

AEI Technical Supplement

Wildlife Habitat on Farmland: Methodology

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Indicator Name: Wildlife Habitat Capacity of Farmland Indicator
Status: National coverage, 1981 to 2001

Background

Agricultural land, which makes up 7.5% of Canada's land mass, has the most fertile soils and the most favourable climatic conditions. Canada's agricultural landscape is comprised of cultivated and grazing land with associated riparian, wetlands, woodlands, and natural grasslands. These habitats support many species of Canada's birds, mammals, reptiles, and amphibians. As land managers, agricultural producers play a significant role in sustaining biodiversity. Conversion of natural landscapes and changes in land use, such as wetland drainage, cultivation of natural lands, overgrazing, loss and fragmentation of forest cover affect wildlife habitat negatively. Conversely, conservation tillage, planting shelterbelts, responsible grazing on natural and tame grasslands, and buffering riparian areas support the sustainability of biodiversity.

The Wildlife Habitat Capacity of Farmland Indicator assesses the trends in the capacity of agricultural lands to provide suitable habitat that will sustain populations of wild terrestrial vertebrates in Canada. The indicator relates the various habitats used by birds, mammals, reptiles and amphibians to five broad land cover categories (habitat types) used in the Census of Agriculture: cropland, summer fallow, tame pasture, natural pasture and "all other land." The indicator improves our understanding of how sectoral, market and policy issues can affect the availability of wildlife habitat on agricultural lands.

Calculation Method

Habitat Suitability Matrices were developed for 493 wildlife species associated with farmland habitat (modified from Neave and Neave 1998). The species list and habitat use information was compiled using information from authoritative wildlife guidebooks, literature review and expert opinion. Matrices were constructed, at the EcoZone scale, for each bird, mammal, amphibian, and reptile known to use agricultural land and adjacent habitats for one or more specific habitat requirements (breeding, feeding, loafing, cover, staging, and wintering). Each habitat use was ranked primary (without this habitat the species cannot use the area), secondary (species will use several habitat types for the same purpose), or tertiary (habitat not required, but species occasionally observed in it). The *Wild Species 2000, General Status of Species in Canada* Report (Environment Canada 2001) was used to generate Provincial species lists. The information within the Habitat Suitability Matrices was converted to a relational database for improved querying and spatial analyses. An example habitat suitability matrix is shown in table 1.

Table 1. Sample Page from the Habitat Suitability Matrix for Mammals in the Prairie Ecozone

Habitat	Arctic Shrew				Masked Shrew				Pygmy Shrew				Northern Shorttailed Shrew				Keen Myotis				Little Brown Myotis			
	r	f	c	w	r	f	c	w	r	f	c	w	r	f	c	w	r	f	c	W	r	f	C	W
Cropland:																								
Crop type																								
Spring wheat																								
Durum wheat																								
Oats																								
Barley																								
Other grains																								
Canola																								
Other oilseeds																								
Alfalfa																								
Tame hay	1	1	1	1	1	2	2					2	2	2										
Other crops																								
Fruits and vegetables																								
Summerfallow																								
Tame or Seeded Pasture	1	1	1	1	1	2	2					2	2	2	2									
Natural Land for Pasture																								
Natural Grassland	1	1	1	1	1	1	1	2	1	1	1	1	2	2	2	2								
Sagebrush/Shrubs					1	1	1	2	1	1	1	1	2	2	2	2								
All other land																								
Houses/ outbuildings																				1		1		
Woodland																								
plantation																								
woodlot with interior					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1		
woodlot without interior					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1		
Shelterbelts/Fencerows																								
treed					1	1	1	1																
grass					1	1	1	1	1	1	1													
Wetlands																								
riparian					1	1	1	1	1	1	1	1	1	1	1	1					1			
shallow with margins	1	1	1	1	1	1	1		1	1	1	1									1			
shallow without margins																								
deep with margins	1	1	1	1	1	1	1		1	1	1	1									1			
deep without margins																								
NOTES	Christian et al. 1997 Whitaker 1996 VanZyll and DeJong 1983 Banfield 1974				Kirkland Peterson Christian et al. 1997 Whitaker 1996 Yahner 1983 VanZyll and DeJong 1983 Banfield 1974				Churchfield Whitaker 1996 Long 1974 -bog margins and uplands -habitat varies seasonally				Christian et al. 1997 Kaufman et al. 1993 Yahner 1983 George and Choate 1986				Burt and Grossenheider 1964 Whitaker 1996				Krusic et al. 1996 Burt and Grossenheider 1964 Fenton 1978 Schowalter et al. 1979 Whitaker 1996 hibernates in caves and mines			

Agricultural habitat types in the Habitat Suitability Matrices correspond to Census of Agriculture categories: Cropland, Summerfallow, Tame or Seeded Pasture (Tame Pasture), Natural Land for Pasture (Natural Pasture), and All Other Land. These broad categories were subdivided to more precisely reflect different habitats found on agricultural land. For example, Natural Pasture was divided into natural grassland, sagebrush/shrubs, and shrubs/woodland.

A Habitat Capacity index is calculated by relating the number of species using each of the five main land cover categories in the Census of Agriculture to the relative area occupied by each land cover category, as in the following formula:

$$\mathbf{HC} = \ln (\#spp. \mathbf{CRPL} \times \% \mathbf{CRPL}) + \ln (\#spp. \mathbf{SF} \times \% \mathbf{SF}) + \ln (\#spp. \mathbf{NP} \times \% \mathbf{NP}) + \ln (\#spp. \mathbf{TP} \times \% \mathbf{TP}) + \ln (\#spp. \mathbf{AOL} \times \% \mathbf{AOL})$$

where;

HC=Habitat Capacity

ln=natural log

#spp. = the number of species using the habitat category

CRPL=Cropland

SF=Summerfallow

NLP=Native Pasture

TP=Tame Pasture

AOL=All Other Land.

Only primary and secondary habitat use for breeding, feeding or cover was considered in the Habitat Capacity calculation. This formula was applied to each Soil Landscape Unit (SLC; version 3.0) polygon containing agricultural land cover to give values for each of the five Census of Agriculture habitat categories.

National and provincial Habitat Capacity trends were calculated for four *Census of Agriculture* reporting years (1986, 1991, 1996, 2001). A twenty-year change in Habitat Capacity (national and provincial) was reported by five classes: negligible to small change (-2.5% to +2.5%), moderate increase (>2.5% to 10% change), large increase (> 10% change), moderate decrease (<-2.5% to - 10% change) and large decrease (< -10% change).

Data Sources

1. The *Soil Landscapes of Canada* (SLC) version 3.0 map series and polygon attribute files (Soil Name File (SNF) and Soil Layer File (SLF)) nested within Ecozones, Ecoregions and Ecodistricts (Ecological Stratification Working Group 1995) (<http://sis.agr.gc.ca/cansis/nsdb/slc/v3.0/intro.html>) provided spatial data for:

- SLC polygon boundaries
- link to ecostratification framework

2. *Census of Agriculture* spatial data for crop type and management, custom-linked to SLC version 3.0 agricultural polygons for 1981, 1986, 1991, 1996, and 2001 for:

- cropland area
- summerfallow area
- tame pasture area
- natural pasture area
- area of “all other land”.
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3. The species list was compiled using information from authoritative wildlife guidebooks (Godfrey 1966; Behler and King 1996; Whitaker 1996).

4. *Wild Species 2000, General Status of Species in Canada* Report (Environment Canada 2001) was used to generate Provincial species lists (<http://www.wildspecies.ca/>).

5. Habitat use information was gathered from a review of scientific literature and expert opinion.

Results

Results related to the changes in the Wildlife Habitat Capacity of Farmland Indicator for two periods: a 10-year period (1991-2001) and a 20-year period (1981-2001) are provided for the provinces and for Canada as a whole in the Wildlife Habitat on Farmland chapter from the Agri-Environmental Indicator Report #2.

Wildlife Habitat Capacity is reported as a trend for each SLC, without making assumptions about the “initial state of wildlife habitat” contained within. Therefore, direct comparison of habitat quality should not be made among SLCs. Examples: The conversion of farmland from Summerfallow to Cropland would increase the habitat capacity of that SLC polygon (many more wildlife species use Cropland than Summerfallow). On the other hand, the conversion of Native Land for Pasture to Cropland would signify a decrease in the habitat capacity, even if habitat availability remained relatively high for that polygon, compared to the previous example.

Limitations

The limitations for this indicator are given in Wildlife Habitat on Farmland chapter from the Agri-Environmental Indicator Report #2.

References

Arnold T.W., Sorenson M.D., Rotella J.J. 1994. Relative success of overwater and upland mallard nests in southwestern Manitoba. *Journal of Wildlife Management* 57: 578-581.

Annand E.M., Thompson F.R. 1997. Forest bird response to regeneration practices in central hardwood forests. *Journal of Wildlife Management* 61: 159-171.

Behler J.L., King F.W. 1996. National Audubon Society field guide to North American reptiles and amphibians. Alfred E. Knopf, New York.

Best L.B. 1986. Conservation tillage: ecological traps for nesting birds? *Wildlife Society Bulletin* 14: 308-317.

Biodiversity Science Assessment Team. 1994. Biodiversity in Canada: a science assessment for Environment Canada. Environment Canada. Ottawa. 245 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC), *Canadian Species at Risk* (Ottawa: COSEWIC), May 2003. (booklet; May 2004 version available soon)

http://www.cosewic.gc.ca/htmlDocuments/CDN_SPECIES_AT_RISK_May2003_e.htm

Cox K.W., *Wetlands: a Celebration of Life*, Final Report of the Canadian Wetlands Conservation Task Force, Issue Paper No. 1993-1 (Ottawa: North American Wetlands Conservation Council [Canada]), 1993. (Sustaining Wetlands Issues Paper Series)

Duebbert H.F., Kantrud H.A. 1987. Use of no-till winter wheat by nesting ducks in North America. *Journal of Soil and Water Conservation*. 50-53.

Edwards C.A., Lofty J.R. 1975. The influence of cultivations on soil animal populations. In: Vanek J. Ed., *Progress in Soil Zoology*. Dr. W. Junk Publishers, the Hague, Netherlands. Pages 399-407.

Federal-Provincial-Territorial Biodiversity Working Group, Biodiversity Convention Office, *Canadian Biodiversity Strategy. Canada's Response to the Convention on Biological Diversity. 1995* (Ottawa: Minister of Supply and Services Canada), 1995 (Cat. No. En21-134/1995E)

http://www.eman-rese.ca/eman/reports/publications/rt_biostrat/intro.html

- Godfrey W.E. 1966. The Birds of Canada. National Museums of Canada, Ottawa
- Hofman E., Bjorge R. 1995. Duck nesting in tillage fallow, chemical fallow and underseed legume fields, south-central Alberta, 1990 and 1991. Unpublished Report, Alberta Environmental Protection.
- Kozakiewicz M. 1995. Resource tracking in space and time. P. 136-148 in: Mosaic Landscapes and Ecological Processes. Hansson L., Fahrig L. and Merriam G. Ed. Chapman and Hall, London.
- Lokemoen J.T., Beiser J.A. 1997. Bird use and nesting in conventional, minimum tillage and organic cropland. *Journal of Wildlife Management* 644-655.
- Loring S.J., Snider R.J., Robertson L.S. 1981. The effects of three tillage practices on Collembola and Acarina populations. *Pedobiologia* 22: 172-184.
- Losito M.P., Baldassarre G.A., Smith J.H. 1995. Reproduction and survival of female mallards in the St. Lawrence River Valley, New York. *Journal of Wildlife Management* 59: 23-30. Marty S. 1997. Saltwater Solace. *Canadian Geographic* 117: 62-72.
- Merriam G., Wegner J., Pope S. Generic ecological framework for National Park planning and management. Carleton University, Ottawa.
- Morrison M.L., Marcot B.G., Mannan R.W. 1992. Wildlife habitat relationships: concepts and applications. University of Wisconsin Press.
- NAWMP 1996. Taking Flight-- North American Waterfowl Management Plan. 1986-1996: 10th Anniversary Report - Canada. Writing by West Hawk Associates. 16 pp.
- Neave P., and E. Neave, *Habitat and Habitat Availability Indicator. Agri-Environmental Indicator Project* (Ottawa: Agriculture and Agri-Food Canada), 1998.
- Paul E.H., Robertson G.D. 1989. Ecology and the agricultural sciences: a false dichotomy? *Ecology* 70: 1594-1597.
- Phillips, R.E., Blevins R.L. Thomas G.W., Frye W.W., Phillips S.H. 1980. No-tillage agriculture. *Science* 208: 108-113.
- Prescott D.R.C., Bilyk J. 1996. Avian communities and NAWMP habitat priorities in the southern prairie biome of Alberta. Alberta NAWMP Centre and Land Stewardship Centre of Canada. NAWMP-026. Edmonton. AB. 43 pp.
- Prescott D.R.C., Murphy A.J. 1996. Habitat associations of grassland birds on native and tame pastures in the aspen parkland of Alberta. Alberta NAWMP Centre. NAWMP-021. Edmonton, AB. 36 pp.

Sauer J.R., Hines J.E., Gough G., Thomas I., Peterjohn B.G. 1997. The North American Breeding Bird Survey Results and Analysis. Version 96.4. Patuxent Wildlife Research Centre, Laurel M.D.

Skinner D.L., Johnston S., Westworth D.A. 1996. Abundance and distribution of mammals on a complementary / rotational grazing system in southern Alberta. Alberta NAWMP Centre. NAWMP-023, Edmonton, AB. 24 pp.

Sovada M.A., Sargeant A.B., Grier J.W. 1995. Differential effects of coyotes and red foxes on duck nest success. *Journal of Wildlife Management* 59: 1-9.

Wild Species 2000, General Status of Species in Canada. 2001. Environment Canada. <http://www.wildspecies.ca/>

Warburton D.B., Klimstra W.D. 1984. Wildlife use of no-till and conventionally tillage corn fields. *Journal of Soil and Water Conservation* 39: 327-330.

Watmough M.D., et al, *Prairie Habitat Joint Venture Monitoring Program Phase I: Recent Habitat Trends in NAWMP Targeted Landscapes* (Edmonton, Alberta: Canadian Wildlife Service), 2002. (Technical Report Series No. 391)

Whitaker J.O. 1996. National Audobon Society Field Guide to North American mammals. Alfred E. Knopf, New York.

Wiken, E.B., Gauthier, D., Marshall, I., Lawton, K. and H. Hirvonen. 1996. A perspective on Canada's ecosystems: an overview of the terrestrial and marine ecozones. Canadian Council on Ecological Areas. Occasional Paper No. 14. Ottawa, Ontario.

Wildlife Ministers Council of Canada. 1990. A Wildlife Policy for Canada. Ottawa.

Wildlife Management Institute. 1995. How Much is Enough? A Regional Wildlife Habitat Needs Assessment for the 1995 Farm Bill. McKenzie D.F. and Riley T.Z. Ed. Washington.

Winter J.P., Voroney R.P., Ainsworth D.A. 1990. Soil microarthropods in long-term no-tillage and conventional corn production. *Canadian Journal of Soil Science* 70: 641-654.