ecosystem and successional mosaic. Forest that is relatively tall, dense and old may hold sufficient levels of biomass and types of woody structuress and food webs that certain species that are uncommon in earlier successional phases may be present in such "primary" "rainforest" (Richards 1952) or "old growth" (Franklin et al. 1981). But rather than assuming that there is such a thing as pure stands of mature phases, they should be considered as mosaics with their own,

internally generated gaps (Brokaw 1985), patches (Pickett and Thompson 1978, Ewel 1983) and edges. Thus, old-growth or rainforest dependent species are not only those that are confined to the immediate area of stands of older trees and associated understory but also those numerous species in every forest type that exploit edges. Such edge species may be not only dependent on a number of specific habitat attributes but also a unique configuration of attributions associated with less mature phases, as well.

Wildland visual amenities on off-shore islands with primary rainforest

Both the remaining wilderness islands and primary rainforest involve some rather distinctive visual resources. Of course, island landforms are highly diverse and so too are visual aspects of archipelagoes. It is similarly difficult to generalize about the visual resources of forests dominated by primary phases though some characterization has been done for temperate areas such as in western North America (Litton 1968, USDA Forest Service 1980).

From a more evocative and almost symbolic perspective (Orians 1986), the world's remaining islands with vegetation primarily in mature rainforest have come to represent to the developed world a kind of restorative purity. There is the richness of the forest and adjacent marine zones and the requisite isolation from industrialism. However, such a response may be more derived from the yearnings of the beholder: islands and primary rainforest are just as vulnerable to global change in fact more so to global warming and species loss induced by habitat alteration and conversion. And far from being stable, most of the world's smaller islands are of comparatively recent origins (Menard 1986). But perhaps, the vulnerability of such remaining island ecosystems might allow for their use of indicators of health of complex sets of marine and terrestrial communities.

Such islands are often perceived in two divergent ways: from the air in a sort of global perspective and through thick, enclosed vegetation. Island viewscapes comprise complex arcs emerging out of horizons of variable widths. Successional mosaics are difficult to discern both from a distance and on the ground. In these ever-humid conditions, visual manifestations of visual variability are less systematic and obvious. This has fostered complex sets of local knowledge and land management practices and now beckons inspired groups from the affluent, developed parts of the world to explore this tremendous horizontal and vertical complexity.

In terms of observer position, there is a wide range of expansive marine views and variations in distance within archipelagoes as well as the sequence of forms along shores. Coupled with various interior, forest views and forest edges, there is often a considerable range of landform information over short distances. This is not the monotonous green Hell suggested by some of the European explorers but rather landscapes of such tremendous complexity that it is easy to focus on a small portion of an island's area such as beaches, points, riparian communities, forests of particularly tall or mature trees, or ridgetops. But the visual resources of these islands, lie not as much in one landscape type but in the tight densities and sequences and dramatic contrast that are afforded.

Islands with large tracts of primary rainforest involve complex and enticing visual resources on three counts. The visual information associated with the varied elements, themes, and symbols

along with subsequent cognition of "diversity" - is extremely dense. Secondly and related to the natural forms and processes and the subsequent symbolism, these island landscapes can be perceived as providing various forms of "refuge". Thirdly, these isolated patches of land and sea are free of much of the clutter of industrialism and suggest a relatively high level environmental "health" in an increasingly degraded biosphere.

Recreation and cultural amenities

As with biological and visual resources, there are two major types of user groups: 1. local communities involving various blends of traditional and modern values and 2. globally oriented eco-tourists with a range of non-consumptive interests in natural landscapes. Within local communities is a range of economic and cultural relationships that determine interests in conservation, eco-tourism and extractive development. Similary, within tourist groups is a range of intended experiences as related to cultural perspectives, requirements for personal satisfaction, and mobility.

Eco-tourism on such islands has generally been focused on comfortable sites with some wilderness visual characteristics: primarily sheltered beaches and flat land but adjacent to areas of relative pristine and diverse habitat. In such situations, even the infrequent presence of kayakers or tour boats, could excede carrying capacity for either the intended experience. These relatively small strips of beach, lowland and dry land can also reach their ecological carrying capacity relatively quickly and synergistic impacts from such things as trampling can become quickly emerge.

The roles of landscape ecology in conservation planning

Principles of landscape ecology could be used to identify key sites, buffers and corridors and the margins of alteration and preservation which are workable. More importantly, landscape ecology can provide the principles for managing inevitably dynamic natural and social processes. But the conservation priorities, in terms of sites and management interventions, for each of these three sets of non-market resources, on these three very different island, could be markedly different.

There are socially significant sites, as related to various local and user groups, and there are vulnerable sites in terms of particular biological, visual and recreational amenities. But the shear number of decisions related to planning configurations of sites over an uncertain time period has been problematic. The response has often involved needlessly rigid concepts of conservation and preservation. And the specific nuances of the interactive nature of these amenities have been ignored in favour of parks for recreation, parks for wildlife conservation and landscape management to minimize the detraction from the sense of wilderness.

Over the last century, there have been only two major approaches to integrated conservation of wildland biological, recreational and visual resources: 1. a design features approach centred on promotion of non-commodity values and often associated with national park tourism and 2. an impact assessment / mitigation approach where non-market values are maintained within forms of "integrated resource management". These two approaches roughly reflect the philosophical differences between North American preservationism emphasizing isolated zones of protection and conservationism focused on "multiple use." But the preservationist / conservationist dichotomy

tends to unravel on islands. Archipelagoes often do not involve enough area in terrestrial and shallow marine zones to have the space to support multiple use (Juvik and Juvik 1984). And similarly there is often a sufficient human presence to preclude unaltered parks and reserves (Dahl 1985a and 1985b).

Intangible resources have tended to be considered last in landscape where any commodity production is planned. In the developed world, such amenities are being considered in more of a central position in land use decision-making. But has rarely been considered successful with divergent user groups such as traditional communities, resource frontier settlers and more self-confident eco-tourists. The trade-offs between extraction and conservation / preservation have often been only vaguely identified and it has been difficult to identify workable and authentic compromises.

These gaps in theory and technique have lead to a **crisis in site planning** for the in situ conservation of biological diversity for such rich and sensitive areas and I argue that the science of landscape ecology is crucial for creating a basis for decision-making. The following examples outline the needs for better planning and what follows is a discussion of the potential roles of some of the key concepts of landscape ecology.

Burnaby Island, Skwa-ikungwa-i, Haida Gwaii (Queen Charlotte Islands), Canada

Skwa-ikungwa-i is a North American example with relatively low species and habitat diversity, endemics associated with glacial refugia and within the context of an affluent country which can afford more parks and to re-examine its indigenous cultures. The Queen Charlotte Islands lie to the west of the northern coast of British Columbia and to the south of southeastern Alaska.

The southern spine of the Queen Charlotte Islands, a myriads of small mountains, fjords and islands is called Gwaii Haanas in the Haida language and has also often been referred to as "the South Moresby." The Burnaby Island area (figure 1) is on the east coast of the South Moresby. Much of the vegetation of the Queen Charlotte Islands consists of temperate rainforest. The area is renowed for its old growth forests dominated by western hemlock, Tsuga heterophylla, western red cedar, Thuja plicata, and Sitka spruce, Picea sitchensis.

The ecosystems of Gwaii Haanas are remarkable for their relatively pristine, north Pacific shore habitats and refugial, island, old growth-dependent, and hysithermal species (Foster 1984). There are complex mosaics of various shore, islet (figure 2), lowland coniferous forest and sub-alpine habitats at various successional phases. Much of the forest is in relatively mature phases (figure 3) though there was on-going gap generation (Brady and Hanley 1984). Since the 1950s, the forests have been transformed by the introduced black-tailed deer, Odocoileus hemionus sitkensis, which, without natural predators on the Queen Charlotte Islands, is literally browsing to stuble much of the shrub layers.

The Haida people were the sole inhabitants of the Queen Charlotte Islands until the archipelago was annexed to the Crown Colony of British Columbia in the mid-Nineteenth Century. Haida communities exploited both the marine and terrestrial resources of the islands on a subsistence

basis though considerable surplus was usually accumulated. It has been inferred that the Haida probably have occupied the area since soon after the last glacial retreat around 10,000 years b. p. (Fladmark 1975) and they these communities adapted to the ecological transitions from tundra to boreal to "warmer" coniferous forest and then to the cooler type of "rainforest" that exists today. Settlements in the Gwaii Haanas area were well-established (Swanton 1905 - A & B) and so too were culturally influenced landscapes.

Haida villages were situated along shore areas (MacDonald 1983) as was much gathering and fishing. While there was gathering in the interior of the forests, particularly western red cedar, much of the berry gathering, of Vaccinium spp. , Rubus spp. , Ribes spp. and Viberum sp. was in culturally modified edges and gaps. Human beings have probably been subtly managing the successional mosaics and species compositions of lowland areas for nearly 10,000 years.

The visual amenities of the area include large, contiguous tracks of coniferous rainforest, highly varied configurations of small mountains, islands and terrestrial-marine strips (Dearden 1988) relatively monotonous and imposing old growth canopy with key forest gaps and alluvial openings; and tightly packed textural zonation from shore to alpine. Key views are from the sea, from certain shore points and from ridge tops.

The opportunities for recreation, education and observance of cultural activities are widely ranging. The area supports some of the most heavily used sites of traditional gathering in northwestern North America. The surface archaeological and educational values of the old village and fort sites are unequaled in the region. The numerous sheltered beaches support kayak and float-plane access with potentials for cabins, tents and lodges. Such facilities could support the increasing levels of kayaking, beach-combing, trekking, float-plane access, boat access and boat tours, fishing, and photography.

Ironically, the coming of the introduced deer, which in this area was in the late 1950s, has almost cleared the way for a touristic landscape. Because of the lack of ungulates in the area, the forest was particularly thick and difficult for travel - even by the norms of northwestern North America. The destruction of the shrub layer has almost neutralized this discomfort while curtailing berry production and the already modest food webs associated with fruit production.

After World War II, the export of timber and fish products expanded and there were dramatic increases in production and areas under extractive management regimens in the 1970s. In the same periods, clearcut logging methods became the norm and the size of cuts and the speed of old-growth removal has increased progressively. Concerns for the protection of the terrestrial and marine environments of the Queen Charlotte Islands, and of the biological resources of traditional interest to the Haida, in particular, has intensified since the mid-1970s.

In an effort to find compromises between pressures for extraction and preservation, the South Moresby Resource Planning Team was constituted through an inter-ministerial secretariat, within the government of the Province of British Columbia. The team was in existence from 1979 until 1984. In its final report (1984), a dichotomous approach of planning for either a "natural zone" or a "resource development zone" was employed. In the final Team report, conservation of habitat values, encouragement of research and educational activities, traditional Haida uses and

guided hunting and fishing would have taken place in natural areas. Timber harvesting would have been excluded while some mineral claims, if not lapsed, could have been developed with strict guidelines. Four "options" were proposed.

The Team's exercise was a failure because it was not sufficiently site-specific and did not deal of the management of logging practices in the commodity portions of the landscape. The Haida, who were not central players in the decision-making process, had a broader political agenda which included sovereignty and land claims. After protected conflict, civil disobedience and negotiations, a tentative agreement was forged to establish Gwai Haanas as a national park reserve in July 1987 (May 1990). However, at the time of this article's publication, no accord has been fully approved between the Haida Nation and Parks Canada.

Most of the vulnerable visual and recreational resources will be protected. However, it will take years to develop a master plan and management strategy that will serve the interests of both the Haida and Parks Canada and which will integrate site-oriented requirements for the maintenance of local biological diversity with the inevitable increase in non-consumptive recreation. Zoning, prohibitions on camping and trampling in sensitive short areas, and intensive design of campsites is inevitable. There is talk and funds for building facilities for large tour groups.

Efforts to manage the degradation of the forest from the introduced deer may well require a combination of intensive fencing and broad-scale hunting and the re-establishment of the traditionally owned berry patches may well require the re-introduction of vegetative material. The fencing and re-introductions could represent restorative patches; a sort of negative fragments. But given, the rugged terrain and large terrestrial areas, the focus will be limited to the most sensitive shore areas - especially beaches with southern and southwestern aspects. Consequently, these landscapes that have evolved with 10,000 years + of human presence will continue to be artifacts of the various periods of history and use.

Siberut, Sumatera Barat, Indonesia

The Mentawai Islands are off the Indian Ocean coast of Sumatra. Siberut (figure 5) is the largest and most northerly of the four Mentawi Islands. The vegetation of Siberut consists of various types of tropical rainforest and, in particular, primary dipterocarp types. The Mentawai islands have some of the highest levels of island species endemism on Earth. The island have been separated from the southeast Asian mainland for roughly 4 million years.

The Mentawai Islands are remarkable in the cultural isolation which extended into the Twentieth Century. This, "enabled the people to retain many cultural practices once common throughout archaic Indonesia"(Mitchell and Tilson 1986). The traditional religion of the Mentawai is centred on a belief in "internal harmony in the environment" and fostered a system of rituals and taboos which "kept people and forest resources in an equilibrium" (Mitchell and Tilson 1986). In recent decades, two government resettlement programmes, in conjunction with missionary activities, have forced people into larger, more centralized villages where access to the rich array of subsistence species has been limited. The biological resources of Siberut are almost impossible to

inventory and it will take centuries to compile accurate lists of the plant and invertebrate species. Certainly, the endemic mammals such as the primate, Hylobates klossi, are a great curiousity. More importantly for local people, is the wide range of species for food and technology - species which are often disturbed and which diminish in areas that are selectively logged (Johns 1983).

For the Mentawai, any loss of forest habitat has negative consequences for food resources. For example, Durian spp., a major staple, regeneration is not always immediate, particularly when other ecological balances are jeopardized, and there may be real shortages of fruit.

While Siberut is low-lying, there is a remarkable degree of small-scaled habitat variation across the heavily incised stream valleys. This in turn supports segregated and relatively isolated communities ranging from the drier ridge-top forests with emergent dipterocarp tree species, that are often the favoured areas for primates, to the swamp forests at lower elevations (Whitten 1982).

The visual resources of Siberut largely involve interior forest views. Siberut is low-lying and swampy forest is surrounded by highly eroded tropical terraces and gully landforms with tightly banded ridge and riverine vegetation (figure 6). At the shore are mangroves and coral reefs. There are highly varied canopy layers within the forest (figure 7). There is a cultural landscape consisting of communal village lands and outlying swidden horticulture, ladang. Expansive views are rare and the few gaps on ridge become crucial in perceiving the greater landscape.

The recreational and cultural features allow for observance of traditional social and religious activities; dugout canoe transport (manual or motorized); modest trekking between villages; and mammal watching; and snorkeling. Selective logging has been going on since the 1970s and the areas of highest interest for tourism are in the southwest which is an area too rugged and swampy for roads.

Research for a conservation master plan for Siberut was begun in 1976 (Whitten and House 1979, WWF - Indonesia 1980, Whitten and Sardar 1981)and the subsequent proposal for management (Mitchell 1982). Three categories of use zones were proposed:

Development Zones (logging areas, settlements, rattan collecting, areas with the best potential for sustainable logging and agriculture);

Traditional Use Zones(wildlife reserve, suakamargasatwa, buffer zone,
village forest and strict protection forest); and

Nature Reserve Zone(Forest fruit collection was for human consumption and no for sale. Hunting, ladang clearings and new villages were to be prohibited.)

A large portion of the Mentawai population has supported the conservation proposals and has probably moved into or become more dependent on the traditional use zones. But the squeezing of the more traditional Mentawai into lands, with on one hand the not-so-subtle attacks on their customs and beliefs on the other influx since the mid-1980s of gawking and maladapted tourists, coupled with a lack of respect for zone boundaries by the logging companies jeopardizes what little "balance" is left.

Fergusson Island, D'Entrecasteaux Islands, Milne Bay Province, Papua New Guinea

Fergusson Island (figure 8) is the largest island in the D'Entrecasteaux Archipelago and one

of the largest islands off of eastern New Guinea. It has an area of 1340 square kilometres with mountains which rise to 1830 metres. The island is particularly significant as it has one of the most pristine mosaics of primary rainforest on a relatively large, off-shore island (figure 9) of anywhere on Earth (IUCN / UNEP 1986).

The area has a poorly understood blend of Australian and Asian plants and animals. Data on the D'Entrecasteaux Islands was key in Diamond's original (1971, 1972) assertion of the dynamics of "saturation" in island biogeography (with its implication for reserve design). The area is also remarkable in its island endemics particularly its forest canopy (figure 10) and ground-dwelling birds and two rare marsupials. Given the steep environmental gradients, the large tracts of primary rainforest and the relatively pristine coral reefs, the island is probably one of the most biological rich points on the planet.

There are at least 8 distinct language groups on Fergusson Island and the cultural diversity is impressive. The communities of the southeast of the island and of the adjacent island of Dobu are matrilineal (Fortune 1932) and were notorious for their malevolence (Benedict 1934).

The visual amenities of this island consist of some of the steepest island scenery on Earth with volcanism, relatively open beaches, off-shore outcrops and reefs; highly varied forest canopy layers, and mosaics of humid and dry forest with grassland. The recreational and cultural resources relate to traditional pursuits and observances; trekking; bird and mammal watching; botanizing; sun bathing, swimming; body surfing; and boating. Nature-oriented tours emphasizing bird watching, with visits spectacular species such as the Goldie's Bird of Paradise, Paradisaea decora (Lecroy et al. 1980), began in the 1980s.

The situation on Fergusson Island would, at first, seem optimal for development of conservation plans which are compatible with the needs of indigenous communities as well with highly regulated extractive activities. Indeed, the island is so rich in mineral and timber resources, that slow careful exploitation could go forward in manners which do not damage most of thes intangible resources.

The traditional patterns of land tenure are largely intact. Land is held by local household units. The subsistence economy is still viable. There is reliance on a wide array of wild species. Population pressures are still low and political power is decentralized. The traditional system of swidden farming (figure 11) and management of resulting successional mosaics is being intensified with population pressesures. There is even a locally initiated wildlife management area. But in this favourable context, it has still been possible for foreign logging operations to establish without any kind of comprehensive land use plan,without any decisions on a network of protected areas with representative tracts of primary rainforest and without a mechanism to channel economic benefits back to the local community.

As well as the loss of primary rainforest-dependent wildlife, massive-scaled logging can degrade adjacent shore and marine areas. The sedimentation from logging can harm the productivity of adjacent reefs (Hodgson 1988). The complex mosaics of gardens, zones of gathering and the myriad of subsequent successional patches and edges are being simplified with a probably loss of habitat and species diversity in low-lying areas.

Options for conservation planning and management

The cumulative impact of much of the extractive development and accompanying infrastructure on islands such as these is further fragmentation. In the case of populations where prospects of survival are already precarious, such change could rapidly lead to disappearances of species. There are parallels with recreational values related to non-motorized transportation and traditional cultures as well as with views that are easily marred with logging roads and mining.

Certain zones are more vulnerable to loss of amenities. In particular, the terrestrial/ marine interface, estuaries, freshwater, and the narrow coastal lowland strips and adjacent slopes can be severely altered through extraction and roads. On some islands, such sensitive areas comprise most of the total areas. Certain particularly unique and diverse sites such as lower foothills, areas of high environmental heterogeneity and certain culturally influenced landscapes are similarly vulnerable. And in such settings, it is not difficult to alter successional mosaics to the point that certain mature phases of certain community types are pervasively altered or extinguished.

Protected areas in such areas are problematic. The isolating sea is too often vulnerable in itself to degradation while the land often does not involve sufficient space for corridors and management areas. Cores of reserves are often too small and buffers are forced to be too all-purpose.

Trade-offs between land use and preservation for the conservation of visual, recreational, cultural and biological resources

Landscape ecology may provide the basis to become more site-specific in conservation efforts and to therefore transcend some of the cruder aspects of the national park and multiple use paradigms. Ironically, it is on marine islands that it is less possible to indulge in the notion of the protected area as habitat island (Cole 1981). The notion of membranes and filters (Giacomini and Romani 1978, Schonewald-Cox and Bayless 1986) is more appropriate and within this is an awareness of the complexity of management of various edges and configurations of habitat types.

Three sets of variables may be available in order to provide the basis for generation of alternative scenarios (Painho et al. 1987) for the conservation of habitat, visual and recreational resources. 1. There can be trade-offs between the total portion of an area in protection and the levels of regulation of human activities in both protected and non-protected zones. 2. There can be trade-offs between the quality of the sites chosen for protection and the extent of the area within a district that is necessary for protection. 3. There can be trade-offs between the extent of management measures within protected areas and mitigation measures of impacts of land use external to protected cores and buffers (Ingram 1989).

The requirements on which these alternatives could be based would involve at least 6 categories: biological, visual and recreation values for two disparate groups - local societies and tourists. Weighting of these values and groups and underlying conflict between various interest groups is inevitable. But given the wide range of possible alternatives, certain preservationist compromises may be possible. Options for the integration of pressures for extractive development

will be limited but potentially satisfatory at least in terms of an increase in local incomes over the long-term.

Such an alternative scenarios approach to the conservation of non-market values may have utility when eco-tourism can provide an economic alternative to extractive patterns. Alternatives can take on political symbolism especially in balancing of priorities between intangible resources and with extractive development.

The prospects for conservation planning for Burnaby Island, Skwa-ikungwa-i, Queen Charlotte Islands, British Columbia with the coming of Parks Canada will centre on the persistence of Haida sovereignty issues and heightened public sensitivity to park management issues extending to marine areas and the setting of conservation and recreation siting criteria. Issues of access to sites and management control by the Haida, the federal government of Canada and tourists will continue to be a source of conflict. The use of ecological data and landscape modelling will expand and become contentious as the Haida Nation acquires the technical expertise to generate their own scenarios for land conservation.

The integration of criteria for biodiversity with those for enjoyment of wildland recreation and visual amenities will require severe restrictions, particularly on camping, which will need to be highly site-specific. The options for shore campsite develop are especially limited.

The prospects for Siberut, Indonesia centre on the political and administrative obstacles to implementation of declared protected areas and the pressures for expansion of local horticulture. Viable solutions to balancing other development aspirations with the conservation of intangible resources will require more site-specific decision-making and adaptive management - all increasingly difficult unless local communities become more politically empowered and motivated to pursue development alternatives to logging. Prospects for conservation on Fergusson Island, Milne Bay Province, Papua New Guinea, with inadequate institutional frameworks for the establishment and management of protected areas, are not good even with enthusiasm for locally managed conservation zones. But the site-specificity and environmental assessment required for extractive developments may provide a window for conservation initiatives. For both Fergusson Island and Siberut, vague zonations of swidden and gathering areas as well as core nature reserves will continue to be less effective than the more difficult efforts to manage the traditional patterns of land use decision-making.

Conclusions

Landscape ecology as a science can be used to tell us as much about individual sites as configurations of sites and their respective contexts. All three of the intangible categories of resources are considered such in large part because they are so site-dependent and yet so difficult to locate in broad-scaled planning. Islands with primary rainforest comprise one setting where information at both the levels of the site, configurations of sites and district are particularly necessary in order to produce workable conservation plans.

The three examples (figure 12) involve different kinds of landforms, ecosystems and cultural pressures and consequently various forms of mosaics, edges, time factors, cause-effect linkages and

conservation responses. Landscape ecology while not providing a basis for understanding biological diversity, visual resources or recreation demand does provide a typology of spatial and temporal patterns that will allow for the informed decision-making to insure the protection of such beautiful and vulnerable things for
an uncertain future.

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list of figures and captions

figure 1 map - Burnaby Island, British Columbia, Canada

figure 2 photograph - Burnaby Island - Small islands to the southeast of Burnaby Island

figure 3 photograph - Burnaby Island - Old growth forest with mature stands of western red cedar, Thuja plicata (centre left), Sitka spruce, Picea sitchensis (centre background), and western hemlock, Tsuga heterophylla, on the extreme right and left

figure 4 photograph - Burnaby Island - forested edge of a saltmarsh with western hemlock, Tsuga heterophylla seedlings and crabapple, Pyrus fusca in the foreground and marsh dominants, Salicornia pacifica and Deschampsia cespitosa, in the background.

figure 5 map - Siberut Island, Indonesia

figure 6 photograph - Siberut - traditional riverside horticultural area, ladang, which in this case is dominated by traditional varieties of banana, Musa spp.

figure 7 photograph - Siberut - dense valley bottom forest with lianas and rattans in the understory

figure 8 map - Fergusson Island, Papua New Guinea

figure 9 photograph - Fergusson Island - the southeast coast of Fergusson Island

figure 10 photograph - Fergusson Island - emergent trees on the edge of primary rainforest that support mating activities of Goldie's Bird of Paradise, Paradisaea decora

figure 11 photograph - Fergusson Island - traditional swidden agriculture on the southwest coast

figure 12 - diagram of the relative sizes and shapes of Burnaby, Siberut and Fergusson Islands