ESTIMATES OF BLACK SPRUCE AND PEATLAND AREAS IN ONTARIO

D. E. KETCHESON AND J. K. JEGLUM

GREAT LAKES FOREST RESEARCH CENTRE

SAULT STE. MARIE, ONTARIO

INFORMATION REPORT O-X-172

CANADIAN FORESTRY SERVICE

DEPARTMENT OF THE ENVIRONMENT

NOVEMBER 1972

Copies of this report may be obtained from

Director,
Great Lakes Forest Research Centre,
Canadian Forestry Service,
Department of the Environment,
Box 490, Sault Ste. Marie, Ontario.

ACKNOWLEDGEMENTS

The authors acknowledge the cooperation of the staff of the Ontario Ministry of Natural Resources (formerly the Ontario Department of Lands and Forests), especially Mr. Brian Cardwell and Mr. David Trafford of the Forest Inventory Unit. We are also grateful for the aid and advice of other members of the study group at the Great Lakes Forest Research Centre.

ABSTRACT

Using available provincial inventory and land data for Ontario, estimates were made of the areas of black spruce-dominated forest, peatland, and black spruce forest on peatlands. To show the distribution of these resources the estimates were made for each of the ecological sections. Percentages of black spruce-dominated forest and black spruce forest on peatland reached the highest levels in the Clay Belt, Northern Coniferous and Central Plateau ecological sections. On a province-wide basis it was found that black spruce-dominated forest occupies 40 per cent of the productive forest land area and that 46 per cent of this is black spruce forest on peatland. Peatlands were estimated to occupy 49 per cent of the province's total land area. This information about the extent and distribution of a major timber species and the broad site types on which it occurs should be of value in forest and land management planning.

TABLE OF CONTENTS

INTRODUCTION

One of the major study areas of the Great Lakes Forest Research Centre deals with the management of black spruce [*Picea mariana* (Mill.) B.S.P.] on peatlands[1]. To determine the relative importance of this resource to the forest economy of Ontario and the possible extent of management involvement with this resource, it is necessary to have an estimate of its areal extent and distribution.

Since black spruce occurs on both uplands and peatlands and since not all peatlands contain black spruce trees, we are dealing with the overlapping portion of two larger resources--the black spruce forests and the peatlands of Ontario. To place black spruce on peatlands in perspective, one must delineate the magnitude of the larger resources.

Thus, the objectives of this report are to estimate the areal extent and distribution of (i) black spruce-dominated forest, (ii) peatlands, and (iii) black spruce-dominated forest on peatland in Ontario.

METHODS

The basic area estimates found in this report are derived from the district reports of the Forest Resources Inventory of Ontario[2] (Dixon 1963; Ontario Department of Lands and Forests 1953). In each report the total area of the district was broken down into productive and nonproductive forest land, nonforested land, and water. The province is also divided into ecological sections (Fig. 1) which are largely coincident with Rowe's (1959) forest sections (Fig. 2). Each report gives a percentage breakdown of the area of the district found in each ecological section.

Because the ecological sections are relatively homogeneous land areas, both physiographically and vegetationally, it was decided to use these as the basic land units for areal estimation. From the district reports the total land area of each ecological section was calculated by multiplying the land area of the district by the percentage of each ecological section falling within that district.

D. E. Ketcheson is an Economist, and J. K. Jeglum a Research Scientist, at the Great Lakes Forest Research Centre, Sault Ste. Marie, Ontario.

[1] "Peatland" is defined as terrain having some arbitrary accumulation of peat such as 30 cm (*cf.* Heinselman 1963) or 40 cm (*cf.* Sjörs 1948).

[2] Other estimates have been made of the area of Ontario's productive forest lands, but we selected these reports because they provide regional area breakdowns.

The calculation of the total productive forest area and nonproductive forest area within each ecological section was done in the same way as the calculation of the total land area. However, this calculation is based upon the assumption that within each district the distribution of the various land classes is uniform. To the extent that this assumption is invalid, the estimates of the areas of the various land classes within each ecological section are incorrect. While this type of error exists in the estimates, it is minimal because most districts are located largely within one ecological section. The estimates of the broad land classes are presented in Table 1.

When the area of productive forest land had been calculated, areal estimates were made of black spruce-dominated forest and black spruce on peatland within each ecological section. These estimates are based upon sample areas selected for each ecological section from the Ontario Ministry of Natural Resources inventory reports. Table 2 presents the productive forest of the sample areas expressed as a percentage of the total productive forest area of each ecological section. Since the latest inventory for the province has not been completed, the samples consisted of those management unit reports which were available. Only those units which occur within a single ecological section were used. The management unit reports are divided into species working groups[3], with each stand within a particular working group described in terms of species composition, age, site, height and area. The area of the spruce working group[4] and that of the pure black spruce stands were extracted from the report.

In this report the black spruce stands in the spruce working group are referred to as "black spruce-dominated forest", and the pure

---

[3] A stand is allocated to a particular working group on the basis of the species having the greatest basal area. Thus, a stand with 40 per cent black spruce, 30 per cent balsam fir and 30 per cent trembling aspen would be in the spruce working group.

[4] The spruce working group includes both black-and white-spruce-dominated stands. However, the authors found white-spruce-dominated stands to be negligible within the areas sampled. Thus, the area of the spruce working group was used as the basis for estimating the area of the black-spruce-dominated forest. (It was recognized that this estimate includes a small error).

black spruce stands are equated with "black spruce forest on peatland".[5] The latter assumption is based on field observation and experience in Ontario, and also on the reasoning that the small amount of pure black spruce that is found on uplands is probably balanced to some degree by the occurrence of a small amount of mixed black spruce on peatland. The estimates of the types mentioned above are presented in Table 3.

Peatland areas in the nonproductive and nonforested land categories were calculated by the method used to estimate the broad land-class areas. Estimates of total peatland areas are presented in Table 4, and definitions of the various forest and peatland types considered in this study are presented in Appendix A.

For comparative purposes the areas dominated by other tree species or species groups were calculated. These estimates are found in Appendix B.

RESULTS

Areal Estimates of Black Spruce Forests

Table 1 presents estimates of productive and nonproductive forest land, nonforested land, and total land areas for the ecological sections as well as for the Unsurveyed Region in the far north and the Southern Agricultural Region. Table 3 presents estimates of the areas for ecological sections of black spruce-dominated forest, black spruce forests on peatland, and black spruce forest mixed with other species.

Figure 3 shows the productive forest area as a percentage of the total land area within each ecological section. Except for the Coastal Plain Section, the Unsurveyed Region, and the Southern Agricultural Region, the proportions of productive forest land are high, varying from 76 to 93 per cent. The low proportions of productive forest land in the Coastal Plain Section and the Unsurveyed Region reflect the fact that they are largely situated in the Hudson Bay Lowlands. The latter area is characteristically flat, poorly drained and predominantly covered with peatland types. Productive forests are found mostly on river banks and other infrequently occurring upland sites (Hustich 1955, 1957; Rowe 1959).

---

[5] To obtain a better estimate of the area of black spruce on peatlands, we included stands of black spruce mixed with larch, as well as pure black spruce, in this category.

In the Southern Agricultural Region, the proportion of productive forest land is considerably less than elsewhere, owing to the classification of a high proportion of the land as agricultural and urban.

Figures 4 and 5 show, by ecological sections, the areas of black spruce-dominated forest and black spruce forest on peatland expressed as percentages of the total land area. Four distinct areas characterize the distribution of these forest types. The southernmost area, roughly corresponding to the Great Lakes-St. Lawrence Forest Region (*cf.* Rowe, 1959), has a low proportion of black spruce areas. This includes the Algonquin, Algoma, Quetico and English River Sections. Within the southern portion of the Boreal Forest Region, *viz.*, the Temagami, Central Transition, Superior and Western Transition Sections, the proportion of black spruce area increases. It reaches a maximum in the Clay Belt, Central Plateau and Northern Coniferous Sections. In the northernmost parts of the Boreal Forest it is lower, corresponding to the increase in nonproductive forest land (Fig. 3).

Figures 6 and 7 express the areas of black spruce-dominated forest and black spruce forest on peatland as percentages of the total productive forest area within each ecological section. The lowest values occur in the southern part of the province, with higher proportions in the north indicating that black spruce forests dominate progressively more of the productive forest area. Furthermore, the peatland segment of the black spruce forest becomes increasingly more pronounced in the northern ecological sections, attaining a maximum proportion in the Coastal Plain Section (Fig. 8).

Areal Estimates of Peatlands

Table 4 presents estimates of the areas of wooded and open peatlands by ecological section. The wooded category includes some productive forest types, namely pure black spruce, cedar-dominated and larch-dominated stands.

Figure 9 presents peatland areas as percentages of total land areas by ecological section. The lowest proportions of peatlands are found in the Southern Agricultural Region and in the southern ecological sections bordering the Great Lakes. Northwards, the proportions increase, attaining the greatest magnitude in the Unsurveyed Region. Values also tend to increase from west to east, which probably relates to the increasingly moist climate (Sanderson, 1948) and flatter topography of the Clay Belt and Coastal Plain Sections. The proportions of wooded peatlands (Fig. 10) to total land area show the same trends.

The proportions of wooded peatlands to all peatlands are highest in the Northern Coniferous and Central Plateau Sections (Fig. 11). There is also a relatively high value in the Clay Belt, suggesting that the highest proportions of wooded peatlands occur just south of the Hudson Bay Lowlands in the Middle Boreal Forest Region (*cf.* Ahti 1964). The same trend is

demonstrated for black spruce forest on peatland as a percentage of total peatlands (Fig. 12). It can be seen that a large majority of peatlands in the Middle Boreal Forest Region of Ontario are covered with productive black spruce forests.

SUMMARY

This study was undertaken to provide information concerning the extent and distribution of black spruce on peatlands, in order to assess its importance as a resource. At the same time estimates were made of the area of black spruce-dominated forest and that of peatland.

It must be emphasized that these estimates are first approximations, intended as guidelines and not as exact measurements of the areas in question. However, they represent new information and provide reasonably accurate comparative values of the area and distribution of the resources.

An estimated 42.9 million acres of black spruce-dominated forest, representing approximately 41 per cent of the province's productive forest land and 20 per cent of the total land area, are found in Ontario. The area of peatland black spruce is estimated at approximately 19.7 million acres or 46 per cent of the spruce-dominated forest area. These figures illustrate the extensiveness of black spruce on both uplands and peatlands throughout the province. The peatland portion of the black spruce resource is concentrated in the northern ecological sections.

Peatlands occupy an estimated 107 million acres or 49 per cent of Ontario's land area. Of this, 92 per cent falls within the Clay Belt, Coastal Plain, Central Plateau and Northern Coniferous Sections and the Unsurveyed Region. Productive peatland black spruce occupies 18 per cent of the total peatland area. The remaining wooded peatlands represent 60 per cent of the total peatland area and are the major component in the nonproductive-forest category.

This report provides basic information on the extent and distribution of a major timber species and the broad site types on which it occurs. As such it represents the type of resource data that is essential to effective forest and land management planning.

REFERENCES

Ahti, T. 1964. Macrolichens and their zonal distribution in boreal and arctic Ontario, Canada. Ann. Bot. Fenn. 1 (1964):1-35.

Ahti, T. and R. L. Hepburn. 1967. Preliminary studies on woodland caribou range, especially on lichen stands, in Ontario. Ont. Dep. Lands Forests Res. Rep. (Wildlife) No. 74:1-134.

Bates, D. N. and D. Simkin. 1969. Vegetation patterns of the Hudson Bay Lowlands. Res. Br., Ont. Dep. Lands Forests. Map 326.

Dixon, R. M. 1963. The forest resources of Ontario. Ont. Dep. Lands Forests. 108 p.

Dixon, R. M. and W. E. Jenns. 1965. Inventory maintenance procedure for the province of Ontario. Ont. Dep. Lands Forests, Silvicult. Ser. Bull. No. 1:1-24.

Heinselman, M. L. 1963. Forest sites, bog processes, and peatland types in the glacial Lake Agassiz region, Minnesota. Ecol. Monogr. 33:327-374.

Hustich, I. 1949. On the forest geography of the Labrador Peninsula. Acta Geogr. 10(2):1-63.

Hustich, I. 1955. Forest-botanical notes from the Moose River area, Ontario, Canada. Acta Geogr. 13(2):1-50.

Hustich, I. 1957. On the phytogeography of the Hudson Bay Lowland. Acta Geogr. 16(1):1-48.

Ontario Department of Lands and Forests. 1953. Forest resources inventory 1953. Dist. Rep. 1-16, 23.

Ontario Department of Lands and Forests. 1964. Cruising instructions 1964 for forest resources inventory field parties. Unpubl. Rep., 12 p.

Ritchie, J. C. 1956. The vegetation of northern Manitoba. I. Studies in the southern spruce forest zone. Can. J. Bot. 34:523-561.

Rowe, J. S. 1959. Forest regions of Canada. Can. Dep. North. Aff. Nat. Resour., Forest. Br. Bull. 123:1-17.

Sjörs, H. 1948. Mire vegetation in Bergslagen (in Swedish, English summary). Acta Phytogeogr. Suec. 21:1-299 + append.

Sjörs, H. 1961. Forest and peatland at Hawley Lake, northern Ontario. Nat. Mus. Can. Bull. 171:1-31.

Sjörs, H. 1963. Bogs and fens on Attawapiskat River, northern Ontario. Nat. Mus. Can. Bull. 186:45-133.

Table 1. Estimates of broad land class areas by ecological section for the province of Ontario

Ecological section	Productive forest area	Nonproductive forest area	Nonforested area	Total land area
	'000 acres			
Algoma	2,677	117	95	2,889
Algonquin	7,653	623	764	9,040
Central Plateau	15,596	2,294	223	18,113
Central Transition	12,247	1,384	312	13,940
Clay Belt	10,458	2,333	152	12,942
Coastal Plain	7,458	18,311	253	26,022
English River	3,840	398	57	4,295
Northern Coniferous	14,755	4,469	210	19,434
Quetico	5,575	673	211	6,460
Superior	4,911	442	83	5,437
Temagami	5,707	454	273	6,434
Western Transition	8,591	890	117	9,598
Southern Agricultural Region	5,793	1,194	16,022	23,009
Unsurveyed Region	0	59,797	1,220	61,017
Total	105,261	93,377	19,992	218,630

Source: R.M. Dixon, 1963.

Table 2. Sample areas expressed as percentages of the total productive forest area of each ecological section[a]

Ecological section	Sample area as a percentage
Algoma	11.36
Algonquin	16.75
Central Plateau	9.00
Central Transition	4.25
Clay Belt	11.50
Coastal Plain	-[b]
English River	11.85
Northern Coniferous	24.16
Quetico	7.27
Superior	4.03
Temagami	6.15
Western Transition	14.98

[a] The sample areas consisted of the management units for which reports were available at the time that this study was carried out. Only those units which occur within a single ecological section were used.

[b] Estimates for this area based on Dixon (1963).

Table 3. Area estimates by ecological section of the black spruce-dominated forest areas of Ontario

Ecological section	'000 acres		
	Black spruce mixed with other species (*cf.* upland)	Black spruce forest on peatlands (*cf.* peatland)	Total black spruce-dominated area
Algoma	326	49	375
Algonquin	249	4	253
Central Plateau	3,144	4,046	7,190
Central Transition	2,184	1,049	3,233
Clay Belt	4,513	4,240	8,753
Coastal Plain	1,780	5,066	6,846
English River	435	49	484
Northern Coniferous	5,622	4,234	9,856
Quetico	682	65	747
Superior	944	240	1,184
Temagami	880	176	1,056
Western Transition	2,473	474	2,947
Southern Agricultural Region	a	a	a
Unsurveyed Region	a	a	a
Total	23,232	19,692	42,924

[a] Not estimated.

Table 4. Estimates of peatland areas by ecological section and by peatland type[a]

Ecological section	Wooded peatlands							Open peatlands			Total
	'000 acres										
	Pure productive black spruce	Cedar-dominated[b]	Larch-dominated	Treed muskeg	Brush, alder and flooded	Stagnant stands	Total wooded	Open muskeg	Bogs	Total open	
Algoma	49	49	0	14	36	0	148	47	0	47	195
Algonquin	4	0	0	70	267	0	341	197	0	197	538
Central Plateau	4046	0	0	1164	250	371	5831	409	27	436	6267
Central Transition	1049	73	93	361	429	0	2005	555	0	555	2560
Clay Belt	4240	77	15	979	400	0	5711	935	0	935	6646
Coastal Plain	5066	0	0	8660	223	3740	17,689	1179	4297	5476	23,165
English River	49	14	0	217	68	0	348	84	0	84	432
Northern Coniferous	4234	2	0	1657	288	922	7103	209	41	250	7353
Quetico	65	0	1	254	185	0	505	197	0	197	702
Superior	240	3	7	197	39	0	486	177	0	177	663
Temagami	176	221	0	53	130	0	580	189	0	189	769
Western Transition	474	51	0	439	156	0	1120	251	0	251	1371
Total	19,692	490	116	14,065	2471	5033	41,867	4429	4365	8794	50,661
Southern Agricultural Region	b	b	b	18	838	0	856	200	0	200	1056
Unsurveyed Region	b	b	b	27,028	1316	13,036	41,380	3050	11,301	14,351	55,731
Total	19,692	490	116	41,111	4625	18,069	84,103	7679	15,666	23,345	107,448

[a] See Appendix A for definitions of peatland types.

[b] Not estimated.

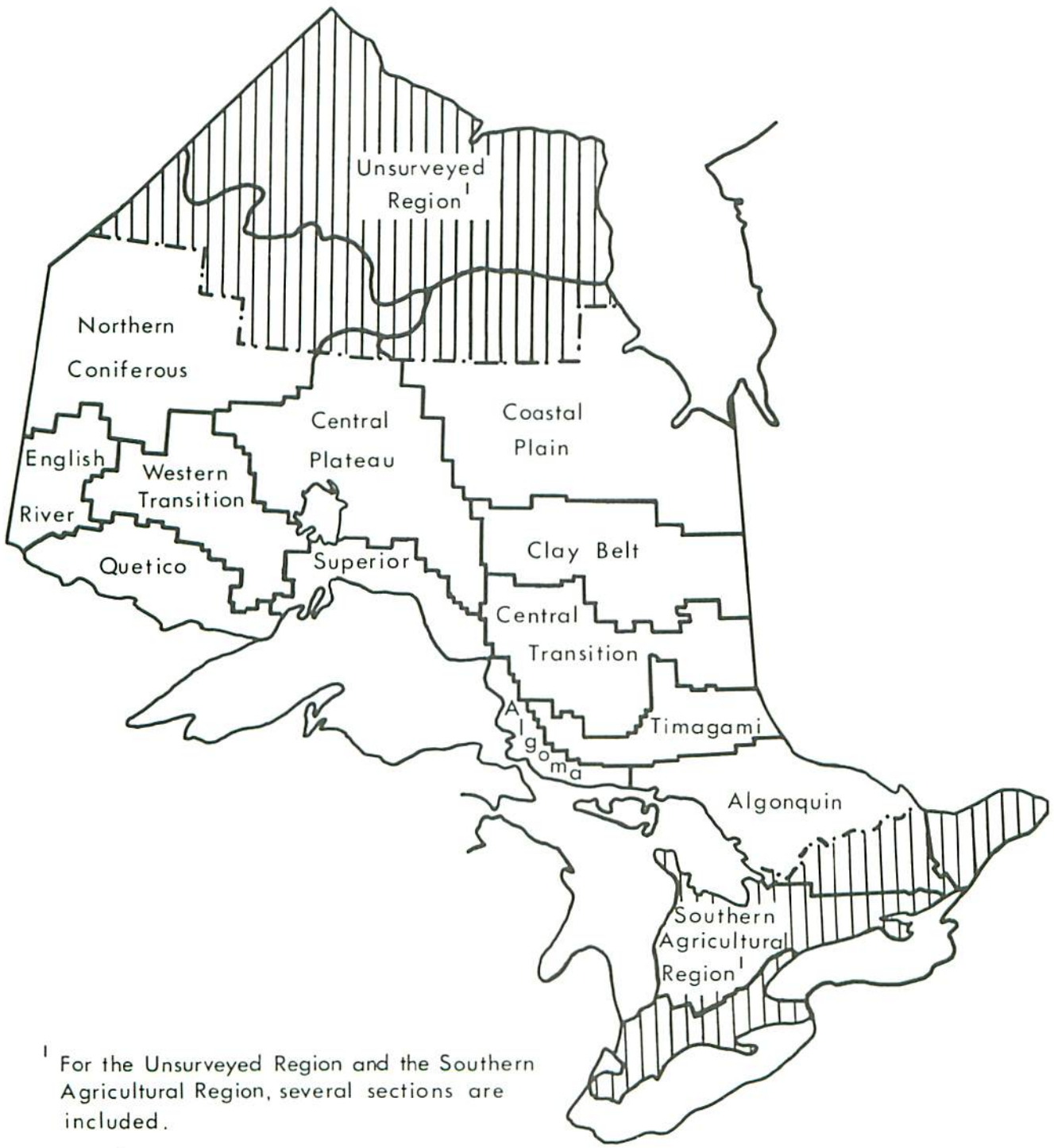
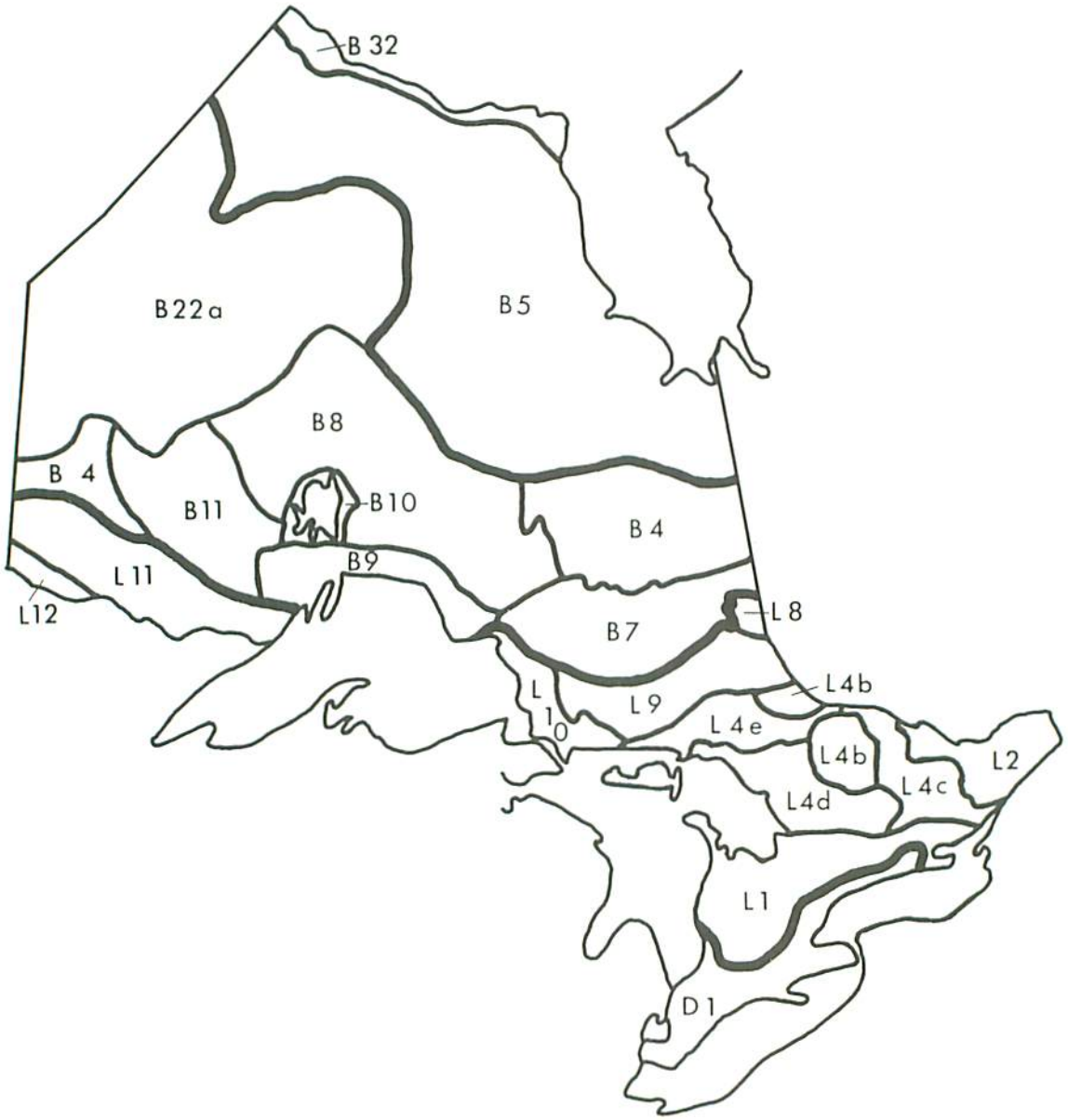


Fig. 1 The province of Ontario by ecological sections.



Source: Rowe, 1959.

Fig. 2 Rowe's forest regions of Ontario.

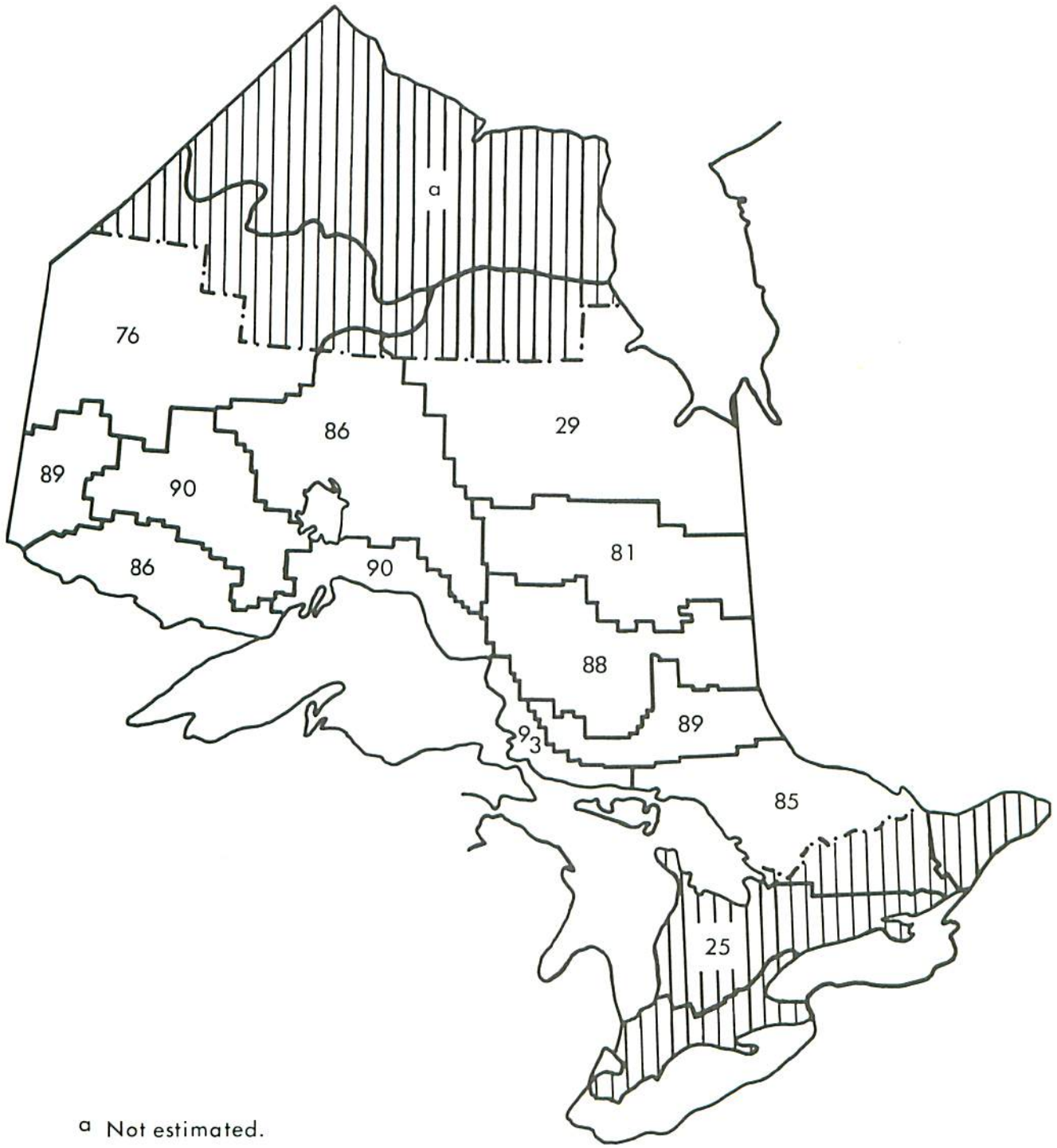
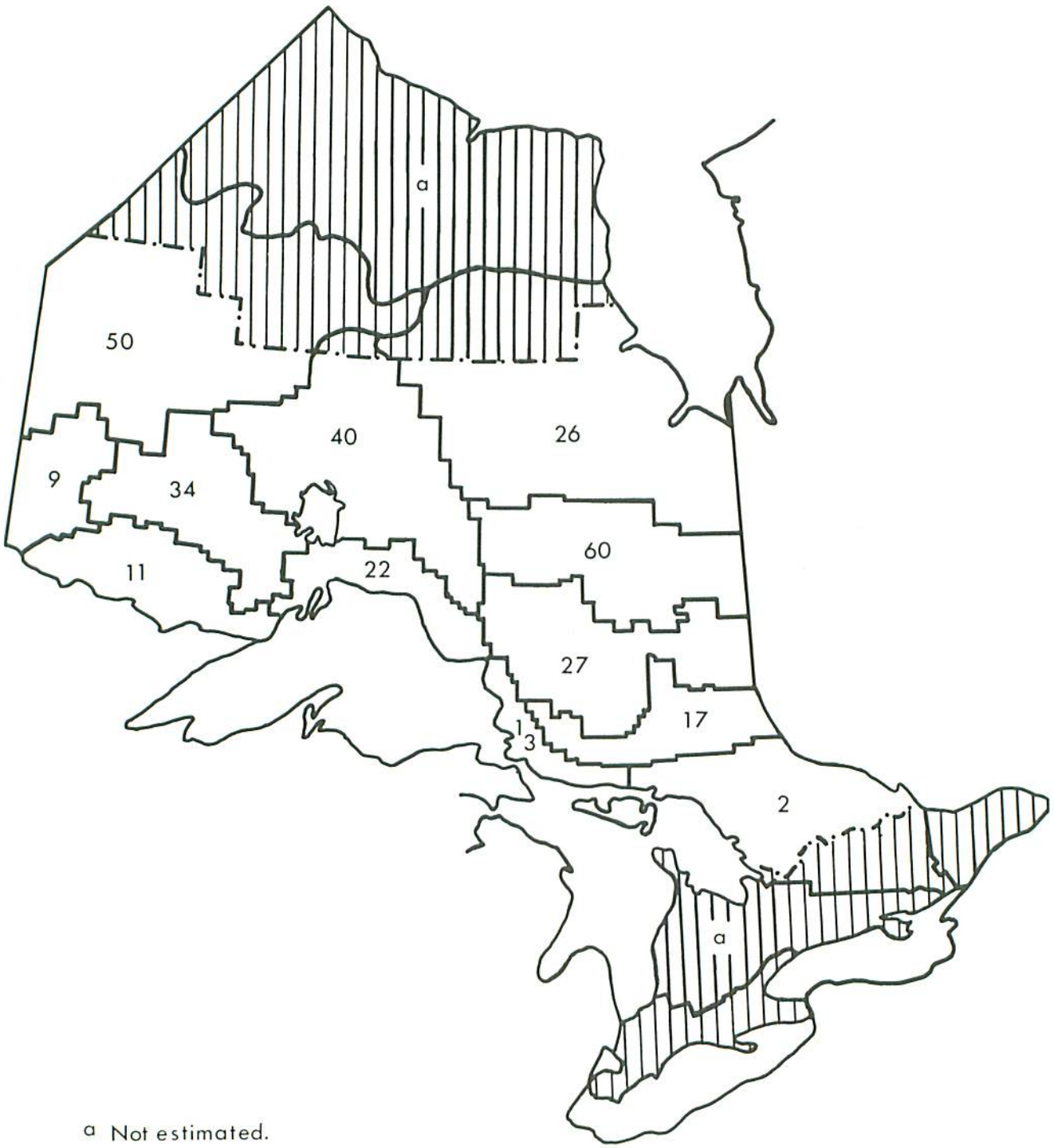


Fig. 3 Productive forest as a percentage of total land area in each ecological section.



[a] Not estimated.

Fig. 4 Black spruce-dominated forest as a percentage of total land area by ecological section.

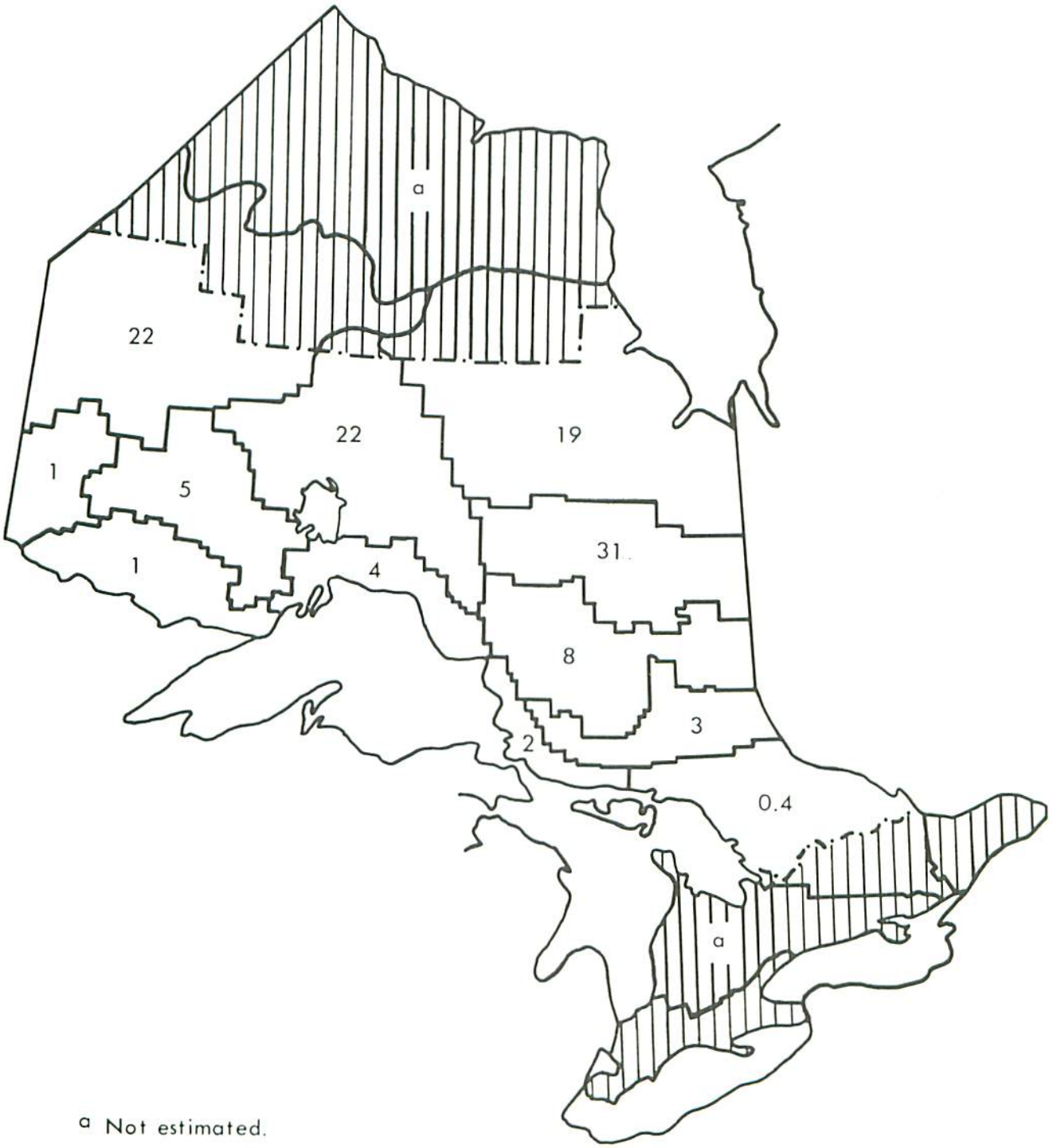
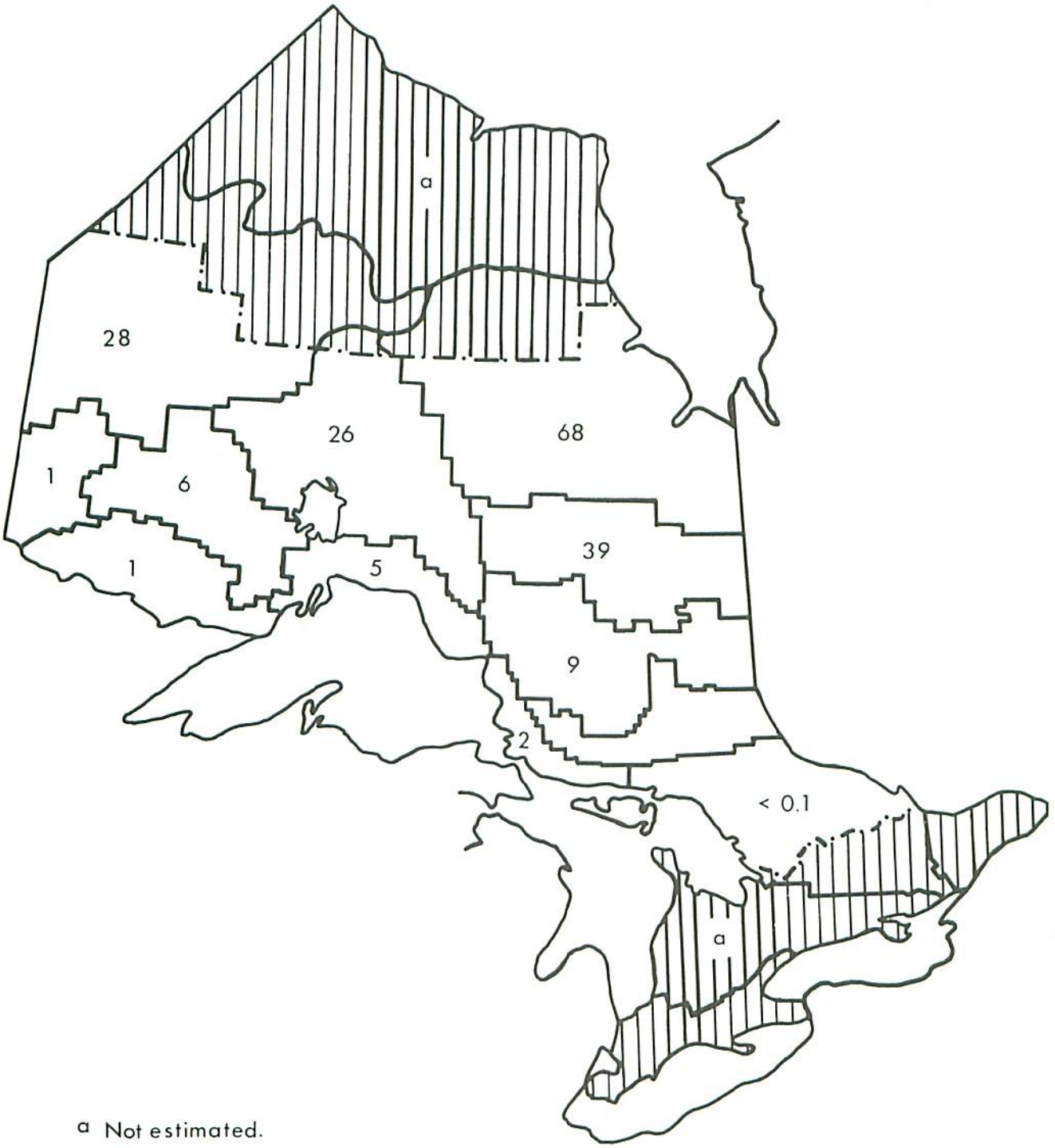


Fig. 5 Black spruce forest on peatland as a percentage of total land area by ecological section.

[a] Not estimated.

Fig. 6 Black spruce-dominated forest as a percentage of productive forest area by ecological section.



[a] Not estimated.

Fig. 7 Black spruce forest on peatland as a percentage of productive forest area by ecological section.

Fig. 8 Black spruce forest on peatland as a percentage of black spruce-dominated forest area by ecological section.

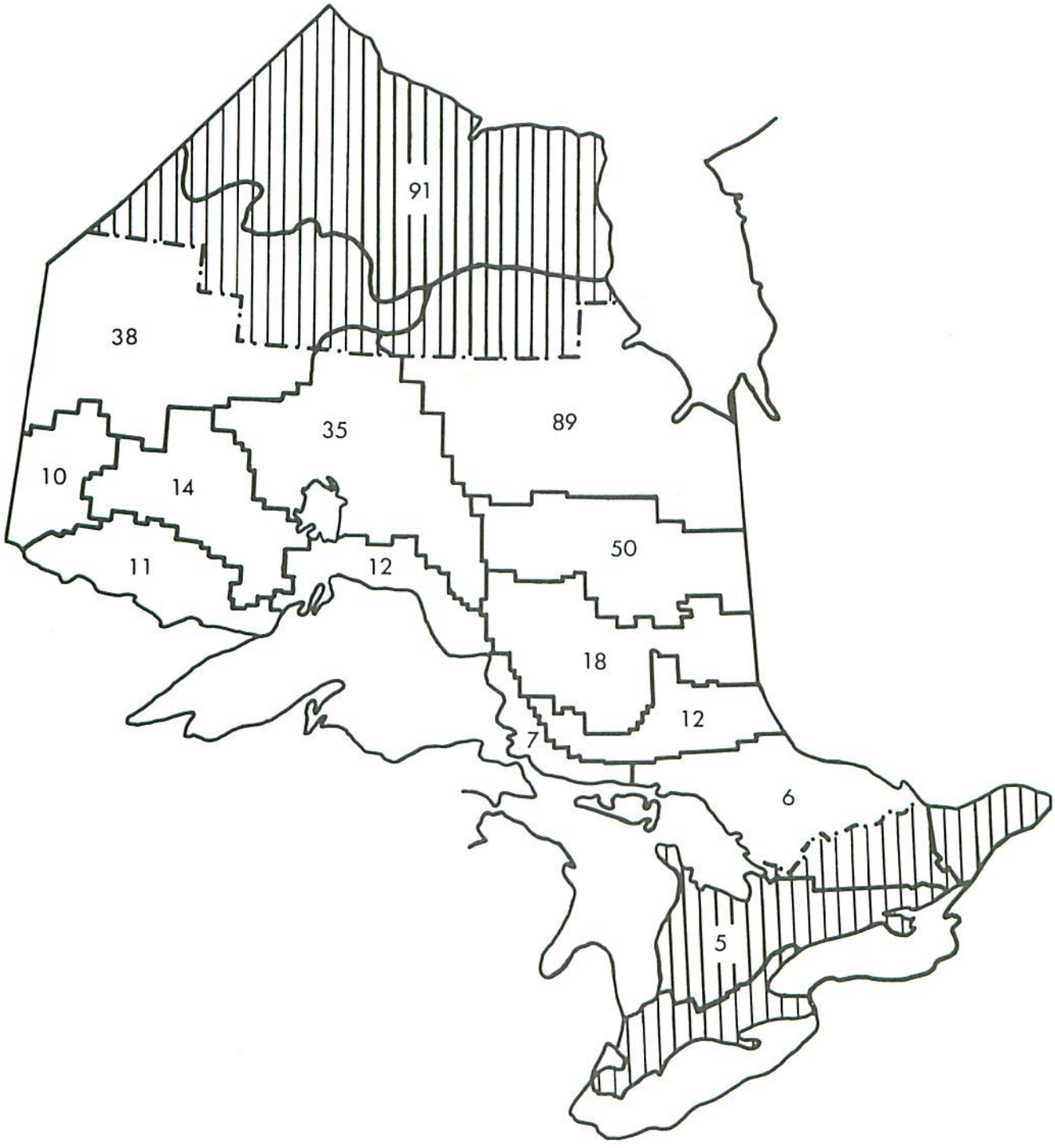


Fig. 9 Peatland area as a percentage of total land area by ecological section.

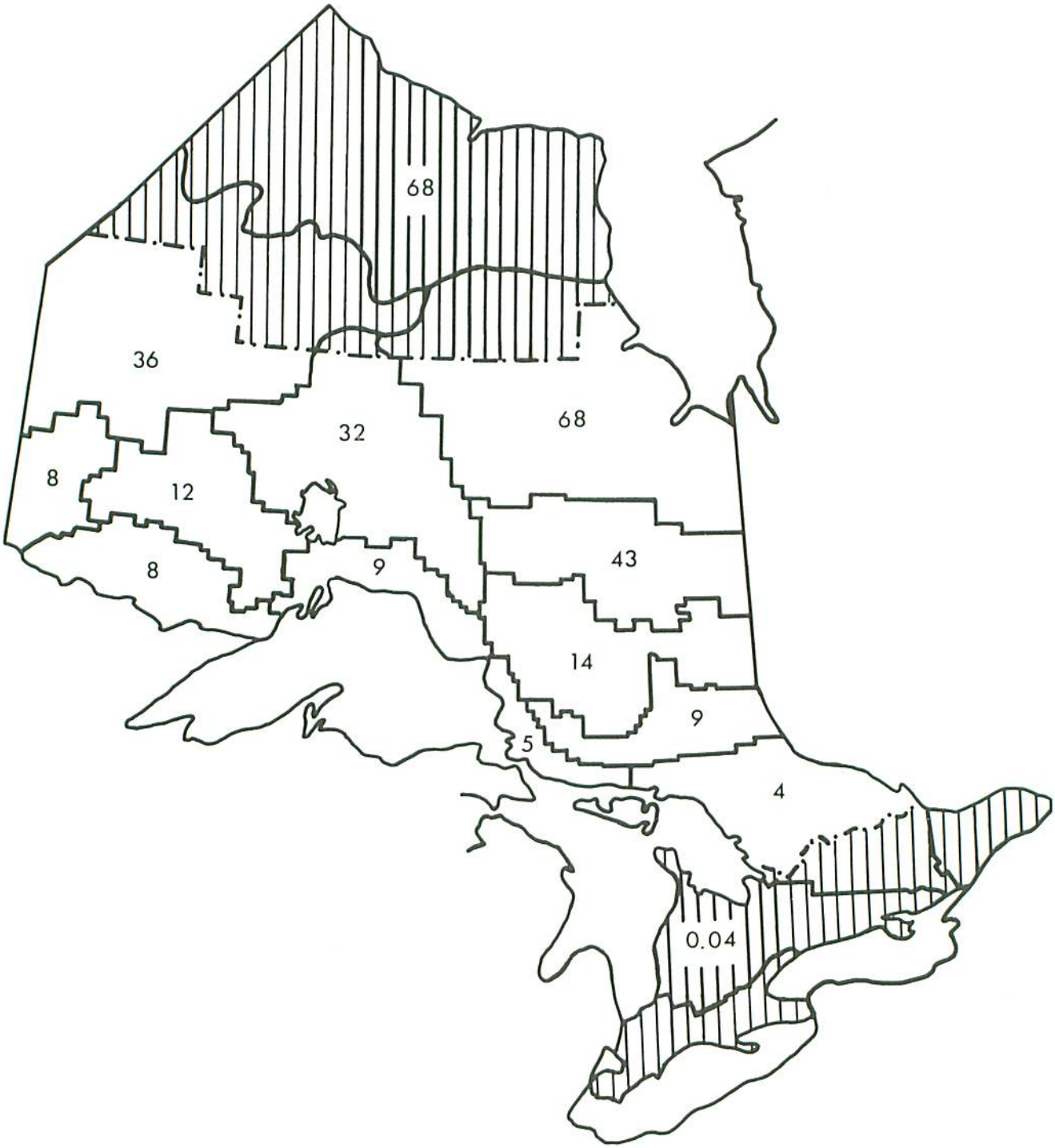


Fig. 10 Wooded peatland area as a percentage of total land area by ecological section.

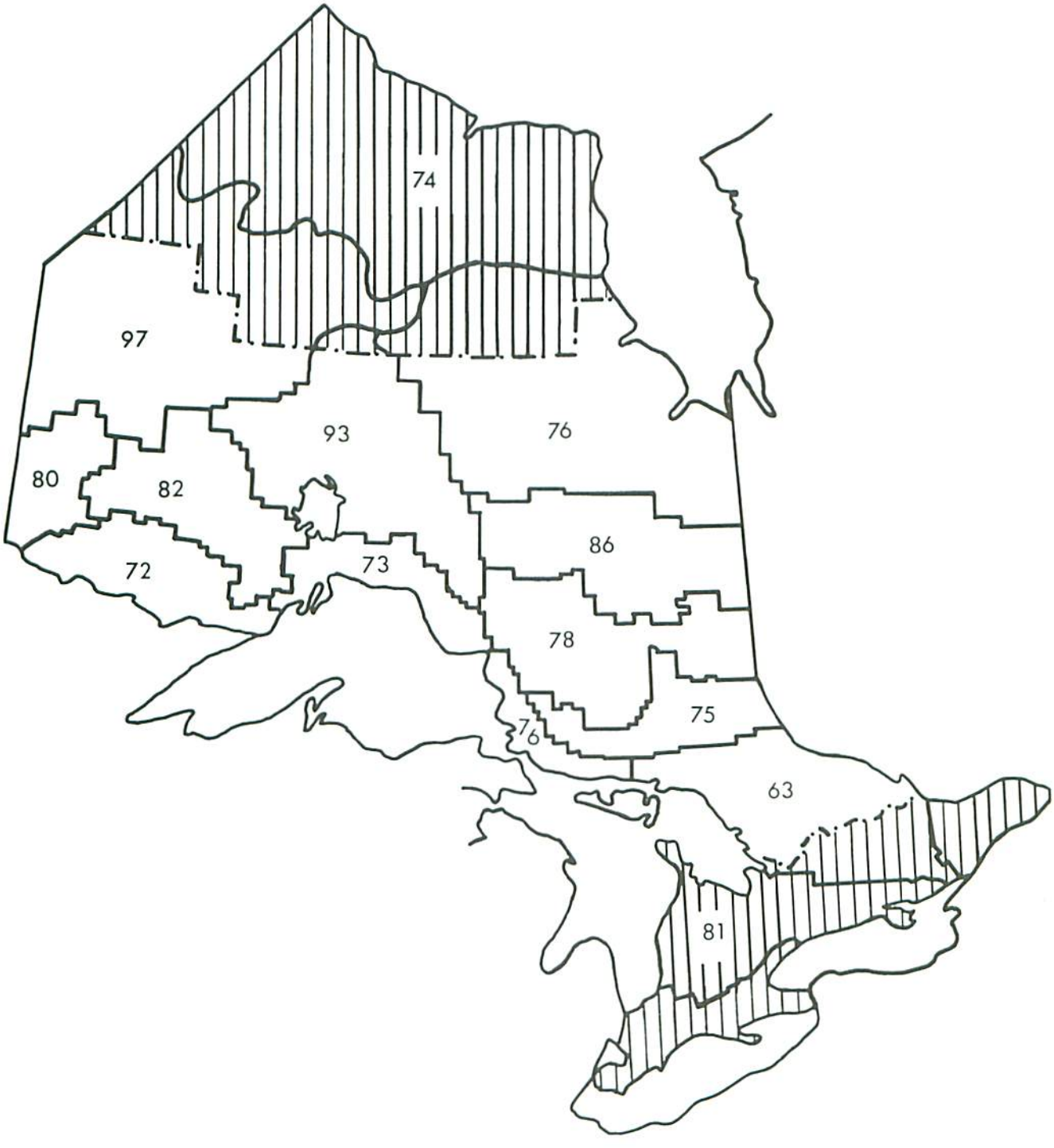
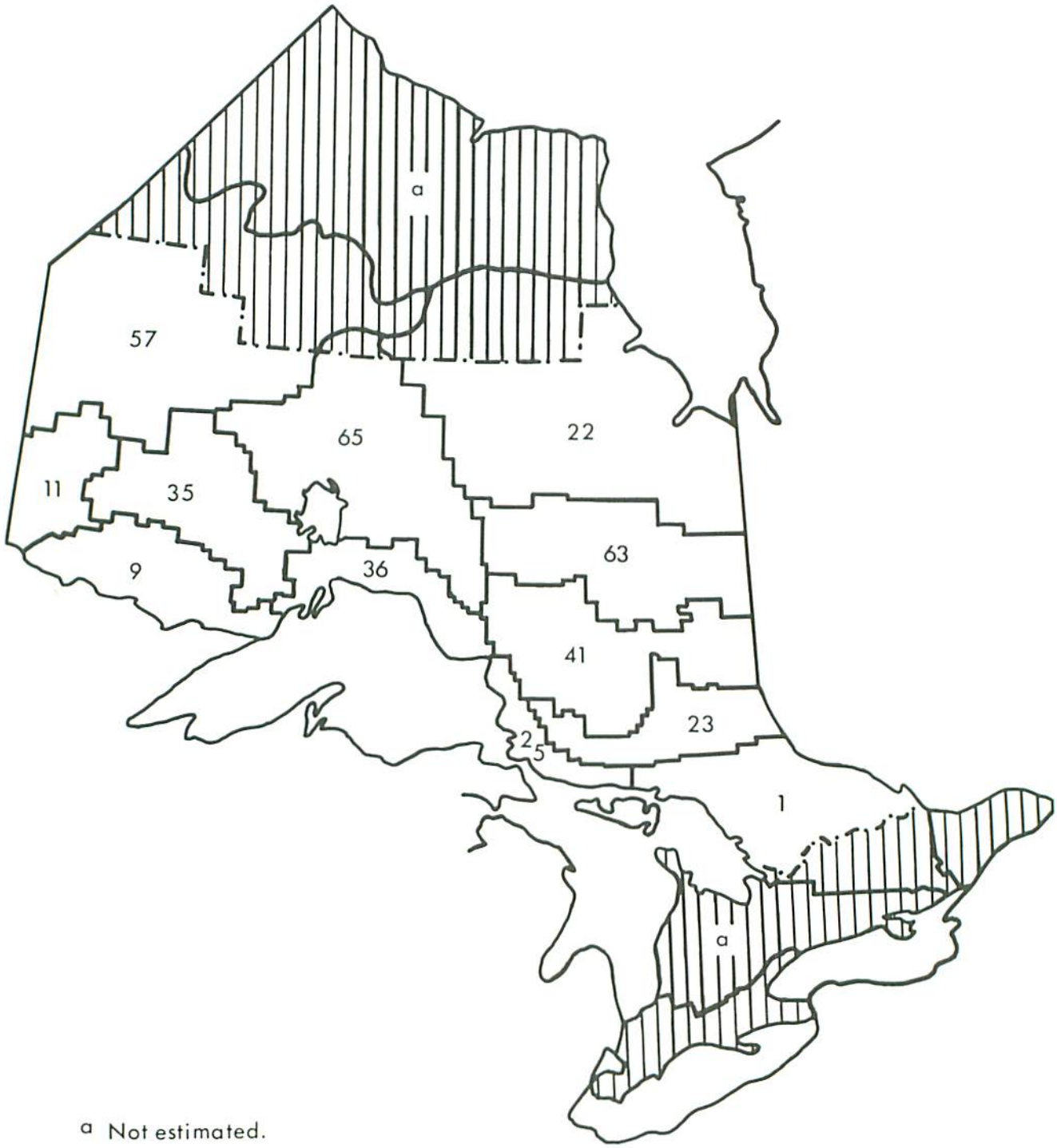


Fig. 11 Wooded peatland areas as a percentage of peatland area by ecological section.



[a] Not estimated.

Fig. 12 Pure black spruce forest on peatland as a percentage of total peatland area by ecological section.

APPENDICES

Appendix A. Definitions and interpretations of forest and peatland types in the inventory

---

Black spruce [*Picea mariana* (Mill.) B.S.P.]-dominated forest - All productive stands in which black spruce has the highest basal area (Ontario Department of Lands and Forests, 1964). This corresponds to the standard inventory definition of working group (Dixon and Jenns 1965). For example, a stand with 40 per cent black spruce, 30 per cent balsam fir and 30 per cent trembling aspen would be in the spruce working group.

Black spruce forest on peatland - All productive stands made up of 100 per cent black spruce and stands in which tamarack [*Larix laricina* (Du Roi) K. Koch.] is the only other species subordinate to black spruce. For the purposes of this study this category is regarded as peatland black spruce, and stands mixed with other species are regarded as upland black spruce. Pure black spruce is similar to "black spruce swamp forest" (Ahti and Hepburn 1967). However, some of the stands with tamarack may be closer to "black spruce-sedge swamp" (*ibid.*), and some stands, probably of small areal extent, are black spruce/feather moss on less than 30 cm of peat.

Cedar [*Thuja occidentalis* L.]-dominated - All productive stands in which cedar has the highest canopy coverage. Although some proportion of this type is on upland, particularly in areas of higher rainfall (e.g., around Lake Superior Provincial Park) and areas of limestone, nonetheless, most of its area is probably on peat deeper than 30 cm.

Tamarack-dominated - All productive stands in which tamarack has the highest canopy coverage. These stands are virtually all on peatland.

Treed muskeg - "An area of muskeg on which stunted trees occur as widely scattered individuals or in small groups" (Dixon and Jenns 1965). This type is largely the same as those described as "muskeg" and "black spruce muskeg" by Hustich (1949, 1955), Ritchie (1956) and Ahti and Hepburn (1967). The definition given by Ahti and Hepburn is as follows: "Muskeg is a swampy to dryish stunted forest with a thick mat of *Sphagnum* and feather-mosses underlain by rather thick peat (2-5 ft). The ombrotrophic portions dominate."

Brush, alder [*Alnus rugosa* (Du Roi) Spreng.] and flooded - "Land not capable of producing commercial trees and covered by shrub growth. These areas often border streams and may be subject to periodic flooding" (Dixon and Jenns 1965).

Appendix A. Definitions and interpretations of forest and peatland types in the inventory (concluded)

Stagnant stands - This category is recognized in the old inventory (Dixon 1963) as occurring only in the far northern, unsurveyed area. Mr. Brian Cardwell (personal communication) notes that: "In our present inventory system (since 1959) it is distinguished as site class 4 black spruce. It represents stunted black spruce on peatlands with varying crown density, but with practically no annual increment." This group may be largely "black spruce-sedge swamp" (Ahti and Hepburn 1967). However, it may also include other tree dominants (e.g., cedar, tamarack) and some treed muskeg.

A unit comparable to stagnant stands in the new inventory for the southern part of the province is that of site class 4 stands of protection forest. However, we did not attempt to estimate this category because we then would have had to estimate how much of site class 4 might have been peatland and how much upland on sterile sites. (The term "stagnant stands" suggests that the site type is waterlogged and on peat.)

Open muskeg - "Wet areas of mosses, grasses, sedges, and small herbaceous plants, often interspersed with small areas of open water" (Dixon and Jenns 1965). Since this definition includes grasses, sedges and herbs, the type is probably predominantly the same as open fen (*cf.* Sjörs 1961, 1963; Heinselman 1963; Ahti and Hepburn 1967).

Bog - This category is recognized in the old inventory (Dixon 1963) as occurring only in the far northern, unsurveyed area. The type is probably largely ombrotrophic, open bog, since the latter type is common in the Hudson Bay Lowland (e.g., Hustich 1957; Sjörs 1961, 1963; Bates and Simkin 1969) but much less common south of this. Ahti and Hepburn's (1967) description probably applies: "Bog is an acid treeless peatland with the ground cover dominated by ombrotrophic *Sphagna*, particularly *S. fuscum*. There is a sparse covering of vascular plants other than dwarf shrubs. Bogs are relatively dry." Our observations suggest that bogs can also be quite wet, e.g., *Sphagnum rubellum* bogs.

Appendix B. Estimates of the area dominated by major species and species groups by ecological section

Ecological section	'000 acres										
	White pine	Red pine	Jack pine	Spruce	Balsam fir	Other conifer	Poplar	Maple	White birch	Yellow birch	Other hardwood
Algoma	5	–	3	375	442	64	3	1017	241	525	3
Algonquin	115	31	–	253	482	276	520	4959	176	283	559
Central Plateau	–	–	4601	7190	125	16	3026	–	639	–	–
Central Transition	159	–	2805	3233	1041	171	1286	24	3466	61	4
Clay Belt	–	–	199	8753	115	105	1025	–	261	–	–
Coastal Plain	–	–	104	6846	15	–	388	–	104	–	–
English River	19	8	1747	484	131	65	1271	–	108	–	8
Northern Coniferous	–	–	3940	9856	30	–	590	–	339	–	–
Quetico	72	78	2068	747	84	45	2146	–	318	–	17
Superior	–	–	1326	1184	1	10	1233	–	1159	–	–
Temagami	571	–	439	1056	1124	223	177	1370	548	200	2
Western Transition	17	9	3720	2947	292	86	1108	–	412	–	–
Southern Agricultural Region	a	a	a	a	a	a	a	a	a	a	a
Unsurveyed Region	a	a	a	a	a	a	a	a	a	a	a
Total	958	126	20,952	42,924	3882	1061	12,773	7370	7771	1069	593

[a] Not estimated.