
Plants

HORSETAILS AND SCOURING-RUSHES

(*EQUISETUM* SPP.) IN MANITOBA

RICHARD J. STANIFORTH 336 Glenwood Crescent, Winnipeg, MB, R2L 1J9.

Email: richard_staniforth@yahoo.ca

Nine species of *Equisetum* occur in Manitoba,^{1,2,3,4} where they were first all recorded together as long ago as 1943.⁵ Even so, there are still no detailed, current maps of their provincial distributions; a necessity if we are to monitor fluctuations which may occur as a result of future environmental changes. This is the third of four articles on the distributions, abundances and habitats of lycopods, ferns and their relatives in Manitoba;^{6,7} plants that have received only limited study in the province.

Once thought to be a distinct Division (the traditional botanical equivalent of "Phylum") in its own right, the horsetails are now believed to have descended from an early off-shoot of the fern Division, the Pteridophyta.^{8,9} The horsetail group was once an important and diverse component of the flora of Paleozoic forests but it has since dwindled down to only 15 extant species of a single contemporary genus, *Equisetum*, nine of which we can find in the ditches and wet woodlands of Manitoba as well as in the other prairie provinces; Horsetails and Scouring-rushes are real "living fossils!"¹⁰ Living and fossil horsetails are peculiar plants! Their stems are regularly segmented, furthermore branches and leaves are arranged into whorls, i.e. clusters which are attached and radiate from single points on the stem.^{3,11,12} Horsetails fall naturally into two subgenera. Those that usually have a whorl of branches at each node (i.e. joint) on the main shoot are the Horsetails (Genus *Equisetum*, Subgenus

Equisetum), and those which are not branched are the Scouring-rushes (Genus *Equisetum*, Subgenus *Hypochaete*).¹¹ These subgenera were intensively studied by R. Hauke in 1963 and 1978.^{13,14} All species have whorls of leaves, albeit these are very much diminished in size and fused into sheaths that surround the stem (Figure 1).

Materials and Methods

During 2011 and 2012, I examined all 1,324 specimens of horsetails and scouring-rushes that had been collected in Manitoba and now housed in Manitoba herbaria; the Manitoba Museum (MMMN), Universities of Manitoba (WIN) and Winnipeg (UWPG), and in my own, non-registered collection ("RS"). The identity of each specimen was checked using identification keys from the Flora of North America.¹¹ Specimens were annotated if necessary. Table 1 lists the specimens. Information from the herbarium labels (such as collection numbers, locations, habitats, dates) was copied into an Excel spreadsheet.

Unless the location given on the herbarium label was too vague, it was converted to a latitude-longitude value using the Manitoba Gazetteer.¹⁵ All lat-long values were then converted to Universal Transverse Mercator (North America Datum 1983) values using a latitude-longitude converter.¹⁶ A distribution map was made for each species, in which each dot on the map indicated that at least one specimen had been collected from that particular 50 x

50 km U.T.M. square. There were 291 50 x 50 km UTM squares recognized in the maps. This procedure parallels the traditional method of mapping organisms in Europe.¹⁷

It was necessary to lump certain habitat, soil and moisture categories into broad classes and also to combine categories that were more or less synonymous, for example "beach" and "shore". Habitat types that were recognized in this study were; a) forest (including; coniferous, mixed,ff deciduous), b) wetland (including; pond, lake, river, ditch, stream, shore, beach, bank, bog, fen, swamp, marsh), c) grassland (including; prairie, meadow, field, clearing), d) disturbed (including; quarry, pit, roadside, railway, abandoned or old field), e) other (including; rock outcrop, sand dunes, eskers). The soil types that I recognized were: a) gravel (including; pebbles, boulders, rocks), b) sand, c) clay (including; silt), d) organic (including; peat) and e) other (including; ash, moss, crevices in rock). The moisture levels that I recognized were; a) standing water (including; emergent), b) wet (including; very wet), c) moist (including; damp, mesic) and d) dry (including xeric). These categories were then summarized for each species. The percentages of specimens in each environment type were then calculated for habitat, soil type and moisture level.

Results and Discussion

Nine species of *Equisetum* (horsetails and scouring-rushes) and four hybrids were identified as occurring within the boundaries of the Province of Manitoba (Table 1). The same species also occur in Saskatchewan and Alberta.^{3,11,19} For the most part, all species are common and widespread. None can be considered to be "at risk" (Table 1). The smooth scouring-rush is the least common and most locally distributed of all our species but even so it does form extensive

colonies, for instance on the north side of Hwy 304 between Stead and Powerview, MB. Several species, including the "Common" (= Field), Marsh, Meadow and Woodland horsetails as well as "Scouring-rush", have been listed under the Noxious Weeds Act of Manitoba; however a new act, which is presently being formulated (2012), excludes any reference to these plants. No *Equisetum* species are listed in the present Weed Control Act of Saskatchewan (2010) or the Weed Control Act of Alberta (2010).

Habitat, soil type and moisture level information was derived from herbarium sheet labels, except for that of the Smooth scouring-rush and hybrid taxa for which there were too few specimens. On average, 85.5% (80-91% depending on species) of the herbarium sheet labels gave usable habitat information. The values for soil type and moisture levels were much lower at 37.4% (23-48%) and 44.5% (32-55%), respectively. Table 2 provides the percentages of specimens for each species and for each of the environmental factors. Specific attributes are discussed under the species entries in the annotated species list given below.

Key to the species of horsetails and Scouring-rushes found in Manitoba.

Hybrid taxa have been found in Manitoba. These have characteristics that are either mixes of those of both parent species, or are intermediate between them. When present, their cones have white, misshapen, sterile spores; whereas non-hybrids have green, spherical spores.^{11,12,19} The hybrids are not included in the identification key, below, but discussed in the Annotated checklist and illustrated in Figure 10.

- 1a. Stems pale brown, fleshy, all cone-bearing but withering quickly after the spores are shed in early spring; sheaths \pm inflated, blackish.....*Equisetum arvense*.
- 1b. Stems green or pale-coloured, herbaceous or perennial, those that are cone-bearing do not wither immediately after the spores are shed; sheaths appressed to stem..... 2.
- 2a. Stems delicate, annual, (usually) with whorls of branches; mature cones have long peduncles, and are rounded at tip.....3.
- 2b. Stems stiff, usually evergreen, unbranched; mature cones are sessile or short-peduncled and are pointed at tip.....7.
- 3a. Sheaths on main stem green at base, coppery-brown above; sheath teeth joined into groups; branches themselves branched..... *Equisetum sylvaticum*.
- 3b. Sheaths on main stem pale green; sheath teeth blackish, often white with margins, separate or joined; branches (if present) rarely branched.....4.
- 4a. Main stem and any branches with large central cavities, soft, easily flattened with fingers; grows in shallow water or at water's edge*Equisetum fluviatile*.
- 4b. Main stem and branches with small central cavities, firm and not easily compressed; plants terrestrial..... 5.
- 5a. Lowest internode of each branch much shorter than the length of the adjacent sheath on the main stem *Equisetum palustre*.
- 5b. Lowest internode of each branch equal or longer than the length of the adjacent sheath on the main stem. 6.
- 6a. Internodes of upper stem rough to touch; teeth on sheaths of main stem separate, narrow, tapering gradually to points, pale with thin dark centres; branch teeth incurved, broadly triangular; cone-bearing shoots soon develop green branches.
.....*Equisetum pratense*.
- 6b. Internodes of upper stem more or less smooth; teeth on sheaths of main stem often coherent into groups, broadly triangular, dark, sometimes with narrow pale margins; branch teeth curving outwards; cone-bearing shoots not green, soon wither.....*Equisetum arvense*.
- 7a. Stems with solid centres, 6 stem ridges, coiled and twisted; sheaths with 3 teeth; cone 2-5 mm long with 2-3 whorls of 3 sporangiophores each *Equisetum scirpoides*.

7b. Stems possess central cavities, stem ridges same number as sheath teeth; more or less straight and erect; sheaths with 3-32 teeth; cone longer than 5mm and with 3 or more whorls of 6 or more sporangiophores each. 8.

8a. Stems 5-10 ridged; sheaths with persistent variegated (black and white) teeth; cones 5-10 mm long at maturity with 3-5 whorls of 6 sporangiophores each.....
.....*Equisetum variegatum*.

8b. Stems 14-40 ridged; sheaths with deciduous teeth; cones 10-20 mm long at maturity with more than 10 whorls of more than 6 sporangiophores each..... 9.

9a. Stems smooth to touch; sheaths gradually widening towards tip, longer than wide, green with black tip..... *Equisetum laevigatum*.

9b. Stems rough to touch; sheaths nearly cylindrical, as wide or wider than long, ash-grey with basal and terminal black bands. *Equisetum hyemale*.

Descriptive checklist of Horsetails and Scouring-rushes found in Manitoba

1. Field horsetail, *Equisetum arvense* L. (Figure 1.)

This is the most abundant horsetail and one of the most widespread plants in the Prairie Provinces. Most specimens had been collected from wet and moist woodlands, from wetlands and disturbed ground where they grew on a variety of soil types. Plants were especially common on road edges and in roadside ditches. In shady woodlands plants tend to have long, horizontal branches; whereas those from open, sunny sites have dense, short, erect branches and appear to be quite different. In southern Manitoba, distinctive fertile shoots appear from late April to early May. These shed their spores, disintegrate and have become replaced by vegetative shoots by early June. Specimens that have branches that are themselves branched are very rare but do occur. Northern plants growing near Hudson Bay often have unusual growth forms; including multi-stemmed shoots, vegetative shoots with small terminal cones, and normal fertile shoots that develop late in summer after the vegetative shoots have matured. Richard Hauke studied these and other variations throughout the range of the species and concluded that none were worthy of taxonomic status.²⁰ The Field horsetail is found throughout all of Manitoba, Saskatchewan and Alberta.^{3,11,12}

2. Water horsetail, *Equisetum fluviatile* L. (Figure 2.)

This is an emergent aquatic plant of ponds and slow rivers but also occurs wherever the terrain is very moist, such as bogs, fens and roadside ditches. It has erect, aerial shoots to 120 cm in height which later produce whorls of branches. A distinctive characteristic is that the stems are soft and easily crushed between thumb and index finger. The leaf sheaths have 12-24 teeth which are far more than for any other horsetail. Its distribution includes all of Manitoba, and all except the southern portions of Saskatchewan and Alberta.^{3,11,12}

3. Marsh horsetail, *Equisetum palustre* L. (Figure 3.)

The Marsh horsetail is the least common, least conspicuous and most challenging of

any of the horsetails to find. Specimens have been collected from wetlands or beside ditches but always on wet or moist soils. Identification is somewhat tricky because the aerial shoots are quite variable; some may be unbranched, others have irregular to regular whorls of branches. Cones are born at the tips of normal green shoots. This species occurs at scattered locations throughout Manitoba except for the far north. In Saskatchewan, it is rare outside of the central region and it is of local distribution in Alberta. ^{3,11,12}

4. Meadow horsetail, *Equisetum pratense* Ehrh. (Figure 4.)

The Meadow horsetail looks like a delicate version of the Field horsetail with which it sometimes coexists. Despite its name, this species is uncommon in meadows in Manitoba and is usually more common in damp deciduous or mixed woodlands. The Meadow horsetail develops pale pinkish fertile shoots in May or June which soon grow green branches that persist for the remainder of the growing season. It is best distinguished from the Field horsetail by the fineness of its branches and distinctively patterned sheath teeth. With the exception of the extreme north, Meadow horsetails are found throughout Manitoba wherever suitable habitats exist. This species is rare outside of the southern boreal forest region in Saskatchewan and it is found throughout Alberta, except for the south. ^{3,11,12}

5. Woodland horsetail, *Equisetum sylvaticum* L. (Figure 5.)

The Woodland horsetail with its fine lacy, compound branches and gracefully arching stems is probably the most attractive of all of the horsetails. Its large green and chestnut-brown sheath and teeth are distinct from other species, as are its regularly branched branches. In common with the Field and Meadow horsetails, this species has separate fertile and vegetative shoots and like the Meadow horsetail, the fertile shoots which first appear in late April and May, produce green branches while the cones are developing. This species grows on moist organic and sandy soils in boreal and mixed mossy woodlands throughout Manitoba, Saskatchewan and Alberta. ^{3,11,12}

6. Common scouring-rush, *Equisetum hyemale* L. (Figure 6.)

Growing to 1.5m in height, this is the tallest and coarsest of the scouring-rushes in Manitoba. It often forms large stands, tens or even hundreds of metres across. Its dark-green stems are evergreen throughout the winter. The wide but short leaf sheaths are made distinctive by their (usual) lack of teeth and ash-grey coloration which is bordered above and below by black bands. It inhabits sandy and peaty areas in a variety of habitats. At first sight such habitats may appear to be dry, but closer inspection usually reveals that the soils are damp or even wet at root depth. It is common throughout the southern half of Manitoba, Saskatchewan and Alberta with isolated colonies northwards. ^{3,11,12} Prairie plants belong to subspecies *affine* Calder & Taylor.¹¹

7. Smooth scouring-rush, *Equisetum laevigatum* A. Br. (Figure 7.)

The stems of the Smooth scouring-rush feel smooth to touch when compared to those of the similar Common scouring-rush. The Smooth scouring-rush has stems which are semi-deciduous, i.e. each autumn; they turn yellow and then die down to just above the ground surface. The sheaths of this species are distinctive in that they lose their teeth when young, leaving black upper margins to the otherwise green sheaths. This is the least common scouring-rush in Manitoba. It is found on moist but well-drained, sandy soils in open grassy places in the southern third of the province, with the exception of

a disjunct colony at the north end of Lake Winnipeg. There are colonies throughout southern Saskatchewan and also in southern Alberta.^{3,11,12}

8. Dwarf scouring-rush, *Equisetum scirpoides* Michx. (Figure 8.)

The Dwarf scouring-rush is the smallest of all scouring-rushes. This species is more or less restricted to wet or moist organic soils of boreal or mixed forests. Tufts of its wiry and contorted, evergreen shoots appear among mosses on the forest floor. Tiny cones appear in mid-summer, but usually remain hidden by sheath teeth at the stem tips until they elongate during following spring. They are the smallest cones of any *Equisetum* species; each cone possesses only 2-3 whorls of sporangiophores. The dwarf scouring-rush is common wherever there are suitable forests throughout Manitoba. The same is true for its occurrence in both Saskatchewan and Alberta.^{3,11,12}

9. Variegated scouring-rush, *Equisetum variegatum* Schleich. ex Weber & Mohr (Figure 9.)

The leaf sheaths of the Variegated scouring-rush are strikingly patterned with black and white bands and other markings, making it the daintiest member of its group. This species often forms dense colonies in wet, roadside ditches. Its lower stems are often submerged with its roots embedded in calcareous clay and tangled amongst aquatic mosses. The species is found throughout boreal regions in all three Prairie Provinces and occasionally southwards into the aspen parkland ecozone.^{3,11,12} Plants found in the Prairie Provinces belong to subspecies *variegatum*.¹¹

10. Hybrids (Figure 10.)

A few specimens of Manitoba scouring-rushes (1:27) and even fewer of Manitoba horsetails (1:200) appeared to be hybrids. They had stem and leaf sheath characteristics that did not match those of the recognized species, and they also bore sterile, white, misshapen spores. These hybrids were: 1) Shore horsetail, *Equisetum x littorale* Kuehl.; the hybrid between the Field horsetail (*E. arvense*) and the Water horsetail (*E. fluviatile*). 2) Ferriss' scouring-rush, *Equisetum x ferrissii* Clute; which is the hybrid between the Common scouring-rush (*E. hyemale*) and the Smooth scouring-rush (*E. laevigatum*). 3) Mackay's scouring-rush, *Equisetum x mackaii* A. Braun; the hybrid between the Common scouring-rush (*E. hyemale*) and the Variegated scouring-rush (*E. variegatum*). 4) Nelson's scouring-rush, *Equisetum x nelsonii* (A.A. Eat.) Schaffn.; the hybrid between Smooth scouring-rush and Variegated scouring-rush (*E. laevigatum* × *E. variegatum*). Three of the same hybrids have been recorded from Saskatchewan²⁰ and one, the Nelson's scouring-rush, occurs in Minnesota.²⁵ Other hybrids have been reported elsewhere, especially from Europe that involve species that are also found in Manitoba and these could possibly occur here.^{21,22,23,24}

The hybrid specimens had been usually collected from sites where two parent species overlapped. Roadside ditches were the most frequent habitat for hybrids. Presumably, the more hydric/ aquatic parent species (e.g. Water horsetail, Variegated scouring-rush) occurred at the bottom of the ditch, whereas the more mesic parent species (e.g. Field horsetail, Smooth scouring-rush, Common scouring-rush) occurred on the roadside or bank. Hybrid specimens were to be found in the zone of overlap part way up the bank.

Table 1. Numbers of specimens of horsetails and scouring-rushes in Manitoba herbaria (MMMN, UWPG, WIN and the author's collection), numbers of UTM squares in which the specimens were collected out of 6068 squares (10 x 10 km) and out of 291 squares (50 x 50 km), and rankings according to NatureServe Canada.²⁶ NatureServe Conservation Status Ranks are: G=Global, S=Subnational (i.e. Province of Manitoba), 1 =Very rare, 2=Rare, 3=Uncommon, 4=Abundant with possible known threats, 5=Abundant and secure, NA=taxon not ranked.

Common name	Scientific name	Herbarium specimens examined	10 x 10 km UTM squares occupied	50 x 50 km UTM squares occupied	Conservation Status Rank
Horsetails:					
Field horsetail	<i>Equisetum arvense</i>	391	226	92	G5 S5
Water horsetail	<i>E. fluviatile</i>	190	132	74	G5 S5
Marsh horsetail	<i>E. palustre</i>	62	42	30	G5 S4S5
Meadow horsetail	<i>E. pratense</i>	89	72	42	G5 S4S5
Woodland horsetail	<i>E. sylvaticum</i>	249	145	78	G5 S5
Shore horsetail	<i>E. x litorale</i>	3	3	3	GNA SNA
Scouring-rushes:					
Common scouring-rush	<i>E. hyemale</i>	122	88	40	G5 S5
Smooth scouring-rush	<i>E. laevigatum</i>	28	19	16	G5 S3S4
Dwarf scouring-rush	<i>E. scirpoides</i>	103	81	56	G5 S5
Variiegated scouring-rush	<i>E. variegatum</i>	76	55	39	G5 S5
Ferriss' scouring-rush	<i>E. x ferrissii</i>	7	6	6	GNA SNA
MacKay's scouring-rush	<i>E. x mackaii</i>	1	1	1	GNA SNA

Table 2. Habitat, soil type and moisture content of sites from which specimens of Horsetails and Scouring-rushes had been collected, as given by herbarium labels. Values are percentages of specimens per category. Values of 25% and greater are highlighted for clarity.

Species	Habitat				Soil type				Moisture level				No. of specimens
	Forest	Wetland	Grassland	Disturbed land	Other	Gravel	Sand	Clay	Other	Standing	Wet	Moist	
Horsetails:													
Field horsetail	35	30	8	23	4	15	27	26	1	3	39	5	383
Water horsetail	14	78	1	8	0	3	11	38	7	53	6	1	190
Marsh horsetail	22	49	2	27	0	25	20	34	0	21	31	0	61
Meadow horsetail	77	10	1	10	1	0	11	12	0	0	62	7	89
Woodland horsetail	56	22	3	17	3	9	25	24	6	0	58	2	249
Scouring-rushes:													
Common scouring-rush	29	24	16	26	5	12	70	6	4	5	47	20	122
Smooth scouring-rush	Insufficient data				Insufficient data				Insufficient data				28
Dwarf scouring-rush	70	21	4	4	1	4	13	13	0	0	56	6	103
Variiegated scouring-rush	21	46	0	32	0	26	15	43	0	14	16	14	76

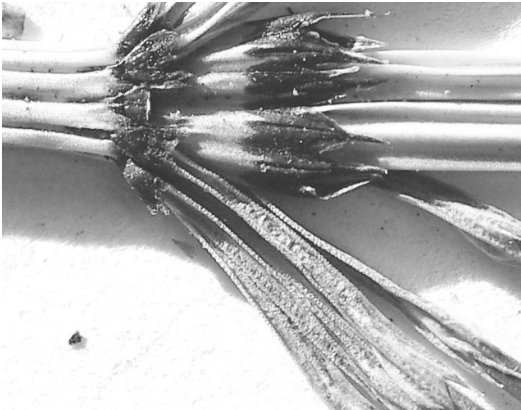
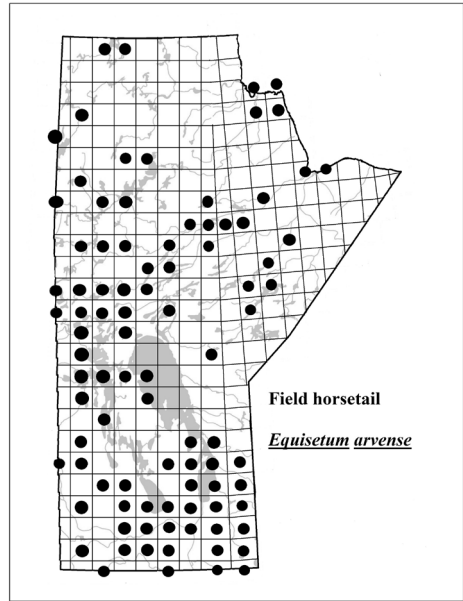


Figure 1. Field horsetail, *Equisetum arvense*. Abundant, throughout MB. Fertile shoots are distinct from the vegetative shoots and appear first, in April-May. The sheath teeth are dark and often grouped in 2-3s. The whorls simple branches have the first internodes longer than the adjacent sheaths on the main stem.

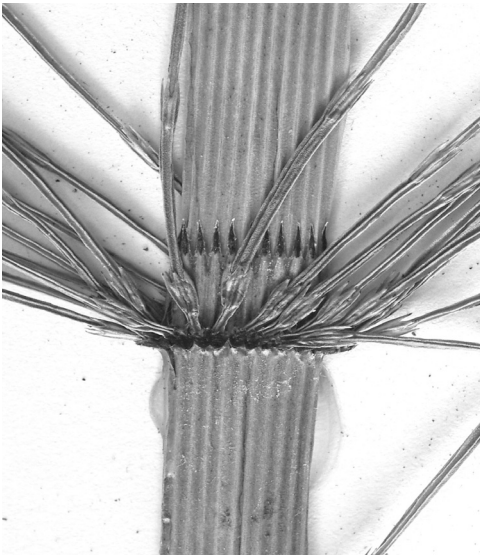
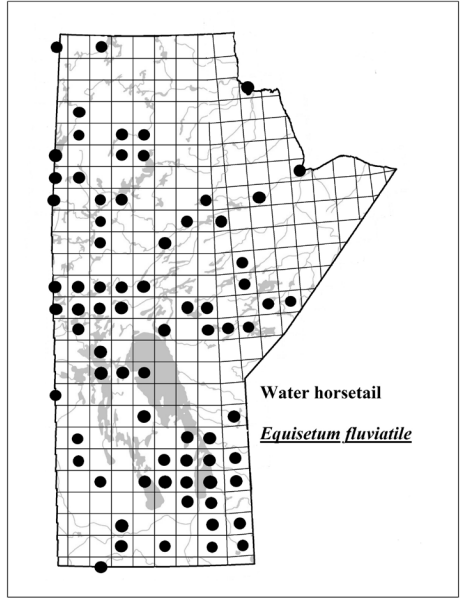


Figure 2. Water horsetail, *Equisetum fluviatile*. Common aquatic plant found throughout MB. Stems maybe branched with simple branches, or unbranched. First internodes of branches are shorter than the stem sheath. Sheaths possess 12-24 teeth. Stems are very soft due to large central cavities.

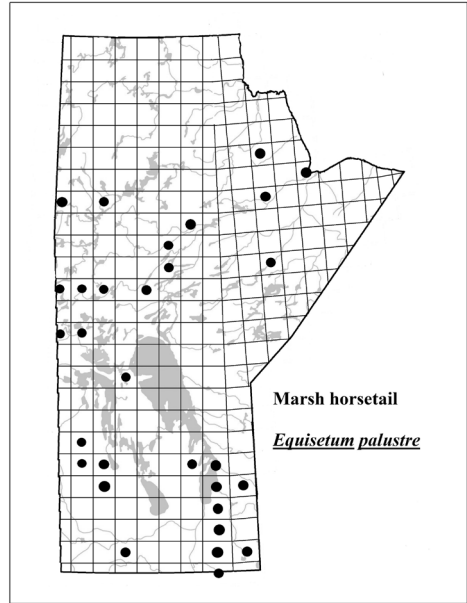


Figure 3. Marsh horsetail, *Equisetum palustre*. Uncommon and local. Mostly found in central MB. Stems maybe branched or not. First internodes of branches are shorter than the stem sheath. Sheaths have 5-10 teeth. Stems are firm.

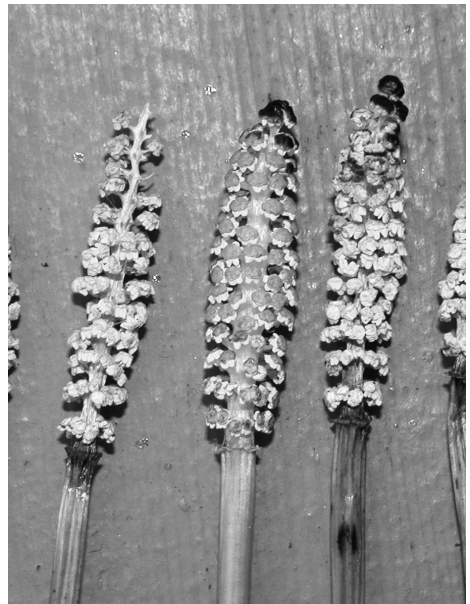
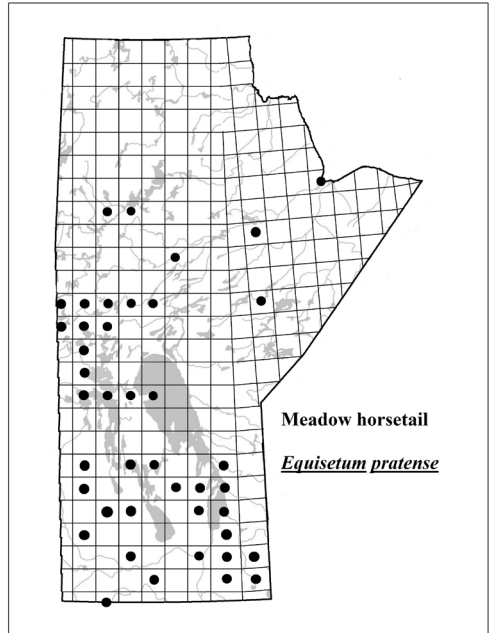


Figure 4. Meadow horsetail, *Equisetum pratense*. Common, absent from the N and SW MB. Fertile shoots become vegetative in early summer. Stems have whorls of delicate, simple branches. First internodes of branches are equal or longer than stem sheath. Sheath teeth 8-18 and narrow.

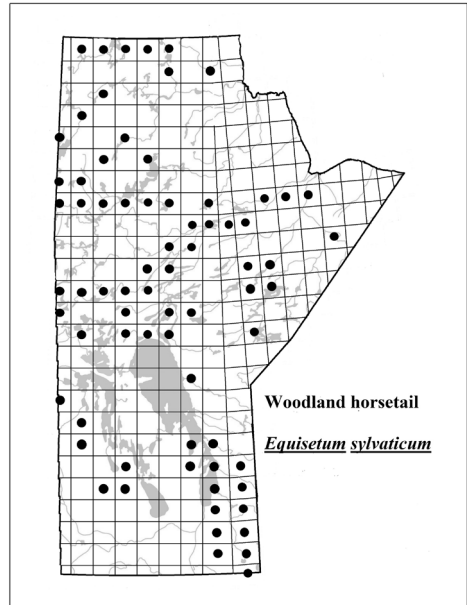


Figure 5. Woodland horsetail, *Equisetum sylvaticum*. Common, absent from the N and SW MB. Fertile shoots become vegetative in summer. Stems have whorls of compounded branches. Leaf sheaths have large, brown teeth which are grouped in 2-3s.

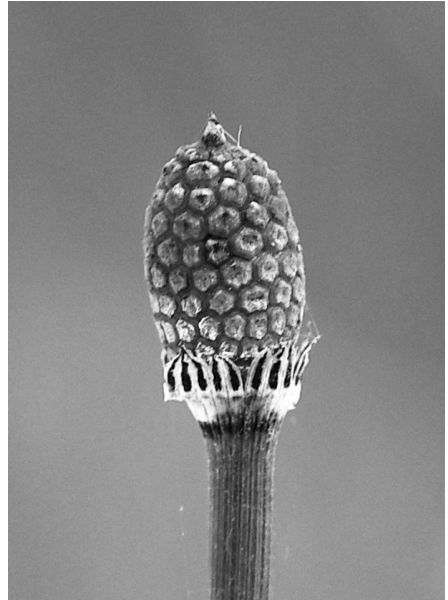
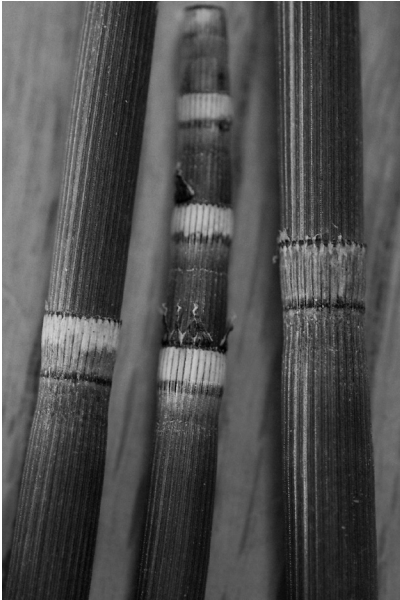
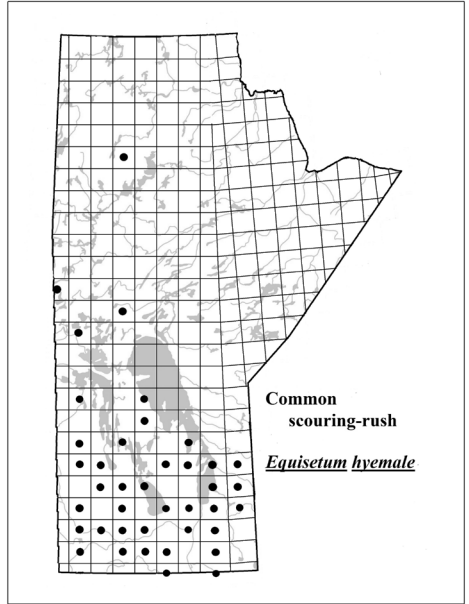
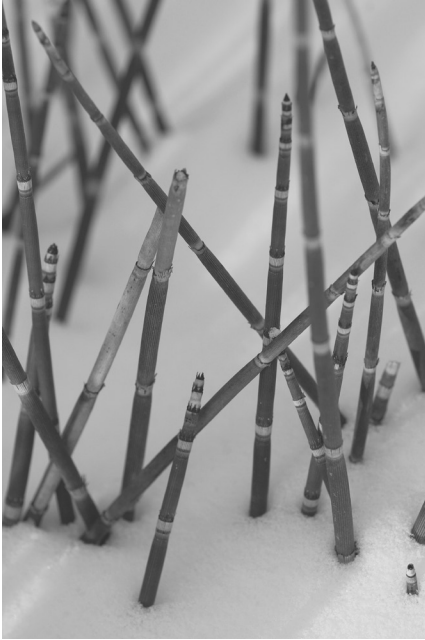


Figure 6. Common scouring-rush, *Equisetum hyemale*. Common on sandy soils, absent from N MB. Stems are unbranched, very firm and rough to touch. Sheaths are short with black terminal and basal bands which separate gray mid-portsions. The stem teeth are soon lost.

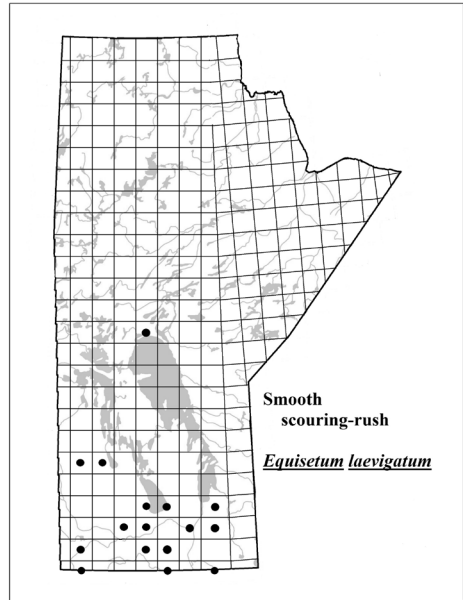


Figure 7. Smooth scouring-rush, *Equisetum laevigatum*. Scarce, only found in S MB. Stems are unbranched. Sheaths are long, green and widen toward the top which has a thin black band. The stem teeth are soon lost.

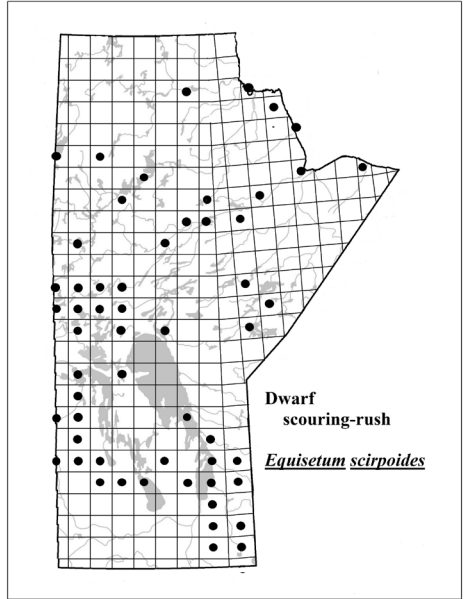


Figure 8. Dwarf scouring-rush, *Equisetum scirpoides*. Common throughout MB, absent in the SW. The clumped stems are unbranched, tiny, and curled. Teeth are in 3s. Cones are tiny 5-10 mm long with 2-3 whorls.

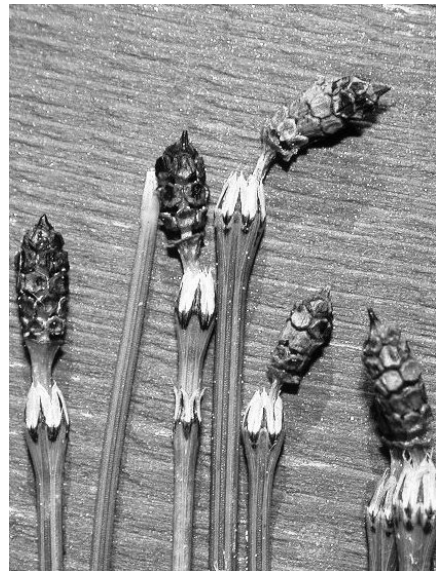
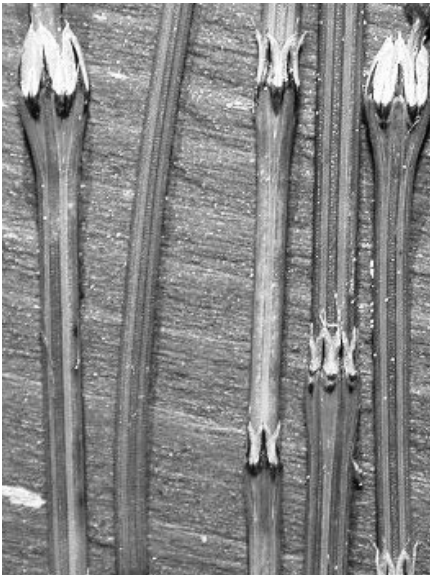
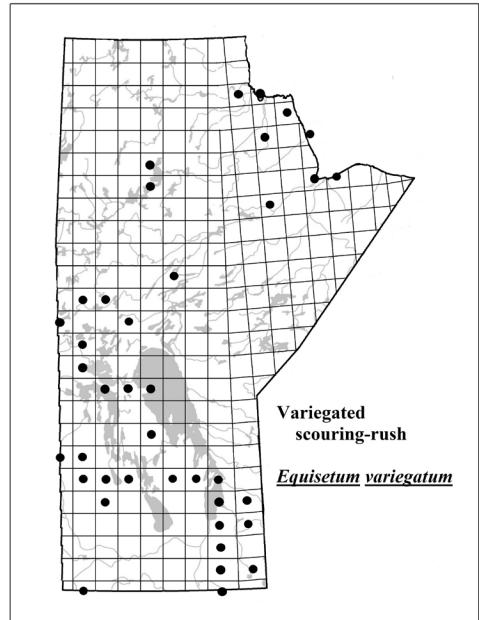


Figure 9. Variegated scouring-rush, *Equisetum variegatum*. Common in ditches throughout MB, but absent in the SW. Stems are unbranched, straight. The 3-12 sheath teeth have striking black centres and white margins. Cones are 10-20 mm long, with 3 or more whorls.

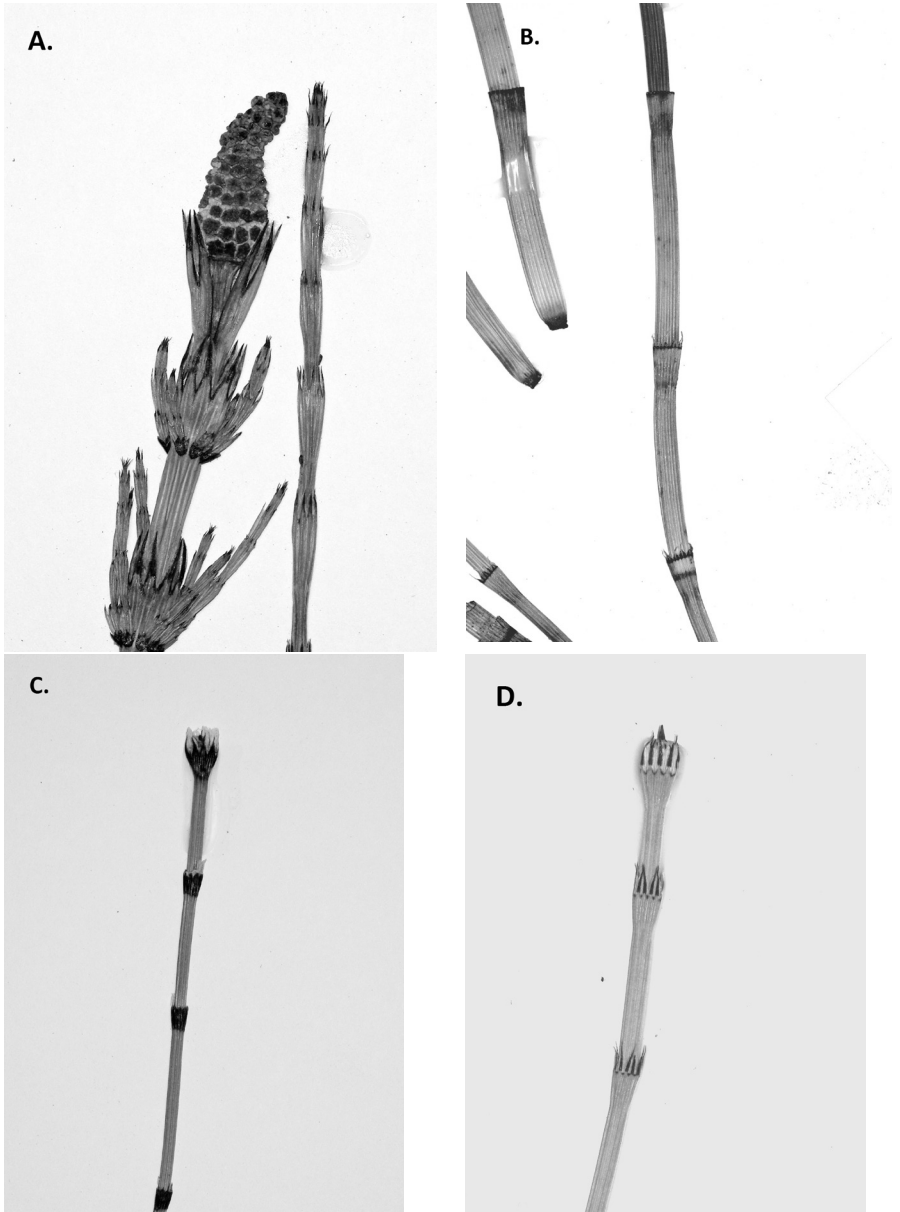


Figure 10. Hybrids. All hybrids of *Equisetum* species produce sterile white, misshapen spores; whereas the fertile spores of non-hybrids are green and spherical. Other distinctive hybrid features include unusual shapes, patterns and colouring of the sheaths and sheath teeth, shown here. Upper left: A. Shore horsetail, *Equisetum x litorale* is the hybrid of Field and Water horsetails. Upper right: B. Ferriss' scouring-rush, *Equisetum x ferrissii* is the hybrid of the Common and Smooth scouring-rushes. Lower left: C. Mackay's scouring-rush, *Equisetum x mackaii* is the hybrid of the Common and Variegated scouring-rushes. Lower right: D. Nelson's scouring-rush, *Equisetum x nelsonii* is the hybrid of the Smooth and Variegated scouring-rushes.

Acknowledgements

I am grateful to Diana Bizecki Robson and Janis Klapecki (The Manitoba Museum), Bruce Ford and Elizabeth Punter (The University of Manitoba) and German Avila-Sakar (The University of Winnipeg) for their encouragement and access to the plant collections. Christopher Friesen and staff at the Manitoba Conservation Data Centre provided the Conservation Status Ranks of various species shown in Table 1 and records of the fern finds. Jessica Elliott of Parks Branch, Manitoba Conservation facilitated collection permits for Provincial Parks. Dan Brunton provided valuable comments regarding hybrids. Kerry Hecker and Vernon Harms shared their valuable skills and experiences during their reviews of this article. Finally, thanks to my wife, Diana Staniforth, for her patience when "holidays" became a synonym for "fern collecting trips", and also for retrieving me when I was hopelessly lost in the bush.

1. Scoggan HJ (1957) Flora of Manitoba. National Museum of Canada. Bulletin No. 140. Biological series No. 47. Department of Northern Affairs and National Resources, Ottawa, ON.
2. Scoggan HJ (1977) The flora of Canada. Part 2 Pteridophyta, Gymnospermae, Monocotyledoneae. National Museum of Natural Sciences. Publications in botany, No. 7(2). National Museums of Canada, Ottawa, ON.
3. Cody WJ, Britton DM (1989) Ferns and fern allies of Canada. Publication 1829/E. Research Branch, Agriculture Canada, Ottawa, ON.
4. Punter E (1995) Manitoba's vascular plants. Manitoba Conservation Data Centre, Winnipeg, MB.

5. Lowe CW (1943) List of the flowering plants, ferns, club mosses, mosses and liverworts of Manitoba. Natural History Society of Manitoba. Winnipeg, MB.

6. Staniforth RJ (2011) Ophioglossid ferns in Manitoba: moonworts, grapeferns and northern adder's-tongue. *Blue Jay* 69(2) 75-87.

7. Staniforth RJ (2012) The Lycopods (Phylum Lycopodiophyta); clubmosses, firmosses, spikemosses and quillworts in Manitoba. *Blue Jay* 70(2) 82-104.

8. Pryer KM, Smith AR, Skog JE (1995) Phylogenetic relationships of extant ferns based on evidence from morphology and *rbcL* sequences. *American Fern Journal* 85:203-282.

9. Judd WS, Campbell CS, Kellogg EA, Stevens PF, Donoghue MJ (2002) Plant systematics. A phylogenetic approach. 2nd Edn. Sinauer Associates, Inc. Sunderland, MA

10. Moran RC (2004) A natural history of ferns. Timber Press, Inc. Portland, OR.

11. Hauke RL (1993) Equisetaceae. In: Flora of North America. Volume 2: Pteridophytes and Gymnosperms. Oxford University Press Incorporated, New York, NY. p. 76- 84.

12. Cobb B, Farnsworth E, Lowe C (2005) A field guide to the ferns and their related families. Northeastern and Central United States. 2nd edn. The New England Wildflower Society. The Peterson Field Guide Series. Houghton Mifflin Company, New York, NY.

13. Hauke RL (1978) A taxonomic monograph of the genus *Equisetum* Subgenus *Equisetum*. *Nova Hedwigia* 30:385-455.

14. Hauke RL (1963) A taxonomic

- monograph of the genus *Equisetum* subgenus *Hippochaete*. *Nova Hedwigia* 8:1-123.
15. Anonymous (1981) *Gazetteer of Canada. Manitoba*. 3rd Edition. Canadian Permanent Committee on Geographical Names. Energy Mines and Resources Canada. Ottawa.
16. <http://www.rcn.montana.edu/resources/tools/coordinates.aspx>
17. Online atlas of the British and Irish flora. (2012) Available at: <http://www.brc.ac.uk/plantatlas/>
18. Harms VL (2003) Checklist of the vascular plants of Saskatchewan and the provincially and nationally rare native plants in Saskatchewan, including important synonyms, authorities, common names and various status indicators. University Extension Press, Saskatoon, SK
19. Harms VL, Leighton AL (2011) Ferns and fern allies of Saskatchewan. *Flora of Saskatchewan Fascicle 1. Nature Saskatchewan Special Publication #30*. Publ. by Flora of Saskatchewan Association and Nature Saskatchewan. Regina. SK
20. Hauke RL (1966) A systematic study of *Equisetum arvense*. *Nova Hedwigia* 13: 81-109.
21. Page CN (1973) Two hybrids in *Equisetum* new to the British flora. *Watsonia* 9: 229-237
22. Page CN (1988) Two hybrids of *Equisetum sylvaticum* L. new to the British Flora. *Watsonia* 17: 273-
23. Lubienski M (2010), A new hybrid horsetail *Equisetum* × *lofotense* (*E. arvense* × *E. sylvaticum*, Equisetaceae) from Norway. *Nordic Journal of Botany*, 28: 530–540.
24. Plant Crib: *Equisetum*. <http://www.bsbi.org.uk/Equisetum.pdf>
25. Tryon RM Jr. (1954) *The ferns and fern allies of Minnesota*. University of Minnesota Press, Minneapolis, MN.
26. NatureServe (2010) NatureServe Explorer: an online encyclopedia of life [web application]. Version 6.0. NatureServe, Arlington, VA. Available at <http://www.natureserve.org/explorer>



Brewer's Blackbird nestling

- Lowell Strauss