OTTER PONDS DEMONSTRATION FOREST

FOREST ECOSYSTEM CLASSIFICATION

NOVA SCOTIA
Natural Resources

Forestry Division, Truro

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Introduction

The Otter Ponds Demonstration Forest (OPDF) is an approximately 500 ha working forest near Mooseland, Halifax County, Nova Scotia. The intent of the OPDF is to promote the philosophy, science, and practice of uneven-aged forest management in the Acadian Forest. This initiative is being managed by a division of the Nova Scotia Woodlot Owners and Operators Association.

At the request of the OPDF Board of Directors, the Nova Scotia Department of Natural Resources was asked to assist in ecosystem classification of the OPDF using the provincial ecological land classification (ELC) system (Neily et al. 2005) and the recently developed provincial forest ecosystem classification (FEC) system (Neily et al. 2011; Keys et al. 2011ab). Due to the size and remoteness of many portions of the OPDF, it was decided to initially classify ecosystems using digital data layers followed up with field validation and revision as required. This preliminary classification will contribute to development of initial management plans for the OPDF; however, operations will still require additional FEC work as specific stand-level prescriptions are developed.

This report comprises four sections (Ecological Land Classification, Forest Groups, Soil Types, and Ecosites), each with a map and supporting text. Maps are also provided in digital format.

Ecological Land Classification

The OPDF is situated entirely within the Eastern ecoregion (400) and includes parts of the Eastern Interior (440) and Eastern Granite Uplands (430) ecodistricts (Map 1). Ecosections found within the OPDF boundary are WFDM, WMDM, WMHO, IMHO, WCKK, and ICHO.

The Eastern ecoregion is 6,427 km^2 (11.6% of the province) and extends from Bedford Basin to the town of Guysborough. It is also the eastern extension of the Appalachian peneplain which slopes towards the Atlantic Ocean. The ecoregion is generally underlain by quartzite (greywacke) and slate of the Meguma Group, along with granitic intrusives. Landforms include rolling till plains, drumlin fields, extensive rockland, and wetlands. Forests are predominantly coniferous, with red and black spruce occupying the majority of sites. Tolerant hardwood forests, dominated by yellow birch and sugar maple (with scattered beech), are usually found on drumlins and upper slopes and crests of steeper hills. The dominant natural disturbances are fire and hurricanes. Removed from the immediate climatic influence of the Atlantic Ocean, the Eastern ecoregion is characterized by warm summers and cool winters.

The Eastern Interior ecodistrict is 4,578 km^2 or 71% of the ecoregion. It includes three distinct drumlin fields (formerly Ecodistrict 420) roughly geo-referenced by the three rivers that flow through them: Sackville, Tangier, and Moser. The OPDF is associated with the Tangier River drumlin field which makes up about 92% of the OPDF area. Soils are predominantly well drained, sandy loams (often stony) derived from quartzite dominated glacial till. Drumlins are mainly loams over sandy clay loams. The ecodistrict is also covered with an abundance of freshwater lakes which have a tendency to be dystrophic, meaning the water is acidic and brown colored. The southeast corner of the OPDF (8% of the area) is associated with the Eastern Granite Uplands ecodistrict which is characterized by coarse, stony (and often shallow) soils derived from granitic glacial till.

Well to moderately well drained drumlins and hummocks provide an opportunity for pure stands of

tolerant hardwoods (e.g. sugar maple and yellow birch) to thrive on crests and upper slope positions. In many locales, sugar maple is replaced with red maple and stands of yellow birch and red maple are dominant. On lower slopes, relatively pure stands of red spruce will ring around the drumlins; while stands of black spruce, balsam fir, and tamarack occupy the imperfectly and poorly drained sites between drumlins. White pine, black spruce, and balsam fir are often found on poorer sites such as those that occur on ridges. On the middle and lower slopes of these ridges, red spruce and balsam fir occur on fresh to moist sandy loams which are often stony.

Natural disturbances within the Eastern Interior and Eastern Granite Uplands ecodistricts are considered frequent for many areas (e.g. ecosections WMHO, IMHO, and WCKK) and mainly due to wind or fire. On drumlin ecosections dominated by tolerant hardwoods (WFDM and WMDM), disturbances are less frequent and in most cases stands are thought to develop through a form of gap disturbance. Other disturbance agents which have influenced stand conditions within the OPDF area include yellow birch dieback; beech canker; and insect damage/mortality (tussock moth, balsam wooly adelgid, eastern spruce bark beetle, spruce budworm). A summary of ecosection attributes is given in Table 1. (See Appendix 1 for more information of natural disturbance regimes).

Table 1. ELC ecosections found in the OPDF area with their associated natural disturbance regimes, ecosites, and common vegetation types (VTs).

Ecosection[(1)]	Natural Disturbance Regime	Ecosites	Early Successional VTs	Mid Successional VTs	Late Successional VTs
WFDM, WMDM	Gap	AC13, AC14	IH6, MW4, MW5	IH7, MW2, TH7	MW1, TH1, TH2, TH8
		AC10, AC11	IH6, MW4, MW5	IH7, MW2, SH5, SH6, TH7	MW1, SH3, SH4, SH5**, SH6**
WMHO, IMHO, WCKK, ICHO	Frequent	AC6, AC7	IH4,*** IH6, SP8***	MW2, SP4a, SH5, SH8, SH9	SH4, SP5
		AC10, AC11	IH6, MW4, MW5	IH7, MW2, SH5, SH6, TH7	MW1, SH3, SH4, SH5**, SH6**
		AC4	WC1, WC2		
		AC8, AC12	WC5, WC6, WD2, WD6, WD8		

*** WFDM = Well drained, fine textured drumlins, WMDM = Well drained, medium textured drumlins, WMHO = Well drained, medium textured hummocks, IMHO = Imperfectly drained, medium textured hummocks, WCKK = Well drained, coarse textured knobs and knolls (hills), ICHO = Imperfectly drained, coarse textured hummocks.**

**** SH5 and SH6 are considered mid to late successional VTs in this area due to the near absence of hemlock and the frequency of natural disturbances.**

***** White birch is more abundant than aspen in these VTs.**

Forest Groups

Six Forest Groups within the OPDF were delineated based on NSDNR ForCov data (Map 2):

- IH (Intolerant Hardwood)
- MW (Mixedwood)
- SH(Spruce Hemlock)
- TH(Tolerant Hardwood)
- WC (Wet Coniferous)
- WD (Wet Deciduous))

Forest Groups were assigned based on dominant species. For example, the Tolerant Hardwood group (TH) was assigned to all polygons where tolerant hardwood species (sugar maple, yellow birch, and beech) were greater than 50% of overstory species. The same approach was used for the Intolerant Hardwood group (IH) where species such as red maple, white birch, and aspen needed to be greater than 50% to define the unit. The Spruce Hemlock group (SH) included all polygons where overstory red spruce and balsam fir were greater than 50%. The Wet Coniferous group (WC) was assigned to all polygons where black spruce and tamarack were greater than 50%; whereas red maple, black spruce, and tamarack were the dominant species in the Wet Deciduous group (WD). Finally the Mixedwood group (MW) incorporated polygons where both softwood and hardwood species occurred and where black spruce or tamarack were not part of the overstory.

Note: recent harvesting along the paved road between Mooseland and River Lake was not identified in the current ForCov database. Forest group assignments for this area were based on the most recent aerial photography (2003) and remnant stands left after harvesting.

Tolerant Hardwood (TH): Dominant VTs are TH2 (Sugar maple / New York fern – Northern beech fern) and TH8 (Red maple – Yellow birch / Striped maple). Inclusions of MW1 (Red spruce – Yellow birch / Evergreen wood fern) and MW4 (Balsam fir – Red maple / Wood sorrel – Goldthread) occur in response to either natural or harvest disturbances. TH1 (Sugar maple / Hay-scented fern) may also occur as an inclusion on drier sites associated with crests and upper slopes.

White ash is rare and beech is uncommon in the overstory of TH stands; however, two notable beech trees were found during field checks. One tree had a 64 cm dbh with 4 m of clear bole and another had a 49 cm dbh with 4-5 m of clear bole (scarred by a seam). Beech regeneration was abundant near these trees. In contrast, large diameter yellow birch were common with one tree measured having a 102 cm dbh. Microtopography in these forests is strongly mounded indicating a history of windthrow. Christmas fern, an indicator of better site fertility, was only scattered in most stands. Dwarf ginseng, also a rich site indicator, was common on the drumlins on the west side of the Tangier River and scattered on drumlins elsewhere.

Intolerant Hardwood (IH): A small patch of IH6 (White birch – Red maple / Sarsaparilla – Bracken) is mapped along the woods road leading to a drumlin on the east side of the Tangier River. This VT is in response to past harvesting. There are some stands where red maple is dominant, but it usually shares the canopy with a component of yellow birch. In these cases the VT is better described as TH8 (Red

maple – Yellow birch / Striped maple). In addition, scattered red oak were found along the western boundary of the OPDF.

Spruce Hemlock (SH): The absence of hemlock in the softwood forests of the OPDF is likely due to a combination of climate and site factors which are not fully understood at this time. However, the presence of scattered hemlock is expected along larger streams and rivers and along steep ravines. VTs found in the SH group include:

SH4 (Red spruce – White pine / Lambkill / Bracken)
SH5 (Red spruce – Balsam fir / Schreber's moss)
SH6 (Red spruce – Balsam fir / Stair-step moss – Sphagnum)
SH8 (Balsam fir / Wood fern / Schreber's moss)
SH9 (Balsam fir – Black spruce / Blueberry)

Mixedwood inclusions were:

MW1 (Red spruce – Yellow birch / Evergreen wood fern)
MW4 (Balsam fir – Red maple / Wood sorrel – Goldthread).

The most common VTs are SH5 and SH6 which are associated with the lower slopes of drumlins, stony tills surrounding drumlins, and with stony ridges. Soil types are fresh to moist and often have a stony phase. The forest floor under these VTs is dominated by extensive coverage of moss species such as Schreber's and stair-step, with three lobed bazzania indicating moist substrates of rotting wood. Where soils are coarse, very stony, and/or shallow over bedrock, black spruce and white pine are found in greater abundance (SH4 and SH9). These poorer and drier soils are found primarily along ridges dispersed throughout the OPDF, with the largest occurrence south of Otter Ponds. Occasionally, small stands of SP4a (White pine / Blueberry / Bracken - Black spruce variant) may be found on these drier and poorer sites.

Mixedwood Forest (MW): The dominant VT is MW1 (Red spruce – Yellow birch / Evergreen wood fern) with either red spruce or balsam fir the dominant softwood. The earlier successional MW4 (Red maple – Balsam fir / Wood sorrel – Goldthread) is found where either natural or harvest disturbances have occurred. In these VTs, balsam fir is deteriorating due to old age and/or insect damage and is regenerating extensively in the understory. Many stands also have large quantities of coarse woody debris which is primarily balsam fir.

Wet Coniferous and Wet Deciduous (WC and WD): Most stands found in the WD group were either WD6 (Red maple – Balsam fir / Wood aster / Sphagnum) or WD8 (Red spruce – Red maple / Wood sorrel – Sensitive fern / Sphagnum) and these were often associated with (or included within) larger softwood units of WC5 (Red spruce – Balsam fir / Cinnamon fern / Sphagnum) or WC6 (Balsam fir / Cinnamon fern – Three seeded sedge / Sphagnum). Only a few scattered WD VTs with dominant hardwood cover were noted as small inclusions (mostly along streams and the Tangier River).

Larger areas of wet soils associated with non-forested wetlands have VTs dominated by black spruce and tamarack and include WC1 (Black spruce / Cinnamon fern / Sphagnum) and WC2 (Black spruce / Lambkill – Labrador tea / Sphagnum).

Note: field validation of Forest Groups only identified dominant VTs associated with mapped polygons. Due to mapping scale, inclusions of VTs not associated with the main Forest Groups may occur. In TH, SH, and MW Forest Groups, these inclusions would primarily be wet forests found in depressions and along small streams and flow channels (e.g. WC1, WC2, WC5, WC6, WD2, WD6, WD8). In the WC Forest Group, these inclusions would primarily be fresh to moist forests found on raised till deposits (e.g. SH5, SH6).

Soil Types

A preliminary soil type map was generated for the OPDF area using digital soil series maps, predicted soil moisture (drainage) maps, NSDNR ForCov database maps, and soil type relationships described in Keys et al. (2011a). Where necessary, these maps were later adjusted based on field checks to produce a final soil type map which was compatible with Forest Group mapping.

Initial soil types were assigned based on dominant parent materials and texture classes associated with mapped soil series units, as adjusted by predicted drainage condition (Table 2). ForCov data was then used to adjust predicted soil types based on the presence of tolerant hardwood (TH) stands which are often associated with increased fertility.

Table 2. Initial soil type assignments based on soil series, drainage, and covertype. Soil types separated by a vertical bar indicate either soil type was considered probable.

Soil Series	Covertype SW/MW/IH			Covertype TH		
	Drainage Class			Drainage Class		
	Well	Imperfect	Poor	Well	Imperfect	Poor
Halifax	ST2	ST3	ST4	ST2	ST3	ST4
Wolfville	ST5 | 2-L	ST6 | 3-L	ST7 | 4	ST11 | 8	ST12 | 9	ST13 | 10
Bridgeville	ST8 | 8-C	ST9 | 9-C	ST10	ST8 | 8-C	ST9 | 9-C	ST10
Gibraltar	ST2 | 1	ST3	ST4	ST2	ST3	ST4
Peat			ST14			ST14

SW = softwood; MW = mixedwood, IH = Intolerant hardwood; TH = Tolerant hardwood

Halifax and Wolfville series soils dominate the OPDF area, with minor coverage by Gibraltar, Bridgeville, and Peat (MacDougall et al. 1963). Dominant parent materials include olive to yellowish-brown sandy loam to gravelly sandy loam glacial till containing mainly quartzite (Halifax series), and reddish-brown loam to sandy clay loam glacial till derived from shale, sandstone, and mudstone (Wolfville series). In the OPDF area, Wolfville soils are mainly associated with drumlins. Bridgeville soils are derived from imperfectly drained, loamy alluvial deposits; while Gibraltar soils are derived from coarse, granitic glacial tills. Peat soils are associated with wetland area (bogs and swamps).

Wolfville series soils associated with drumlins in eastern Halifax County generally have less clay than typical Wolfville soils (MacDougall et al. 1963). This suggests sites underlain by these soils would mainly be associated with ST2-L and ST3-L and not ST5 and ST6. This was indeed the case for most areas surveyed during field checks. However, occasional sites were found with higher clay contents near the surface and this possibility should be kept in mind as individual stands are being assessed (especially where drainage is impeded).

Field checks also occasionally showed high surface quartzite content resulting in stony phase soils in areas not associated with drumlins. This possibility, as well as occasional near-surface bedrock, should be kept in mind as individual stands are being assessed.

The Bridgeville soil polygon mapped along the Tangier River in the northwest section of the OPDF was found to be riparian wetland rather than imperfectly drained active floodplain. This unit was re-labeled accordingly.

On the OPDF soil type map (Map 3), units are mapped by predicted dominant soil type as calibrated by scattered field checks. Soil types separated by a slash [e.g. 2-L/3-L] indicate the area is predicted to be a complex of both types. Soil types listed in brackets [e.g. 2-L(8)] indicate the area is predicted to have scattered inclusions of bracketed soil types within the main soil type(s) listed.

Managers are reminded that predicted soil type must be verified at the stand level before prescribing treatments. Also, it is possible for mapped units to contain soil types other than those predicted.

Ecosites

Using relationship tables found in Keys et al. (2011b), a predicted ecosite map for the OPDF area was generated based on dominant vegetation types and predicted soil types (Figure 4). To facilitate landscape-level planning, only dominant VT/ST combinations were used for ecosite mapping. Inclusions (if any) can be addressed during operational (stand-level) planning. A more detailed summary of ecosite assignments is given in Appendix 2.

Drumlin sites are mainly associated with medium to rich ecosites (AC13 and AC14) which make up about 24% of the OPDF (not including water). Non-drumlin uplands are mainly associated with medium fertility ecosites (AC10 and AC11) and make up about 55% of the area. A large portion of the OPDF (20%) is also associated with wet, very poor to poor sites (AC4 and AC8) including treed and non-treed wetlands. Approximately 1% of the area is classed as industrial (mining) and is not associated with any ecosite unit.

Literature Cited

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Appendix 1
Natural Disturbance Regimes

Natural disturbance regime describes the frequency and type of natural disturbances that influence forest ecosystem patterns and biodiversity on a given landscape. Three main disturbance regimes recognized in Nova Scotia are:

Frequent: Disturbances which result in the rapid mortality of an existing stand and the establishment of a new stand of relatively even-age. The time interval between stand initiating events typically occurs more frequently than the longevity of the climax species that would occupy the site - therefore, evidence of gap dynamics and understory recruitment is usually absent. This regime results in the establishment and perpetuation of early to mid successional vegetation types.

Infrequent: Stand initiating disturbances which result in the rapid mortality of an existing stand and the establishment of a new stand of relatively even-age, but the time interval between events is normally longer than the average longevity of the dominant species - thereby allowing gap dynamics and understory recruitment to evolve and become evident (eventually creating uneven-aged stands). This regime generally leads to the establishment and/or perpetuation of mid to late successional vegetation types.

Gap replacement: Stand initiating disturbances are rare. Instead disturbances are characterized by gap and small patch mortality, followed by understory recruitment, resulting in stands with multiple age classes. This regime generally leads to the establishment and/or perpetuation of late successional vegetation types.

Appendix 2

Predicted ecosites within the OPDF based on dominant vegetation types and soil types.

Forest Group Covertype	Dominant Vegetation Types	Predicted Soil Types	Predicted Ecosite
IH	IH6	2L (3L)	AC10
IH	IH6	2L (8)	AC10
IH	IH6	3L/6 (4)	AC11
MW	MW1	2	AC10
MW	MW1	2 (3)	AC10
MW	MW1	2L (3L)	AC13
MW	MW1	2L (8)	AC13
MW	MW1	2L/3L	AC13/14
MW	MW1	3 (4)	AC11
MW	MW1	3L (4)	AC14
MW	MW1	3L/6 (4)	AC14
SH	SH5, SH6	2	AC10
SH	SH5, SH6	2 (3)	AC10
SH	SH5, SH6	2L (3L)	AC10
SH	SH5, SH6	2L (8)	AC10
SH	SH5, SH6	2L/3L	AC10/11
SH	SH5, SH6	3	AC11
SH	SH5, SH6	3 (4)	AC11
SH	SH5, SH6	3L (4)	AC11
SH	SH5, SH6	3L/6 (4)	AC11
TH	TH2	2	AC10
TH	TH2	2	AC10
TH	TH2	2	AC10
TH	TH2	2 (3)	AC10
TH	TH2	2L (3L)	AC13
TH	TH2	2L (8)	AC13
TH	TH2	2L/3L	AC13/14
TH	TH2	3L (4)	AC14
TH	TH2	3L/6 (4)	AC14
WC	WC1, WC2	14/4	AC4
WC	WC1, WC2	4/14	AC4 | 8
WC	WC1, WC2	4/7	AC4 | 8
WD	WD6, WD8	4/14	AC8 | 12
WD	WD6, WD8	4/7	AC8 | 12
Mapped Wetlands	na	14	AC4 | 8
CC / Plantation	na	2	AC10
CC / Plantation	na	2L (8)	AC13
CC / Plantation	na	3 (4)	AC11
Industrial	na	na	na