

Colloque Eastern CANUSA

Les sciences forestières au-delà des frontières

Eastern CANUSA Conference

Forest Science across the Borders

19-21 octobre 2006 / October 19-21, 2006
Université Laval, Pavillon Alphonse-Desjardins
Québec (Québec) / Quebec, QC
Canada

Manuel de conférence

Seconde édition avec résumés populaires

Conference handbook

Second edition with popular abstracts

Compilé par / Compiled by

Guy R. Larocque
Mathieu Fortin
Nelson Thiffault

Organisé par :
Hosted by:

Natural Resources Canada
Canadian Forest Service

Ministère des Ressources naturelles et de la Faune du Québec
Direction de la recherche forestière

Université Laval
Faculté de foresterie et de géomatique

Forest inventory maps: A useful tool for a wetland habitat classification and regionalization in Quebec's forests

Ménard, Sylvain^{1,2}, Marcel Darveau² and Louis Imbeau⁴

Abstract

Even if we have acquired a good knowledge of wetlands' ecology and classification, quantification of the abundance of wetland types and delineation of homogeneous regions in terms of wetland habitats are still lacking in forest dominated landscapes. The most limiting factor for coarse-scale studies of wetlands is clearly the absence of a precise and reliable wetland spatial database available at low costs. Our objective is thus to develop such a tool based on forest inventory maps. A distribution study of wetlands was conducted on a 540 000 km² area located in boreal Quebec. A total of 448 numerical forest inventory map leaflets systematically distributed were chosen, covering 20% of the study area. Using GIS rules and queries, it was possible to discriminate several types of deepwater and wetland habitats of faunal interest according to a classification system inspired from Rempel's (1997) wetland habitat classification for boreal forest waterfowl and adapted by Breton (2005) (Ménard *et al.* 2006). Results evidenced the spatial heterogeneity, richness and complexity of the wetlands found in our study area. On average, wetlands and deepwater occupy respectively 11.7 % and 10.3 % of the study area but these proportions showed considerable spatial variation. We conclude that forest inventory maps can be used to quantify the area of wetland habitats and to define homogeneous regions in this regard, and therefore provide a functional tool for coarse-scale wetland management and protection.

Introduction

Because large portions of forested landscapes are rather isolated from inhabited regions, they are not submitted to the pressures of urbanisation and agriculture, and many people (including conservation organisations) tend to think that they are implicitly protected. However, it is difficult to determine the scope of the global impact of forestry, mining, hydroelectricity, the gaz and oil industry and even recreotourism on wildlife and their habitat. If foresters and biologists

¹Université du Québec en Abitibi-Témiscamingue, Département des sciences appliquées, 445 boul. de l'Université, Rouyn Noranda, QC, J9X 5E4, Canada. s_menard@ducks.ca.

²Ducks Unlimited Canada, 710, Bouvier, bureau 260, Québec, QC, G2J 1C2, Canada.

³Département des sciences du bois et de la forêt, Faculté de foresterie et de géomatique, Pavillon Abitibi-Price, Université Laval, Québec, QC, G1K 7P4, Canada.

⁴Université du Québec en Abitibi-Témiscamingue, Département des sciences appliquées, 445 boul. de l'Université, Rouyn Noranda, QC, J9X 5E4, Canada.

want to provide management guidelines in the eastern forest, they need to fill knowledge gaps relative to wetland classification and its importance to wildlife. Even if we have acquired a good knowledge of the ecology and classification of wetlands, a quantification and regionalisation of the abundance of wetland habitats are still lacking in boreal Quebec. The most limiting factor for coarse-scale studies of wetlands in Quebec's forests is clearly the absence of a precise and reliable wetland spatial database available at low costs.

Methods

Because forest inventory maps are not able to accommodate any of the existing wetland classification systems, wetland habitats have been mapped using a functional system that we have especially developed for this purpose (Ménard *et al.* 2006). The system is inspired from Rempel's (1997) wetland habitat classification for boreal forest waterfowl which was developed for aerial photography. Breton *et al.* (2005) adapted and automated the system so it could be used with forest inventory maps. We started out from this system, refining and improving it. Our classification system has two hierarchical levels (Tab. 1). At the first level, wetlands are grouped into four classes: 1) Aquatic, 2) Shoreline, 3) Swamp (five sub-classes according to trophic level, soil and vegetation), 4) "Bare wetland", corresponding to commercially unproductive wetlands (bogs, fens, marshes, etc.). Two sub-classes have been added: 1) isolated wetland and 2) wetland complex. This subclass proved to be necessary when preliminary results showed the presence of large polygons (> 8,000 ha) in which several types of wetlands and forest stands were embedded.

At the second level, the Shoreline and Bare wetland classes are subdivided according to the hydrological system that it is in contact with. Those systems (reservoir, lake, pond, isolated pond, river) are discriminated by their size, water level variation and the presence / absence of water level regulation. For habitats in contact with more than one hydrological system, hierarchy has been defined as follows: Reservoir > Lake > Pond > River > Isolated pond.

In order to map wetland habitats, we have acquired 448 forest inventory map leaflets (in numerical form) of the Quebec Ministry of Natural Resources and Wildlife (3rd edition; scale 1:20,000; 14 km x 18 km = 252 km² per leaflet). Our design overlays the design of a grid of 156 waterfowl survey plots distributed in Quebec's boreal forest by the Canadian Wildlife Service (CWS) in the 1990s, allowing us to investigate waterfowl –wetland habitat relationships in a concomitant project. The maps cover 20 % of the 540,000 km² study area bounded in the north by the 51°15' N and in the south by the Saint-Lawrence lowlands (Fig. 1).

The forest inventory map has been chosen because it is an easy to use database that covers almost entirely the forested portion of the province. It is also a well known tool that is already used not only by forest managers, but also by biologists and land use planners. In numerical form, it contains a lot of information pertaining to wetlands and deepwater habitats. Hydrography (surfaces and linear features) is defined by an attribute (lake, river, reservoir, perennial and ephemeral streams) and the Quebec Forest Inventory Service (SIEF) has mapped unproductive wetlands (wetlands with no timber production: alder swamps, flooded forests and "bare wetlands") and determined ecological types for productive stands, characterising potential vegetation and station (Grondin *et al.* 2003). The database allows us to identify wetlands as small as 1 ha for unproductive wetlands and 8 ha for productive stands.

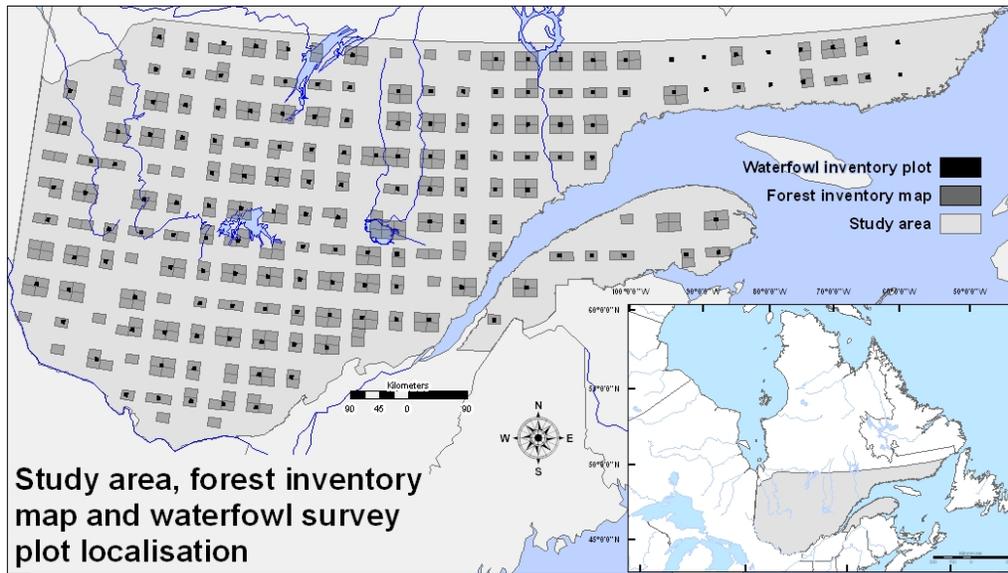


Figure 2: Study area (gray) and acquired forest inventory maps (dark gray).

Results and discussion

Results evidenced the spatial heterogeneity, richness and complexity of the wetlands of forested Quebec. Wetlands and deepwater occupy respectively 11.7 % and 10.3 % of the study area (Tab. 1) and vary considerably across the region (Fig. 2). Considering a sampling effort of about 20 %, these results are in concordance with the National Wetland Working Group's (NWWG 1988) estimation which is of 9 % wetland coverage.

Table 1: Wetland habitat classification. The land cover proportion is calculated over the 448 forest inventory maps (130 000 km²). The estimated km² is for the total study area.

Class	Subclass	System	Type	Land cover (%) [*]	Estimated km ^{2†}
Aquatic		Reservoir	AqD	2.7	14,310
		Lake	AqL	6.1	32,668
		Pond	AqP	0.8	4,173
		Isolated pond	AqI	0.1	385
		River bed	AqR	0.6	3,345
Total				10.27	54,882
Shoreline		Reservoir	ShD	76*	43,636 [†]
		Lake	ShL	83.3	230,398
		Pond	ShP	59.1	10,733
		Isolated pond	ShI	64.7	104,665
		River	ShR	73.1	682,197
Total				74.06	1,071,631
Swamp		Alder	SwA	0.9	4,820
		Poor forested	SwP	1	5,100
		Rich forested	SwR	1.2	6,551
		Forested bog	SwB	2.1	11,132
		Flooded	SwF	0.3	1,345
Total				5.42	28,950
Bare wetland		Complex	BwC	1.5	8,263
		Isolated	BwX	0.6	3,471
		Reservoir	BwD	0.1	336
		Lake	BwL	1.1	5,859
		Pond	BwP	1.1	5,851
		Isolated pond	BwI	0.03	208
	River	BwR	1.8	9,589	
Total				6.28	33,579

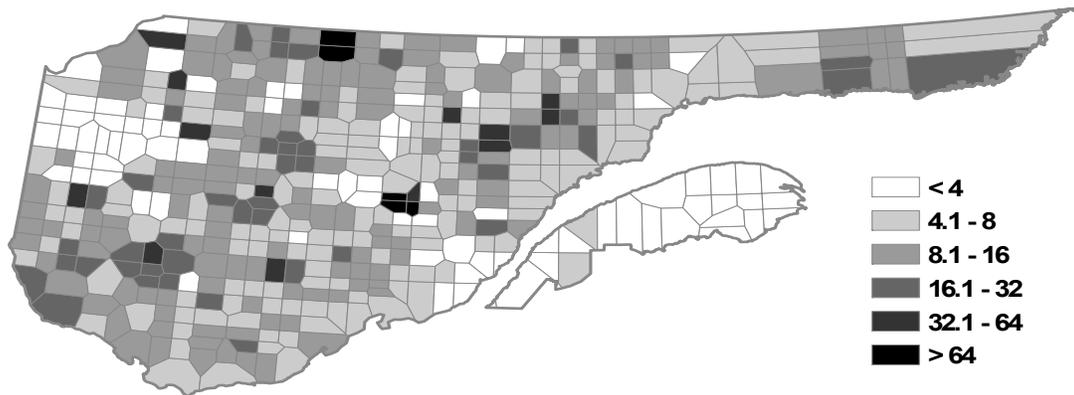


Figure 3 : Deepwater habitat (Aquatic class) land coverage for each map. Tessellation was used to fill the gaps between the maps

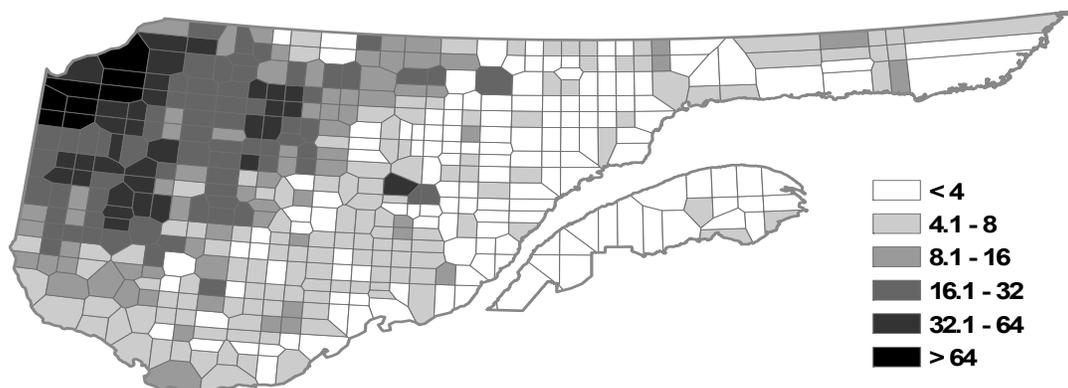


Figure 4: Wetland habitat (Bare wetland and Swamp class) land coverage for each map.

Conclusion

We believe that our classification system will add much value to a tool that is already valuable for other purposes. It's a simple, efficient tool, available at low cost, which we hope will answer the needs of several users. The wetland habitat distribution study results will be used to create homogenous regions in terms of wetland habitats associations and proportions. This regionalisation should be quite useful for research, land use planning, and modelling. Furthermore, because Quebec's forest inventory maps are revised every 10 years, it will be possible to refine the classification as the database becomes more precise.

References

- Breton, M.-N., Darveau, M. and Beaulieu, J. 2005. Développement d'une méthode de classification automatisée des milieux humides et des milieux riverains en forêt boréale. Canards Illimités Canada. Rapport technique n° Q2005-1
- Grondin, P., Saucier, J.-P., Blouin, J., Gosselin, J. and Robitaille, A. 2003. Information écologique et planification forestière au Québec, Canada. Ministère des Ressources Naturelles de la Faune et des Parcs, Direction de la Recherche Forestière.
- Ménard, S., Darveau, M., Imbeau, L. 2006. Méthode de classification des habitats humides du Québec boréal à partir de la carte écoforestière du 3^e décennal. Canards Illimités Canada. Rapport technique n° Q2006-3
- NWWG. 1988. Wetlands of Canada. Montréal: Environment Canada and Polyscience publication inc, 452 p.
- Rempel, R. S., Kenneth, A. F., Gadowski, T. R., Gabor, S. and Kenyon, R. 1997. A simple wetland habitat classification for boreal forest waterfowl. *Journal of Wildlife Management* 61(3): 746-757.

Theme: Forest ecosystems
