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Requirements for the design and management of edges
in planning reserves with old growth forest

If protected tracts of old growth are to be effective at maintaining all of the elements of local biological diversity, over the long term, the inevitable "edge effects" must be minimized. The perimeters of protected forest tend to become degraded over time because of structural changes such as from blow-down and increased light penetration. And there are more longer-term threats such as from invasive species which are associated with major ecological disturbances in adjacent areas (Garrat 1984). The first principle of edge management is to minimize the total length of the perimeter: to make boundaries (Wiens et al. 1985) as simple as possible. The second principle is to always plan for a buffer area around an old-growth core which might well involve timber harvesting but with finely-scaled prescriptions such as gradual helicopter logging and no roads directly adjacent to core reserves. Formulas for optimal reserved area to edge length ratios and the width of buffers need to be determined for particular forest types and biogeoclimatic zones and should be based on landform analyses, requirements of sensitive wildlife, the spatial structure of gaps created by natural disturbance factors and aesthetic considerations.

Edges between different communities, landscape types and successional types are called **ecotones** (Hansen et al. 1988, Holland 1988). There are natural ecotones which have been created by natural disturbances such as fire, landslides, blowdowns, insect infestations etc. And there are human-induced ecotones created by roads, timber removal and grazing.

Ecotones involve very different **spatial and temporal scales**. There are some ecotones such as between some forest and grassland areas that are relatively permanent. And there are edges around small, natural gaps in the forest that only last for a few years until there is regrowth. Ecotones are rarely permanent and are nearly always moving in one direction or another.

Ecotones are neither "good" nor "bad" in ecological terms. But some organisms are better adapted to edges and certain kinds of edges than others. Therefore, if we want to maintain the full array of local biological diversity and respective ecological processes at the district or regional level, it is necessary to understand, inventory and to manage ecotones.

As well as not being "biological deserts", tracts of old growth forest in British Columbia are not all the same - even within the same biogeoclimatic sub-zone. Rather they are hetergeneous mosaics (Raney et al. 1981) with different ecological subunits as based on such factors as landform, soil, microclimate and natural disturbance. If we want to preserve old growth fragments for the preservation of local biological diversity, we need to consider the processes that create and limit natural ecotones both on the administrative boundaries (Schonewald-Cox and Bayless 1986) and in respective interiors.

The areas on the perimeters of old growth fragments will be gradually degraded by "the edge effect". The severity of such a set of factors varies greatly between ecosystems and between biogeoclimatic zones (more in the coastal western hemlock zone and less in the interior dry Douglas fir zone). The more most important edge effect factors for B.C. forests include: vulnerability to blowdown, slippage and soil disturbance and erosion, increased light penetration, and invasive species.

Preservation of old growth fragments will not be without costs especially for inventorying, planning, design and monitoring - not to mention some loss to the AAC. In order to get the best values for our limited resources, reserves need to be selected and designed in order to minimize the negative impacts of human-induced edge while allowing for the continuation of natural (internal) edge-inducing factors. If we don't think that we allocate the necessary resources for research and monitor, the fragments will need to be bigger.

An investment of research and design, now, will allow for more sustainable (and cheaper) conservation in the short-term. How we intend to cope with edge effects and integrate these concerns into forest land use planning could have a major impact on the amount of timber available for cutting, the types of harvesting methods in adjacent areas and the margins of security for the conservation of some species.

No old growth reserve is an "island" (Janzen 1983) and no fragmented ecosystem can withstand certain kinds of changes (Lovejoy et al. 1984). But in relatively simple and resilient temperate ecosystems such as those of the forests of B.C., we can control most edge effects through the designation of cores and various concentric buffers. A buffer might have logging - but harvesting at a more **incremental** rate and without as many roads. A buffer would not be removed from the AAC but instead would be flagged for a special harvesting treatment which would be conceived of as part of the selection and design of the old growth fragment.

In order to know how best to select and design old growth reserves to minimize edge effects, there needs to be a number of on-going (monitoring-oriented) research projects. There needs to be description and correlations of different kinds of edges as defined by the biogeoclimatic zones and sub-zones with landform types, the natural disturbance regimens, the nature of the adjacent land uses and disturbance (clearcutting versus less radical types of forest alteration), and the natural regimen of disturbance.

research priority 1: description of "natural" edges for each biogeoclimatic zone

research priority 2: monitoring and description of the dynamic nature of these edges and correlation with disturbance factors (natural and human-induced)

research priority 3: "edge vulnerability assessment" for particular species and expansion of the simplistic concept of the forest interior species e.g. interior dependent in what way(s) ? or edge-aversion of what factors?

research priority 4: cumulative impacts of edge alteration across districts as correlated to disruption of natural disturbance and addition of human induced disturbance

evaluation of implications for design 1: determine optimal edge to protected area of old-growth ratio for particular forest types with variables (the size and surrounding of nature reserves question (Hooper 1970)(determine key variables))

evaluation of implications for design 2: determine "good" (not threatening to local biological diversity) edges and bad (threatening to some elements of local biological diversity) edges and ways that good edges can be optimized and bad edges can be minimized

evaluation of implications for design 3: determine ways to minimize the expansion of edge effect for particular forest and landform types

Priorities for research in biogeoclimatic zones:
coastal western hemlock / interior western hemlock: structural impacts of logging-induced ecotones
coastal Douglas fir / interior Douglas fir: impacts of increased light penetration
interior Dougls fir / Ponderosa pine: impacts of soil disturbance and invasive plant species

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