RANGE EDGE AND OUTLIER POPULATIONS

HIGH CONSERVATION VALUE 1, QUESTION 5

Does the forest support concentrations of species at the edge of their natural ranges or outlier populations?

BACKGROUND

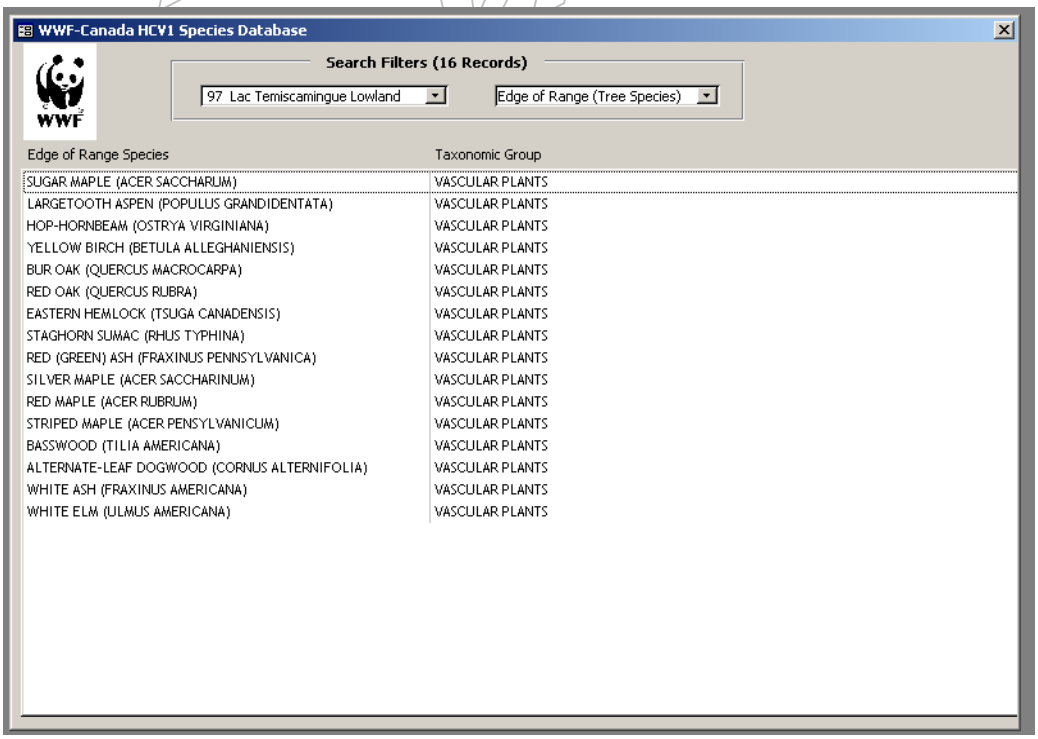
Outlier and edge of range populations of species have long received scrutiny by ecologists, geneticists, plant breeders and conservationists among others. All species have limited distributions at broad geographical scales. At local scales, the distribution of many species is influenced by the interplay of the three factors of habitat availability, local extinctions and colonization dynamics. Gradients in these three factors generate species' range limits and different routes to range limits give rise to distinct spatiotemporal patterns (Holt and Keitt 2000).

Range edge populations are rarely static. Across the boreal forests of North America, many plant and animal species reach their northern range edges in the southern boreal forest while many far northern and Arctic species reach their southern limits in the northern boreal or taiga. In some areas, species ranges are limited by temperature, whereas in others (*e.g.* the western provinces) annual precipitation may be a greater limiting factor than temperature. In some cases, local environmental conditions (climate, soils) may be sufficiently modified to support outlier populations of species disjunct from their main range area. Concentrations of arctic plants along the north shore of Lake Superior are a good illustration of this phenomenon.

In some cases, range edge populations have been shown to harbour more genetic variation or to express more unique genotypes than is characteristic for populations elsewhere in the range. Peripheral populations, which have often adapted to the most extreme environmental conditions across the range as a whole, are also best positioned to be the frontrunners for the species that allow it to adapt to changing environmental conditions. From a conservation perspective, these attributes of range edge populations are important to help guard against potential range contraction (especially for species at risk) and to assist with adaptation to global warming.

Since trees species are a fundamental component of forest stands, contributing significantly to stand biomass as well as to both its structure and function, range edge populations of these species are of particular significance to HCVF assessments. This does not mean, however, that other taxa should be excluded from this type of analysis.

Figure 5.1 Sample output from the WWF-Canada HCV1 species database application.



Edge of Range Species	Taxonomic Group
SUGAR MAPLE (ACER SACCHARUM)	VASCULAR PLANTS
LARGETOOTH ASPEN (POPULUS GRANDIDENTATA)	VASCULAR PLANTS
HOP-HORNBEAM (OSTRYA VIRGINIANA)	VASCULAR PLANTS
YELLOW BIRCH (BETULA ALLEGHANIENSIS)	VASCULAR PLANTS
BUR OAK (QUERCUS MACROCARPA)	VASCULAR PLANTS
RED OAK (QUERCUS RUBRA)	VASCULAR PLANTS
EASTERN HEMLOCK (TSUGA CANADENSIS)	VASCULAR PLANTS
STAGHORN SUMAC (RHUS TYPHINA)	VASCULAR PLANTS
RED (GREEN) ASH (FRAXINUS PENNSYLVANICA)	VASCULAR PLANTS
SILVER MAPLE (ACER SACCHARINUM)	VASCULAR PLANTS
RED MAPLE (ACER RUBRUM)	VASCULAR PLANTS
STRIPED MAPLE (ACER PENSYLVANICUM)	VASCULAR PLANTS
BASSWOOD (TILIA AMERICANA)	VASCULAR PLANTS
ALTERNATE-LEAF DOGWOOD (CORNUS ALTERNIFOLIA)	VASCULAR PLANTS
WHITE ASH (FRAXINUS AMERICANA)	VASCULAR PLANTS
WHITE ELM (ULMUS AMERICANA)	VASCULAR PLANTS

HCV1 Q5 – RANGE EDGE AND OUTLIER POPULATIONS

DATA SOURCES

Multiple sources of information will be required to estimate where range edges occur for many species and it is suggested that qualified ecologists (specialists) be consulted in the preparation of information for this indicator.

In general, field guides, breeding bird atlases, and regional life-science inventories will contain geographic information on local population occurrences or in some cases include regional map ranges which can act as a first approximation or estimation of where range edges occur.

Data sources for digital mapping of species distribution include:

- NatureServe (bird and mammal distributions; see http://www.natureserve.org/getData/birdMaps.jsp http://www.natureserve.org/getData/mammalMaps.jsp)
- Regional CDCs (*e.g.* Ontario Natural Heritage Information Centre; see http://www.mnr.gov.on.ca/MNR/nhic/nhic.cfm)
- USGS Trees of North America (see http://climchange.cr.usgs.gov/data/atlas/little/)
- COSEWIC listed species (see http://www.speciesatrisk.gc.ca/search/speciesResults_e.cfm)

INTERPRETING THE PRECAUTIONARY PRINCIPLE

Range edge and outlier populations are often more vulnerable to being lost than range areas where populations are in closer proximity (more connected). This is partly due to the lower probability of adjacent healthy populations being able to provide a 'rescue effect' service (essentially acting as a back-up source) to replenish population numbers in the event of a temporary population decline or loss. This same phenomenon can also be an important consideration for rare species that occur in small populations scattered within a range area or with species whose preferred habitats are widely scattered across the landscape.

For these reasons, species populations that qualify as occurring at their range edge should be identified as HCVs and habitat areas needed to maintain their populations should be recognized as HCVFs. As noted earlier, this will be especially important for forest tree species and the stands in which they occur as forestry activities can alter the competitive interactions and successional processes required to sustain these populations (and possibly other species dependent on their occurrence in the landscape).

ADDITIONAL GUIDANCE

Defining what constitutes a range edge population, versus populations that are characteristic of the main range area for a given species is not an exact science and can be highly scale-dependent. In part, this determination will require (1) an examination of the overall geographic extent of the global range of the species to ascertain, at a coarse scale, if the forest licence area in which the assessment is occurring is approaching or overlapping latitudinal or longitudinal range edges, (2) a more detailed regional examination of the geographic pattern of the species range to assess habitat characteristics associated with population occurrences and (3) at the local level, the degree of connectedness among meta-populations. As a first approximation, we suggest that populations be considered for HCV status when they:

- Represent the outermost 100 km of the known continuous range area [this is very arbitrary… we need to find a defensible number here – maybe a function of the dispersal rate? This would provide a tie to reduced gene flow, which is largely what allows peripheral populations to differentiate]
- Represent relatively narrow, linear extensions of the main range area (*e.g.* along riparian corridors)
- Are reproductively disjunct or isolated from the main range area (the distance between such qualifying populations and the main range area will vary with the species dispersal ability)

If a species is known to be in decline or if it is considered to be a significant species representative of regional habitat types, range edge or outlier populations of these species become especially important to conserve and should be identified as HCVFs.

To assist with the identification of range edge and outlier populations that could potentially occur within a forest license area, WWF has assembled a regional look-up table using the framework of the Terrestrial Ecoregions of Canada (Figure 5.1 illustrates sample output for Ecoregion 97, the Lac Temiscamingue Lowland). At this time the table lists only potential tree species populations based on the estimated overlap of species range areas depicted in Hosie (1990). Given the size of the terrestrial ecoregions, the listing of a tree species for that region does not automatically

Figure 5.2 Range of eastern hemlock, *Tsuga canadensis*.

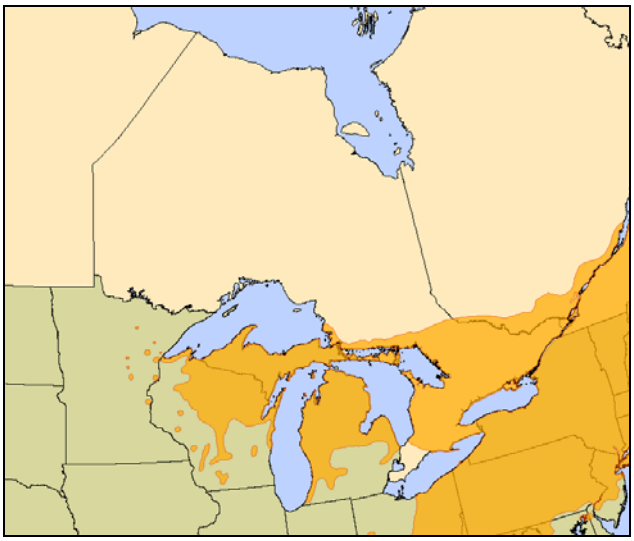
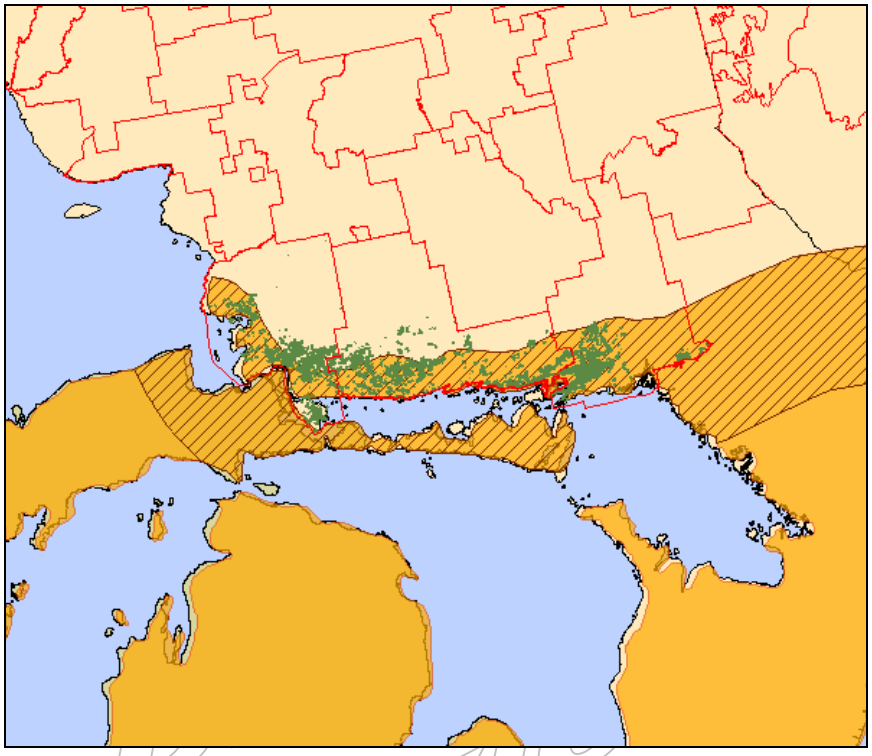


Figure 5.3 Generalized range of eastern hemlock, *Tsuga canadensis*, a 100 km buffer from range edge, and stands containing eastern hemlock in the Algoma, Northshore and Sudbury Forests.



mean that all populations of that species in that region are at their range edge. It does provide guidance, however, for systematically examining all of those tree species that have range edge populations in the region and if these intersect the forest licence area under examination, then they should be listed as HCVs and the stands in which they occur as HCVFs.

In some cases, there may be a need to identify sites as HCVF areas that formerly supported range edge populations of tree species that have declined significantly as a result of past forest practices. An example of this situation pertains to eastern hemlock in the Algoma area in central Ontario. Stands of this long-lived, highly shade-tolerant (and often difficult to re-generate) species have diminished in many parts of its range, including those in this northern part of its range (Figures 5.2 and 5.3). We recommend identifying remaining populations and stands within 100 km of its range edge as HCVFs, with the highest priority being those that are most isolated from adjacent populations. In addition, we recommend that where site conditions exist that could have formerly supported eastern hemlock in the Algoma area, that these be actively managed as HCVFs in a manner that could help restore populations to a level more representative of historical conditions.

Where range edge populations can be maintained under an existing management prescription, sites may still need to be identified as HCVFs in order that monitoring occurs to ensure that management techniques are effective

SUMMARY OF RECOMMENDATIONS

Populations that should qualify as range edge under this indicator include those that:

- Represent the outermost 100 km of the known continuous range area
- Represent relatively narrow, linear extensions of the main range area (*e.g.* along riparian corridors)
- Are reproductively disjunct or isolated from the main range area (the distance between such qualifying populations and the main range area will vary with the species dispersal ability)

Where ranges have contracted or where numbers of range edge populations have diminished, site conditions or habitats that could support the re-introduction or restoration of populations should also be considered as HCVFs.

LITERATURE CITED

Hosie, R.C. 1990. Native Trees of Canada, 8th edition. Fitzhenry & Whiteside Ltd.380 pp

Holt, R. and T. Keitt. 2000. Alternative causes for range limits: a metapopulation perspective. Ecology Letters 3 (1): 41-47