Collaboration for Environmental Evidence

Systematic Review No. 81

WORKING TITLE: Hotspots in a cold climate - are woodland key habitats biodiversity hotspots?

Draft Review Protocol

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Cover Sheet

Title	**Working title:** *Hotspots in a cold climate- are woodland key habitats biodiversity hotspots?*
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1. Background

Forests in the Fennoscandia and Baltic regions have a long history of human utilization. From the beginning of the 20th century forest harvesting methods shifted from selection felling towards clear-cutting. Modern, highly mechanised forestry with clear-cutting, intensive silviculture, thinning of regenerating stands and short rotation times, has been employed since 1950s in Fennoscandia and since 1990s in the Baltic States. Because in Fennoscandia and Baltic countries the majority of the forests are commercially managed conservation of biodiversity critically depends on management actions that take place in the production forests, i.e. in areas outside forest reserves. Starting from the early 1990's, new forestry practices, such as leaving retention trees and controlled burning, have been used to take biological values of production forests into consideration.

One tool for conservation of the forest biodiversity is the conservation of small habitat patches called Woodland Key Habitats (WKH). The concept of WKH was initiated in Sweden in the early 1990´s. Nitare & Noren (Nitare et al, 1992) described WKH as a habitat where red-listed species occur or are likely to occur. The concept is based on two assumptions. First, red-listed species are assumed to be clustered into certain sites or habitats rather than to occur evenly or randomly in the forest landscape. Second, it should be possible to identify WKH´s by their structural features and indicator species and thus direct observation of red-listed species would not be necessary.

WKH concept has been adopted from Sweden to Finland, Norway, Denmark, Latvia, Lithuania, Estonia, and Russia and it has become an essential instrument in the conservation of forest biodiversity as an assumed biodiversity hotspot. Large scale WKH inventories have been conducted nationally and there are several studies assessing whether WKHs really are biodiversity hotspots in a forest landscape e.g. (Gustafsson et al, 1999, Gustafsson, 2000, Johansson et al, 2001, Sverdrup-Thygeson, 2002, Gustafsson et al 2004, Pykälä et al 2006).

Since the logging of production forest is by large conducted as clear cuts, and the main idea is to conserve biodiversity in production forest by WKHs, then the biodiversity qualities should be able to persist even when WKHs are surrounded by clear cuts. However, clear cut of the surrounding production forest of WKH will most likely cause changes for the WKHs due to e.g. isolation and edge effect. The edge effect may cause change in the microclimatic conditions due to increased exposure to sunlight and wind. Physical damage caused by the wind reduce lichen abundance (Esseen et al, 1998) but responses of species to edge effects seem to be species-specific and context-dependent (Moen et al, 2003). Since the main idea is to conserve biodiversity in production forest by WKHs then the biodiversity qualities should be able to persist even when WKHs are surrounded by clear cuts. Therefore, the comparison of biodiversity qualities between WKHs surrounded by production forest and WKHs surrounded by clear cut should be performed. In addition, to really evaluate the status and validity of WKHs as biodiversity hotspots, and thus a sound conservation tool, a systematic review is well argued.

2. Objective of the Review

2.1 Questions

To systemically collate and synthesize published and unpublished evidence originating from the Fennoscandia and Baltic countries as well as Russia, in order to address the following questions:

1. "Are Woodland Key Habitats (WKH) biodiversity hotspots (i.e. do they have higher biodiversity qualities) compared to the surrounding production forests?"
2. "Is there a difference in biodiversity qualities between WKHs surrounded by production forest and WKHs surrounded by clear cuts?"

2.2 Subjects

Listed below are the biodiversity qualities that will be studied to assess the hotspot status in primary question 1. and to compare the differences between WKHs in primary question 2. The geographical scope is in Fennoscandia and Baltic countries, and in Russia. Both questions are stated above.

1. red-listed species richness
2. total species richness
3. volume of dead wood
4. large diameter trees
5. the volume and proportion of deciduous trees of total volume of trees

3. Methods

3.1 Search strategy

In order to collate information for the review the following steps will be carried out:

3.1.1 Review scoping

The keywords were tested to first of all find the most relevant ones, and secondly, to find out whether there are enough studies conducted to execute a competent review. This was done by using the following keywords in ISI Web of Knowledge search:

Keyword 1		Keyword 2	Hits
Woodland key habitat*			291
Woodland key habitat*	AND	species richness	54
	AND	red-listed species	30
	AND	dead wood	33
	AND	production forest*	28

	AND	managed forest*	30
	AND	clear cut*	7
	AND	hotspot*	4
	AND	biodiversity	93
	AND	Sweden OR Finland OR Norway OR Latvia OR Lithuania OR Estonia OR Russia OR Denmark ***	>100 000
	AND	deciduous tree*	¤
Key habitat*	AND	species richness	573
	AND	red-listed species	40
	AND	dead wood	111
	AND	production forest*	225
	AND	managed forest*	126
	AND	clear cut*	38
	AND	hotspot*	61
	AND	biodiversity	1,116
	AND	Sweden OR Finland OR Norway OR Latvia OR Lithuania OR Estonia OR Russia OR Denmark	>100 000
	AND	deciduous tree*	¤

After the scoping the list of keywords remained mostly the same. However, we decided to not combine keywords "Woodland key habitat" and countries (marked by ***). We also decided to add a new keyword (added and marked with ¤ in the "hit" column at the table above). With the "Key habitat"-keyword we will combine one other keyword at a time plus the countries, for example: Key habitat AND species richness AND Sweden OR Finland OR Norway OR Latvia OR Lithuania OR Estonia OR Russia OR Denmark.

3.1.2 Database search

The following databases are used for the searches:

- ISI Web of Knowledge
    1. Web of Science®
    2. BIOSIS Previews®
    3. CABI: CAB Abstracts®
    4. Food Science and Technology Abstracts ™
    5. Journal Citation Reports®
- Scopus

3.1.3 Internet search

The first 100 results of each of the searches will be considered and will be included in the review if relevant. The search will be conducted by Google Scholar. The same keywords will be used as in the database search.

3.1.4 Specialist searches

The following institutions will be consulted. Here we decided to restrain the organizations to Sweden and Finland due to the fact that the material from other countries would have been difficult to extract when written in native languages.

- Swedish Forest Agency
- Forestry Development Centre Tapio

3.2 Study inclusion criteria

The studies will be assessed for inclusion in the review based on a hierarchical assessment of relevance first by looking only the title (if the number of hits in >500). If the number of hits is lower then all the abstracts will be read, followed by reading the full text of articles with relevant abstracts. Abstracts will be deemed relevant if the desired subject and outcome are present (listed below).

3.2.1 Relevant subject

All the studies that investigate WKHs surrounded by production forests, and WKHs surrounded by clear cuts, and include collected data.

3.2.2 Types of intervention

Conservation of WKHs from silvicultural measures in production forests.

3.2.3 Types of comparators

It is expected to compare the biodiversity qualities between WKHs and surrounding production forests, and between WKHs surrounded by production forests and WKHs surrounded by clear cuts.

3.2.4 Types of outcome

WKHs are or are not hotspots for biodiversity, WKHs surrounded by production forest are richer or poorer in biodiversity qualities compared to WKHs surrounded by clear cuts or there are no differences.

3.2.5 Types of studies

The selected studies will be those that present comparisons of biodiversity qualities between WKHs and surrounding production forests, or comparisons of biodiversity qualities between WKHs surrounded by production forests or surrounded by clear cuts. Studies can be articles in peer-reviewed journals, book chapters, theses, or reports from governmental or non-governmental organizations. Other type of grey literature will also be included. Both quantitative and qualitative presenting studies will be included.

3.3 Potential effect modifiers and reasons for heterogeneity:

The definition of WKHs differs between countries. Hence ecological differences between WKHs from different countries could be expected. Also, there could be heterogeneity in the structure and age of the production forests surrounding the WKHs.

3.4 Study quality assessment

Material found during the search will be categorized into three quality categories:

1. Peer-reviewed articles from internationally recognized journals
2. Books, book chapters, reports, non-peer reviewed journal articles, Masters and PhD theses
3. Unpublished grey literature

3.5 Data extraction strategy

To extract information from selected studies, tables will be designed to compile quantitative and qualitative data from each of the studies. The following information will be included in the tables:

- Author
- Year
- Studied biodiversity qualities (indicators?)
- Country and study area
- Experimental design (what has been compared)
- Habitat type
- Habitat size
- Main result : statistics (t, z, F, X^2 etc.), df or sample size, mean values

3.6 Data synthesis and presentation

The synthesis of the data will include summary tables containing characteristics and results of each study. If enough studies are found, quantitative meta-analysis will be conducted.

4. Potential Conflicts of Interest and Sources of Support

None expected *a priori.*

5. References

Esseen, P., Renhorn, K., 1998. Edge Effects on an Epiphytic Lichen in Fragmented Forests. Conservation Biology 6, 1307-1317.

Gustafsson, L., 2000. Red-listed species and indicators: vascular plants in woodland key habitats and surrounding production forests in Sweden. Biological Conservation 1, 35-43.

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Gustafsson, L., Hylander,K., Jacobson, C., 2004. Uncommon bryophytes in Swedish forests-key habitats and production forests compared. Forest Ecology and Management 1-3, 11-22.

Johansson, P., Gustafsson, L., 2001. Red-listed and indicator lichens in woodland key habitats and production forests in Sweden. Canadian Journal of Forest Research/Revue Canadienne de Recherche Forestiere 9, 1617-1628.

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Nitare, J., Norén, M., 1992. Nyckelbiotoper kartläggs i nytt projekt vid Skogsstyrelsen. Svensk Botanisk Tidskrift 86, 219-226 (in Swedish with English abstract).

Pykälä, J., Heikkinen, R.K., Toivonen, H., Jääskeläinen, K., 2006. Importance of Forest Act habitats for epiphytic lichens in Finnish managed forests. Forest Ecology and Management 1-3, 84-92.

Sverdrup-Thygeson, A., 2002. Key habitats in the Norwegian production forest: A case study. Scandinavian Journal of Forest Research 2, 166-178.