Biodiversity Assessment Tool,
Research and Development
for the

Western Newfoundland
Model Forest

MODEL FOREST NETWORK
RÉSEAU DE FORÊTS MODÈLES

July 24th meeting
Progress and forest management options

Meeting Schedule

- Introduction (Sean Dolter, CFS/Len Moores, DFR&A_NF&L).
- Remindering BAP goals of the Phase I – Coarse filter analysis (Frederik Doyon).
- Mid-progress report in transferring BAP technology (Phase I) for the WNMF (Frederik Doyon).
- Definition of forest management options (Frederik Doyon & WNMF team).
- Requirements for docking forest projections to the BAP analysis toolbox (Frederik Doyon).

8-802-001

July 24, 2000 meeting

Transferring BAP technology to WNMF

Frederik Doyon, RPF, PhD
Institut Quebecois d'Amenagement de la Foret Feuillue

Meeting schedule

- **Introduction** (Sean Dolter, CFS/Len Moores, DFR&A_NF&L)
- **Remindering BAP goals of the Phase I – Coarse filter analysis** (Frederik Doyon, IQAFF)
- **Mid-progress report in transferring BAP technology (Phase I) for the WNMF** (Frederik Doyon, IQAFF)
- **Definition of forest management options** (Frederik Doyon, IQAFF & WNMF team)
- **Requirements for docking forest projections to the BAP analysis toolbox** (Frederik Doyon, IQAFF)
- **Discussing Wednesday field trip** (Frederik Doyon, IQAFF)

Remindering BAP goals

- Strategic planning tools to assess biodiversity value outcomes of different forest management options
- BAP phase I (coarse filter analysis)
  Ecosystem diversity & Landscape structure
- Mid-project deliverables
  - Habitat classification
  - Habitat reclassification algorithm
  - Adjacency contrast analysis

Mid-project progress report

- Habitat classification
- Habitat structure
- Adjacency contrast value
- Reclassification algorithm

Biodiversity Assessment Tool,

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Phase I: Coarse-filter analysis

Mid-project progress report

Frédérik Doyon, RPF, PhD
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July 2000

TABLE OF CONTENTS

List of Figures

List of Tables

List of Appendices

Introduction

Forestry has a major impact on biodiversity by changing within habitat-structure as well as the proportion and the spatial distribution of habitats in the landscape (Hunter 1990, Thompson 1993). It is therefore important to define habitat units that can be used to track changes in environmental conditions in the landscape under a disturbance regime (forest management and else). In the Biodiversity Assessment Project (BAP), habitats are the geographic units used for the ecosystem and the landscape assessment (Duinker *et al.* 1997). Classification of meaningful habitat units is a critical step, particularly when spatial considerations are taken in account (MacGarigal and Whitcomb 1995). Moreover, as indicator species are often selected according to their habitat specificity (often presented as a habitat/wildlife matrix (D'Eon and Watt 1994)), habitat classification has an impact on the indicator cortege selection.

1 Methodology

A hierarchical classification procedure has been used. Two levels are defined for stand composition and for stand structure. For composition we defined a broad level which expresses more the vegetation type, and the specific level, which described the tree species association. For the structure, a first level (strucstage) discriminates developing stands and forest stands, while the second level (standstage) describes more finely the silvicultural stage of the stand. Since, the number of habitat types is also a critical issue as the complexity of analysis grows exponentially with the number of habitat types, we limited the number of them as we coould. The ecological classification of Newfoundland has also served as a basis for identifying major habitat types (Meades and Moores 1994).

As forest management activities alter mainly terrestrial forested habitats, emphasis was placed on these habitats. Terrestrial habitats were split first by separating forestable and non-forestable habitats (Figure 1). Non-forestable habitats have been organised into woody and non-woody habitats. These habitats will be considered static when the forest will be projected in the future. Forestable habitats

were firstly separated based on the composition, and then according to their structure.

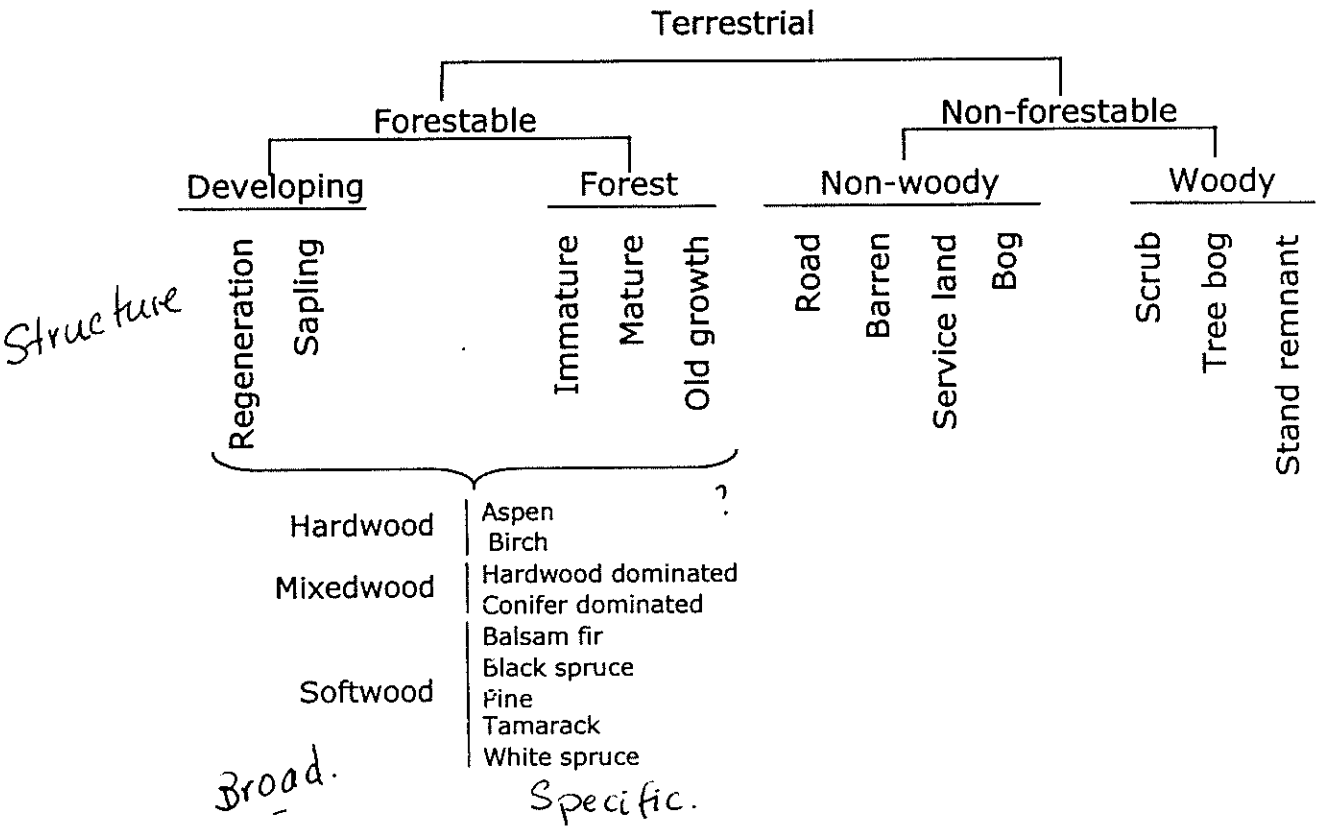


Figure 1. Habitat type hierarchical classification.

1.1 Broad composition types

Four broad composition types have been defined as it was used in the Alberta version of BAP (Doyon 1997). These are pure hardwoods, pure softwood, hardwood dominated mixedwood and softwood dominated mixedwood. We used the field **species_co** to assign one of type to each stand. Pure stands required 75% and more of one of the two types of trees (hardwood, softwood). For stands having more than one species in the **species_co** field, we used the summation of the mid-class associated with the position of the species in the field. For example, "bWbFtA" was assigned to hardwood-dominated mixed.

1.2 Specific composition types

Specific composition classes were defined according to the representativeness of a species association in the landscape. As this level of classification is hierarchically controlled by the broad habitat type, it had to consistent with it.

1.3 Developmental stages

For each specific composition type, we broke them down into five stand development stages. Developmental stages are period during which the habitat structure of a stand stay similar while it ages. It is obvious that habitat conditions change not abruptly more gradually but for the purpose of habitat classification. The first two stages are the developing stages. During the regenerating stage, trees are mostly seedlings. Shrubs and herbs can be abundant depending on the disturbance and the site (Meades and Moores 1994) that allows the establishment of the new cohort. The second one is the sapling stage. Stems of the stand at that stage have a dbh between 1 and 5 cm and are usually highly crowded. The next three stages are forest stages. The immature stage corresponds to the time when the stems are at the pole size. The mature stage represents the period during which commercial timber is available. It is usually the longest stage among the five, whatever the specific composition type is. Finally, the last stage is the old growth stage and it corresponds to the time when the stand starts to break down.

To define these stages by specific composition type, we first look at the age class distribution to get an idea of the proportion of area by age class using the forest inventory map. For defining when a stand become old growth, we used the typical mortality age of the species as defined in Loehle (1988). We also compared this break down to the yield curves for making sure that the transition between mature and old growth corresponded to the inflexion point of the curve. TSPs will help is refining this later on. A first draft of the developmental stage classification will be submitted to the expert judgement of experienced silviculturists at the Newfoundland and Labrador Department of Forestry and Agriculture.

1.4 Habitat structure characterisation and adjacency contrast

We used the PSPs to characterise the structure of the different habitat types using the following habitat variables:

- Fir percentage;
- Spruce percentage;
- Hardwood percentage;
- Total basal area;
- Stem density;
- Stand height;
- Percentage of the basal area per dbh class (0-5, 5-10, 10-20, 20-30, 30-40, 40+);
- Understory vegetation cover (high shrub, low shrub, high herb, low herb, moss and lichens);
- Snag basal area;
- Downed woody debris volume index.

Around 80 PSPs was not enough to characterise all the habitat types. For habitat types that we did not have PSPs representing them, we arbitrarily assigned values according to our best knowledge (Appendix I). Obviously, we expect to use the TSPs (when available) for refining the habitat characterisation. The habitat structure characterisation served for defining adjacency contrast between each habitat type. The correlation matrix was computed on the standardized (by variables) habitat structure matrix. Each variables was assumed to have the same weight. Correlation values in the resulting matrix were recoded to be between 0 and 1. The inverse (correlation-1) was then computed to obtained a measure of contrast instead of one of similarity. The adjacency ASCII file for BAP was therefore created using the habitat type four digit code (Broad composition, specific composition, strucstage, and standstage) (Appendix II).

1.5 Reclassification algorithm

To respect the information structure as required for using BAP technology (Rudy 2000), we adjusted the habitat reclassification algorithm to fit to the habitat types described here and the data information as generated by the projection tools.

2 Results

2.1 Habitat composition

The WNMF is characterised by a high proportion of non-productive lands not supporting forest stands (56%, Figure 2). In addition to reasons of site low fertility, scrubs and stand remnants are important probably also because of a high recurrence of spruce budworm outbreaks. In fact, of the 44% of land remaining, 85% of the forest stands are softwood stands (Figure 2), dominated by the balsam fir (Table 1), a species highly sensitive to the spruce budworm. Softwood dominated mixedwood is the second more abundant broad composition type, mostly represented by fir-birch stands. Hardwood and hardwood dominated mixedwood represent a minor component of the productive forest with only 5%. Birch and birch-fir stands are the most important of these broad composition types.

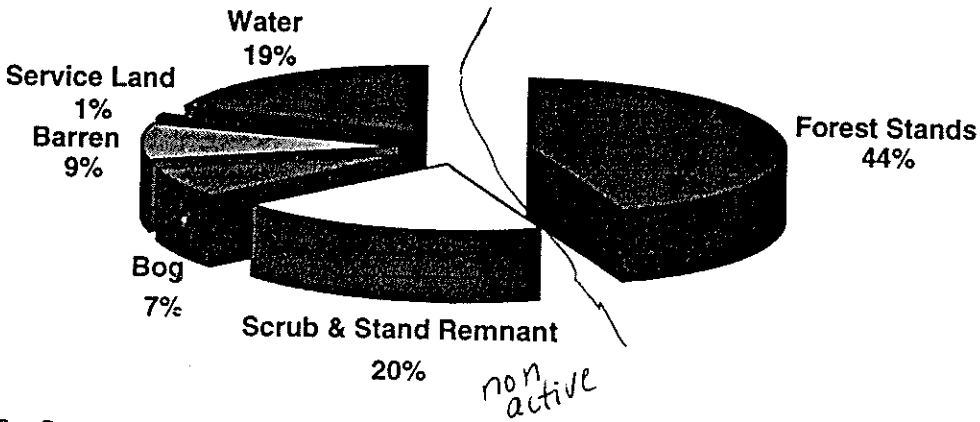


Figure 2. Proportion of forest productive and non-productive lands in WNMF.

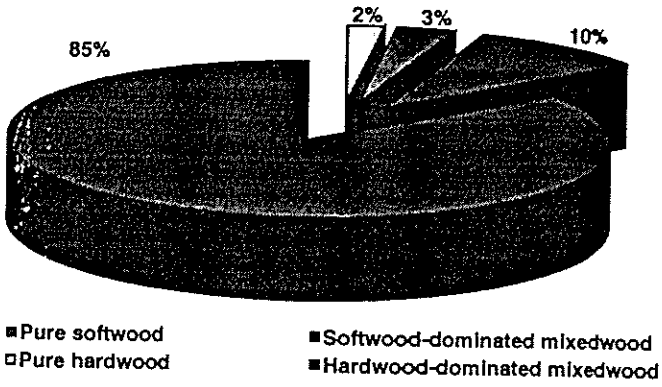


Figure 3. Proportion of broad composition types in WNMF.

A first classification of specific composition gave us 15 types (Table 1). However, some specific composition types are very rare in the WNMF. We decided to considered only the first seven more important as the 8 others represented less than 2% all together of the productive landscape. Therefore, Spruce-Birch was reclassified into Fir-Birch, Birch-Spruce into Birch-Fir, White Spruce and Tamarack into Black Spruce, Pine into Fir, and Aspen-Fir and Aspen-Spruce into Birch-Fir.

Table 1. Percentage covered by each specific composition type. The first seven ones that have been kept for the habitat classification.

Specific composition	Area (km^2)	Percentage	Cumulative
Fir	1728.97	50.90%	50.90%
Fir-Spruce	662.88	19.51%	70.41%
Fir-Birch	302.18	8.90%	79.31%
Spruce-Fir	248.54	7.32%	86.62%
Black Spruce	246.39	7.25%	93.88%
Birch-Fir	93.94	2.77%	96.64%
Birch	60.70	1.79%	98.43%
Spruce-Birch	27.06	0.80%	99.23%
Birch-Spruce	16.81	0.49%	99.72%
White spruce	5.92	0.17%	99.89%
Tamarack	1.23	0.04%	99.93%
Aspen	1.03	0.03%	99.96%
Pine	0.56	0.02%	99.98%
Aspen-Spruce	0.40	0.01%	99.99%
Aspen-Fir	0.37	0.01%	100.00%

2.2 Developmental stages

Habitat types were obtained by splitting into developmental stages a specific composition type. We end up with 35 forested habitat types. Based on the age class distribution, the typical mortality age (Loehle 1988), and local expertise, and yield curves, developmental stages were considered to be similar for specific composition

types involving balsam fir and white birch only (Table 2). Specific composition types involving spruce are believed to develop more slowly. The actual productive forest of WNMF is sort of regularized (Figure 4), although we detected an overrepresentation of regenerating stands (Table 3). Mature habitats cover most of the productive area (54%). Regenerating and pole-size stands are the next to most important developmental stages. Sapling and old growth stages are rare habitats in the WNMF covering only 2% and 1% respectively.

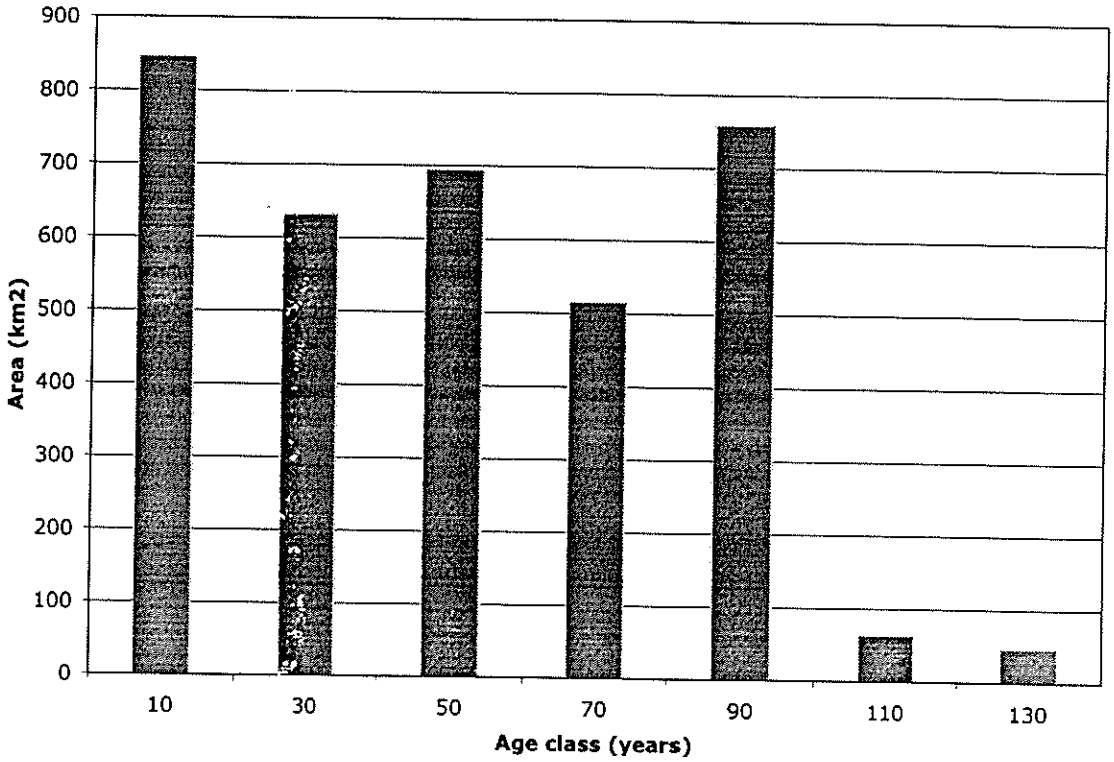


Figure 4. Age class distribution of the productive forest in the WNMF.

Habitat type doesn't seem to be randomly organised in space (Figure 5). For example, hardwood and hardwood-dominated mixedwood stands are more often found in lower elevation sites along valley bottoms (Corner Brook – Pasadena axis) and lake shores (Grand Lake, Deer lake, and Geoges Lake) suggesting different past disturbance history and/or non-random ecological conditions distribution in the WNMF landscape.

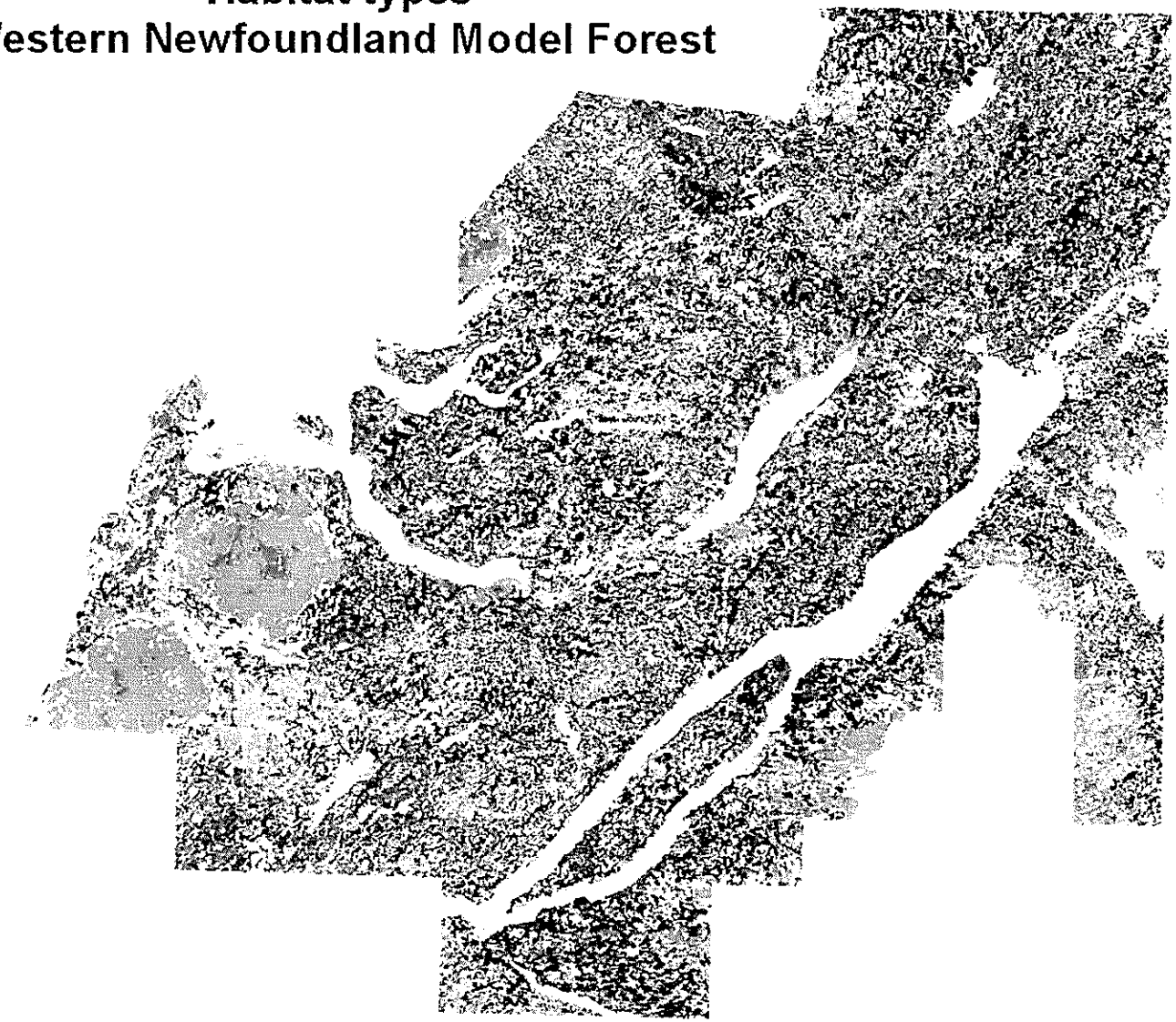
Table 2. Age breakdown for developmental stage by specific composition type for defining habitat types.

Composition		Developmental Stages (years)				
		Developing		Forest		
Broad	Specific	Regenerating	Sapling	Immature (pole)	Mature (timber)	Old Growth
HW	Birch	0-10	11-20	21-40	41-100	101+
HWm	Birch-Fir	0-10	11-20	21-40	41-100	101+
SWm	Fir-Birch	0-10	11-20	21-40	41-100	101+
SW	Black Spruce	0-15	16-25	26-55	56-150	151+
	Fir	0-10	11-20	21-40	41-100	101+
	Fir-Spruce	0-10	11-20	21-45	46-130	131+
	Spruce-Fir	0-10	11-20	21-50	51-145	146+

Table 3. Area percentage covered by each forested habitat types in WNMF.

		Developmental Stages (years)					Total
Composition		Developing		Forest			
Broad	Specific	Regenerating	Sapling	Immature (pole)	Mature (timber)	Old Growth	
HW	Birch	0.12%	0.06%	0.07%	1.46%	0.01%	1.72%
HWm	Birch-Fir	0.46%	0.05%	0.44%	3.57%	0.07%	4.59%
SWm	Fir-Birch	1.14%	0.24%	0.88%	5.20%	0.12%	7.60%
SW	Black Spruce	0.83%	0.00%	2.21%	3.40%	0.00%	54.90%
	Fir	21.33%	1.42%	7.82%	23.54%	0.79%	6.44%
	Fir-Spruce	2.41%	0.25%	2.12%	13.03%	0.00%	17.81%
	Spruce-Fir	0.54%	0.07%	2.41%	3.92%	0.00%	6.94%
Total		26.83%	2.08%	15.95%	54.14%	1.00%	

Habitat types
Western Newfoundland Model Forest



N
W E
S

Habitat types
- Spruce-Fir regenerating
- Spruce-Fir sapling
- Spruce-Fir immature
- Spruce-Fir mature
- Black Spruce regenerating
- Black Spruce immature
- Black Spruce mature
- Birch regenerating
- Birch sapling
- Birch immature
- Birch mature
- Birch old growth
- Birch-Fir regenerating
- Birch-Fir sapling
- Birch-Fir immature
- Birch-Fir mature
- Birch-Fir old growth
- Fir-Birch regenerating
- Fir-Birch sapling
- Fir-Birch immature
- Fir-Birch mature
- Fir-Birch old growth
- Fir regenerating
- Fir sapling
- Fir immature
- Fir mature
- Fir old growth
- Fir-Spruce regenerating
- Fir-Spruce sapling
- Fir-Spruce immature
- Fir-Spruce mature
- Bog
- Scrub & Stand Remnant
- Bare Land
- Water

10 0 10 20 30 Kilometers

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July 2000

Figure 5. Habitat type map in WNMF.

2.3 Habitat structure

Based on the PSP data we have been able to characterise 10 of the 35 habitat types, which represent 61% of the forested area. Unfortunately, the PSP sampling design did not seem to cover regenerating developmental stages therefore excluding *de facto* 27% of the forested area. Moreover, the small amount of PSP did not allow to characterise hardwood vegetation type. Even if these stands are not important in terms of forestry (softwood volume considerations), they are extremely important for biodiversity and a sampling design should allow to cover these habitats in the future. If not, habitat information should be taken in the TSP falling in these stands. As the "fir" specific composition type was highly dominating (Table 3), we decided to verify if fir stands on good and high productivity sites would be different than ones on medium and poor productivity sites in terms of habitat structure.

General trends can be detected across the developmental stage gradient (Figure 6):

- basal area increases from sapling stage to mature stage and then decrease at the old growth stage;
- a greater percentage of the basal area comes from larger trees as the stands ages
- downed woody debris and volumeand snag basal area increases as the stand ages;
- stand height increases as the stand ages
- moss and lichen cover stabilizes at the immature stage;
- understory vegetation is more abundant at sapling and old growth stages.

When comparing the habitat structure of "fir" specific composition type on different site productivity, we observe that understory vegetation, particularly the shrub layers, is more abundant on good sites than on medium sites. This result corroborates the higher vegetation competition hazard found on more productive forest types (Meades and Moores 1994) and suggests that site productivity should be used as a stratificator for "fir" specific composition type. The higher abundance of understory is not only due to the richness in nutrients but also to the fact that stands on more productive site are usually more opened than ones on less productive sites (Figure 7). The difference in basal area observed at the immature stage (Figure 6)

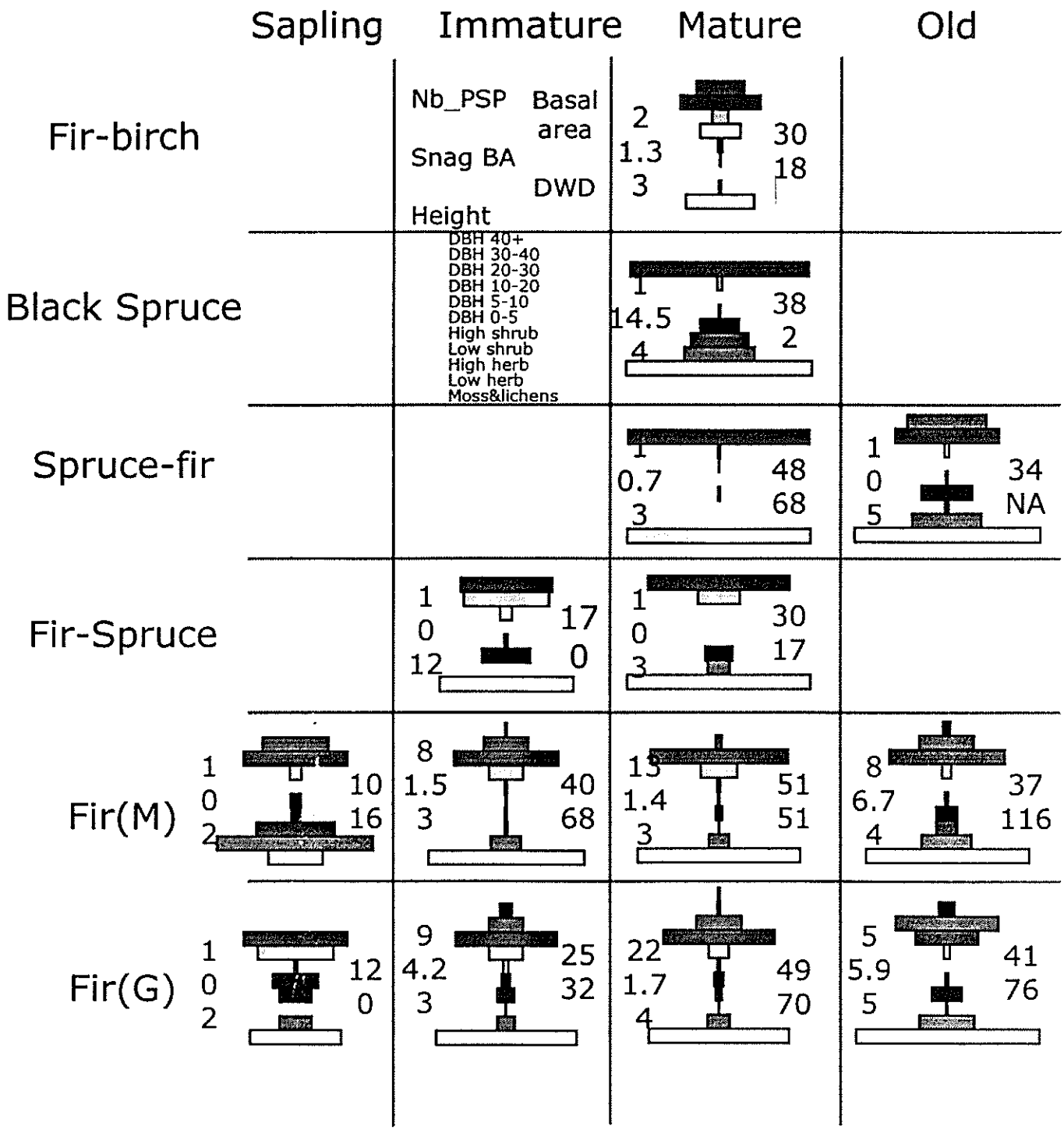

Figure 6. Habitat structure based on the PSP data

could be an effect of delay in tree establishment on productive site due to vegetation competition. However, at the mature stage this difference is no more detectable. Height is also another reason of splitting fir stands based on site productivity. Low productivity sites support lower fir stands than good productivity sites do. Stand height is an important habitat structure feature. Concerning downed woody debris, patterns differed between the two site productivity. Downed woody debris are usually higher on medium sites than on good sites. It is recognised that dead organic material decompose more quickly on rich sites (He and Mladenoff 1999). The fact that more downed woody debris are found on good productivity site at the mature stage is probably due to the fact that stands on good sites are more disturbed, as expressed by a lower stand density.

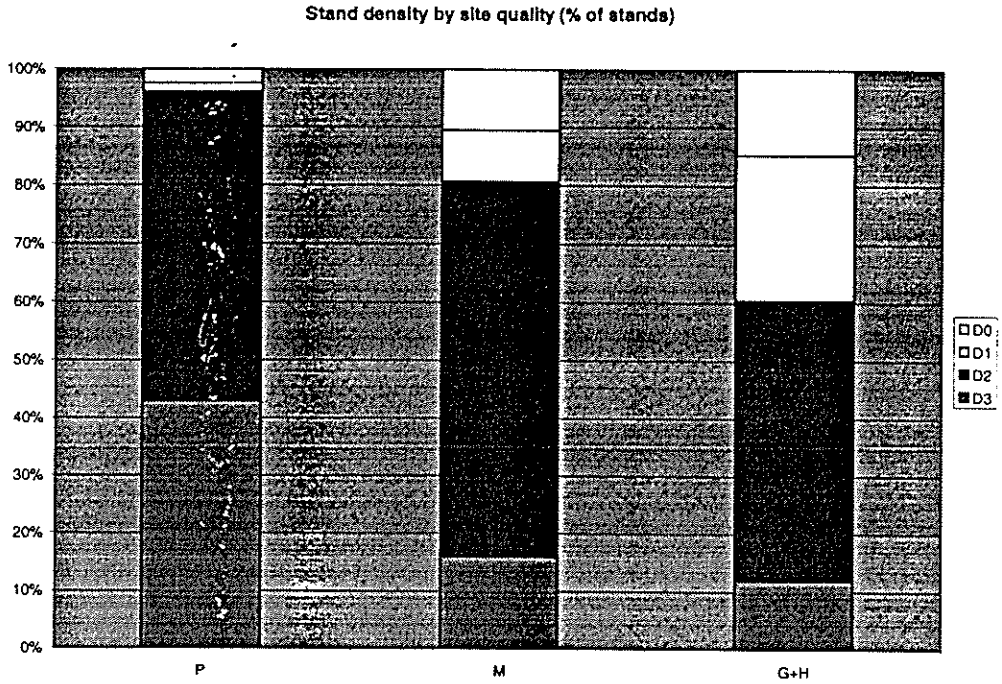

Figure 7. Stand density by site quality in WNMF.

When looking at differences in vertical structure between fir-dominated and spruce-dominated habitat types, the first thing to notice is the dbh structure (Figure 4). Fir stands are much more uneven than spruce stands. Spruce-dominated stands have a greater moss and lichen cover. The only PSP allowing to describe the black spruce mature habitat type is showing a strongly structured understory where all the understory layers are well-represented. Snag basal area was the highest in that

PSP. Contrarily, the fir-birch mature habitat type is highly uneven and show a weakly-developed understory, even for the moss-lichen vegetation layer.

2.4 Adjacency contrast

Nine hundreds and forty-six adjacency contrast values have been computed (Appendix II). In average, contrast value increases between two developmental stages as age difference between the two increases (Table 4). The highest contrast appears between old growth and regenerating stages. Non-"forestable" habitats are highly contrasted with forestable habitats.

Table 4. Average contrast value between developmental stages.

Stage	R	S	I	M	O	Ba	Bo	S&R	W
Regenerating (R)	0.09								
Sapling (S)	0.40	0.39							
Immature (I)	0.74	0.56	0.36						
Mature (M)	0.81	0.60	0.38	0.26					
Old growth (O)	0.87	0.72	0.47	0.44	0.20				
Bare Land (Ba)	0.28	0.51	0.80	0.79	0.64	0.00			
Bog (Bo)	0.44	0.60	0.68	0.72	0.57	0.47	0.00		
Scrub & Remnant (S&R)	0.36	0.51	0.74	0.75	0.66	0.37	0.19	0.00	
Water (W)	0.40	0.51	0.70	0.76	0.56	0.21	0.55	0.33	0.00

2.5 Reclassification algorithm

The algorithm will require to know for each polygon the age of the stand and the percent composition for the first 3 species (Appendix III).

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Appendices

Appendix I. Habitat structure of the habitat types.

Habitat type	bF	bSc	HW	Height	Basal area percentage by dbh class						Understory cover					BA	Density	Snag	DWD
					0-5	5-10	10-20	20-30	30-40	40+	HS	LS	HH	LH	ML				
Bare Land	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	40.0	50.0	5.0	0.0	300	0.10	2.0
Bog	5	5	5	1.0	50.0	0.0	0.0	0.0	0.0	0.0	20.0	50.0	15.0	20.0	100.0	5.0	500	2.50	8.0
Scrub & Stand Remnant	5	5	5	1.0	50.0	0.0	0.0	0.0	0.0	0.0	70.0	40.0	10.0	20.0	10.0	10.0	400	4.00	15.0
Water	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.00	0.0
Birch reg	15	0	85	1.0	50.0	45.0	5.0	0.0	0.0	0.0	20.0	10.0	40.0	70.0	30.0	3.0	20000	2.00	10.0
Birch sap	15	0	85	2.0	17.3	32.7	37.8	12.2	0.0	0.0	15.0	8.0	0.0	10.0	50.0	13.0	12000	1.00	8.0
Birch imm	15	0	85	3.0	5.2	25.4	54.4	13.1	2.0	0.0	2.5	12.2	1.1	13.0	65.0	30.0	8113	2.86	20.0
Birch mat	10	5	85	4.5	4.2	11.0	75.5	9.0	0.3	0.1	2.4	7.5	10.5	14.8	80.0	40.0	8844	3.92	25.0
Birch old	10	5	85	5.0	1.0	3.6	45.0	37.0	5.0	3.0	1.5	25.0	5.0	35.0	85.0	35.0	1896	6.32	40.0
Birch-Fir reg	35	5	60	1.0	50.0	45.0	5.0	0.0	0.0	0.0	20.0	10.0	40.0	70.0	40.0	3.0	20000	2.00	15.0
Birch-Fir sap	35	5	60	2.0	17.3	32.7	37.8	12.2	0.0	0.0	15.0	8.0	0.0	10.0	60.0	13.0	12000	1.00	12.0
Birch-Fir imm	35	5	60	3.0	5.2	25.4	54.4	13.1	2.0	0.0	2.5	12.2	1.1	13.0	76.2	30.0	8113	2.86	25.0
Birch-Fir mat	30	10	60	4.0	4.2	11.0	75.5	9.0	0.3	0.1	2.4	7.5	10.5	14.8	83.8	40.0	8844	3.92	30.0
Birch-Fir old	30	10	60	5.0	1.0	3.6	45.0	37.0	5.0	3.0	1.5	20.0	10.0	40.0	85.0	35.0	1896	6.32	45.0
Black Spruce reg	15	75	10	1.0	50.0	45.0	5.0	0.0	0.0	0.0	20.0	10.0	40.0	70.0	40.0	2.0	20000	4.00	20.0
Black Spruce sap	15	75	10	2.0	0.2	0.3	0.5	0.0	0.0	0.0	15.0	8.0	0.0	10.0	60.0	9.3	12000	2.00	16.0
Black Spruce imm	15	75	10	2.5	0.1	0.3	0.7	0.1	0.0	0.0	2.5	12.2	1.1	13.0	76.2	25.0	8113	6.00	50.1
Black Spruce mat	15	75	10	4.0	0.0	2.8	97.2	0.1	0.0	0.0	1.0	21.0	31.0	38.0	101.0	38.3	2950	14.52	37.7
Black Spruce old	10	80	10	4.2	0.0	0.0	0.0	0.0	0.0	0.0	2.0	25.0	4.7	45.0	105.0	34.0	2000	16.00	96.1
Fir-Birch reg	55	5	40	1.0	50.0	45.0	5.0	0.0	0.0	0.0	20.0	10.0	40.0	70.0	40.0	3.0	20000	2.00	6.0
Fir-Birch sap	55	5	40	2.0	17.3	32.7	37.8	12.2	0.0	0.0	15.0	8.0	0.0	10.0	60.0	13.0	12000	0.50	5.0
Fir-Birch imm	55	5	40	2.5	5.2	25.4	54.4	13.1	2.0	0.0	2.5	5.0	1.1	13.0	76.2	30.0	8113	1.00	12.0
Fir-Birch mat	45	15	40	3.0	21.7	8.6	43.7	26.0	0.0	0.0	2.5	0.5	0.0	1.0	37.0	29.7	8000	1.30	18.0
Fir-Birch old	45	15	15	4.0	1.0	3.6	45.0	35.0	10.0	5.0	1.5	18.2	6.0	35.0	90.0	35.0	3000	3.00	25.0
Fir-G reg	80	5	15	1.0	50.0	45.0	5.0	0.0	0.0	0.0	40.0	40.0	10.0	70.0	40.0	3.0	20000	2.00	20.0
Fir-G sap	80	5	15	2.0	1.9	41.6	56.5	0.0	0.0	0.0	25.0	18.0	0.0	18.0	50.0	12.3	2825	0.00	16.0
Fir-G imm	80	5	15	2.8	3.0	18.1	53.7	18.4	6.8	0.0	4.8	9.2	0.5	9.8	74.7	24.7	7372	4.24	31.9
Fir-G mat	80	5	15	4.0	1.5	10.9	60.8	24.4	1.6	0.8	5.1	3.5	0.1	12.1	76.6	49.1	8210	1.74	70.4
Fir-G old	80	5	15	5.3	0.0	3.3	33.3	54.9	8.5	2.0	1.8	16.2	0.8	29.0	98.4	40.9	1692	5.90	76.0
Fir-M reg	75	10	15	1.0	50.0	45.0	5.0	0.0	0.0	0.0	20.0	20.0	50.0	90.0	25.0	3.0	20000	2.00	23.0
Fir-M sap	75	10	15	2.0	0.0	6.6	56.9	36.5	0.0	0.0	6.0	5.0	43.0	85.0	30.0	19.5	1125	0.00	16.0
Fir-M imm	75	10	15	3.0	1.4	18.4	55.4	23.8	1.1	0.0	0.8	1.3	1.7	16.2	82.8	39.5	10918	1.47	68.3
Fir-M mat	70	15	15	3.5	1.8	19.7	75.2	3.4	0.0	0.0	0.9	3.7	0.2	10.8	88.5	51.4	9548	1.40	51.5
Fir-M old	70	15	15	4.1	0.0	5.0	61.9	29.0	4.0	1.0	1.6	11.5	11.4	26.7	87.5	37.1	2347	6.74	116.3
Fir-Spruce reg	50	40	10	1.0	50.0	45.0	5.0	0.0	0.0	0.0	25.0	17.5	35.0	70.0	40.0	3.0	20000	2.00	7.0
Fir-Spruce sap	50	40	10	1.5	17.3	32.7	37.8	12.2	0.0	0.0	15.2	9.4	43.0	26.6	52.0	12.3	12000	1.00	2.0
Fir-Spruce imm	50	40	10	2.0	6.6	45.1	48.4	0.0	0.0	0.0	2.0	26.0	0.0	0.0	71.0	16.9	6048	2.86	12.0
Fir-Spruce mat	55	35	10	3.0	0.0	22.8	77.2	0.0	0.0	0.0	0.0	15.0	0.0	12.0	100.0	29.8	3050	3.92	17.0
Fir-Spruce old	55	35	10	3.5	1.0	3.6	45.0	35.0	5.0	1.0	1.5	18.2	4.7	30.9	95.3	26.0	1896	6.32	30.0
Spruce-Fir reg	40	50	10	1.0	50.0	45.0	5.0	0.0	0.0	0.0	25.0	17.5	35.0	70.0	40.0	3.0	20000	2.00	14.0
Spruce-Fir sap	40	50	10	2.0	17.3	32.7	37.8	12.2	0.0	0.0	15.2	9.4	43.0	26.6	52.0	12.3	12000	1.00	6.0
Spruce-Fir imm	40	50	10	3.0	5.2	25.4	54.4	13.1	2.0	0.0	2.5	12.2	1.1	13.0	76.2	27.0	8113	2.86	30.0
Spruce-Fir mat	35	55	10	3.5	0.1	1.1	98.8	0.0	0.0	0.0	0.0	1.0	0.0	0.0	100.0	47.7	7903	3.92	68.0
Spruce-Fir old	35	55	10	4.0	0.0	2.5	50.5	42.0	3.0	2.0	1.0	27.0	2.0	37.0	100.0	34.1	1650	6.32	80.0

bF=balsam fir, bS=black spruce, HW=hardwood, HS=high shrub, LS=low shrub, HH=high herb, LH=low herb, ML=moss and lichen, BA=stand basal area, Snag=snag stand basal area, DWD= downed woody debris volume index, reg=regenerating, imm=immature, mat=mature, old= old growth

Appendix II. Contrast value between two contiguous habitat types.

HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast
1	1	1.00	1123	2	0.34	2125	3	0.33	3111	4	0.59	4112	1111	0.43	4023	1112	0.36	4324	1123	0.50	4425	1124	0.47
2	1	0.53	1125	2	0.46	4211	3	0.60	3112	4	0.39	4123	1111	0.17	4024	1112	0.37	4325	1123	0.42	1	1125	0.40
3	1	0.63	2111	2	0.52	4212	3	0.54	3123	4	0.23	4124	1111	0.10	4025	1112	0.19	4411	1123	0.19	2	1125	0.46
4	1	0.79	2112	2	0.38	4223	3	0.42	3124	4	0.48	4125	1111	0.08	4311	1112	0.50	4412	1123	0.23	3	1125	0.38
1111	1	0.74	2123	2	0.30	4224	3	0.38	3125	4	0.59	4011	1111	0.86	4312	1112	0.46	4423	1123	0.47	4	1125	0.51
1112	1	0.37	2124	2	0.26	4225	3	0.46	4111	4	0.51	4012	1111	0.48	4323	1112	0.45	4424	1123	0.52	1111	1125	0.29
1123	1	0.27	2125	2	0.41	3111	3	0.59	4112	4	0.37	4023	1111	0.17	4324	1112	0.31	4425	1123	0.40	1112	1125	0.52
1124	1	0.26	4211	2	0.53	3112	3	0.45	4123	4	0.38	4024	1111	0.15	4325	1112	0.17	1	1124	0.26	1123	1125	0.75
1125	1	0.40	4212	2	0.48	3123	3	0.14	4124	4	0.25	4025	1111	0.07	4411	1112	0.50	2	1124	0.30	1124	1125	0.74
2111	1	0.74	4223	2	0.48	3124	3	0.31	4125	4	0.41	4311	1111	0.86	4412	1112	0.45	3	1124	0.27	1125	1125	1.00
2112	1	0.29	4224	2	0.48	3125	3	0.35	4011	4	0.58	4312	1111	0.69	4423	1112	0.31	4	1124	0.27	2111	1125	0.20
2123	1	0.13	4225	2	0.54	4111	3	0.78	4012	4	0.52	4323	1111	0.33	4424	1112	0.31	1111	1124	0.42	2112	1125	0.41
2124	1	0.20	3111	2	0.52	4112	3	0.58	4023	4	0.20	4324	1111	0.09	4425	1112	0.17	1112	1124	0.72	2123	1125	0.71
2125	1	0.41	3112	2	0.36	4123	3	0.27	4024	4	0.11	4325	1111	0.02	1	1123	0.27	1123	1124	0.92	2124	1125	0.68
4211	1	0.75	3123	2	0.19	4124	3	0.21	4025	4	0.36	4411	1111	0.86	2	1123	0.34	1124	1124	1.00	2125	1125	0.98
4212	1	0.42	3124	2	0.18	4125	3	0.30	4311	4	0.60	4412	1111	0.67	3	1123	0.31	1125	1124	0.74	4211	1125	0.11
4223	1	0.34	3125	2	0.42	4011	3	0.61	4312	4	0.57	4423	1111	0.08	4	1123	0.39	2111	1124	0.32	4212	1125	0.34
4224	1	0.42	4111	2	0.70	4012	3	0.38	4323	4	0.29	4424	1111	0.10	1111	1123	0.53	2112	1124	0.63	4223	1125	0.47
4225	1	0.38	4112	2	0.45	4023	3	0.13	4324	4	0.09	4425	1111	0.03	1112	1123	0.86	2123	1124	0.89	4224	1125	0.51
3111	1	0.73	4123	2	0.28	4024	3	0.16	4325	4	0.39	1	1112	0.37	1123	1123	1.00	2124	1124	0.98	4225	1125	0.56
3112	1	0.25	4124	2	0.17	4025	3	0.27	4411	4	0.62	2	1112	0.40	1124	1123	0.92	2125	1124	0.67	3111	1125	0.13
3123	1	0.14	4125	2	0.35	4311	3	0.66	4412	4	0.58	3	1112	0.49	1125	1123	0.75	4211	1124	0.18	3112	1125	0.28
3124	1	0.25	4011	2	0.54	4312	3	0.49	4423	4	0.26	4	1112	0.52	2111	1123	0.42	4212	1124	0.35	3123	1125	0.52
3125	1	0.45	4012	2	0.30	4323	3	0.42	4424	4	0.21	1111	1112	0.78	2112	1123	0.78	4223	1124	0.45	3124	1125	0.55
4111	1	0.57	4023	2	0.14	4324	3	0.24	4425	4	0.41	1112	1112	1.00	2123	1123	0.96	4224	1124	0.62	3125	1125	0.84
4112	1	0.35	4024	2	0.20	4325	3	0.30	1	1111	0.74	1123	1112	0.86	2124	1123	0.85	4225	1124	0.48	4111	1125	0.15
4123	1	0.23	4025	2	0.30	4411	3	0.66	2	1111	0.51	1124	1112	0.72	2125	1123	0.65	3111	1124	0.24	4112	1125	0.24
4124	1	0.17	4311	2	0.59	4412	3	0.49	3	1111	0.59	1125	1112	0.52	4211	1123	0.21	3112	1124	0.48	4123	1125	0.53
4125	1	0.30	4312	2	0.43	4423	3	0.20	4	1111	0.64	2111	1112	0.70	4212	1123	0.29	3123	1124	0.72	4124	1125	0.56
4011	1	0.78	4323	2	0.56	4424	3	0.22	1111	1111	1.00	2112	1112	0.97	4223	1123	0.34	3124	1124	0.69	4125	1125	0.79
4012	1	0.76	4324	2	0.41	4425	3	0.35	1112	1111	0.78	2123	1112	0.77	4224	1123	0.43	3125	1124	0.45	4011	1125	0.10
4023	1	0.16	4325	2	0.45	1	4	0.79	1123	1111	0.53	2124	1112	0.61	4225	1123	0.36	4111	1124	0.12	4012	1125	0.40
4024	1	0.11	4411	2	0.59	2	4	0.45	1124	1111	0.42	2125	1112	0.41	3111	1123	0.33	4112	1124	0.31	4023	1125	0.44
4025	1	0.31	4412	2	0.43	3	4	0.67	1125	1111	0.29	4211	1112	0.48	3112	1123	0.61	4123	1124	0.44	4024	1125	0.41
4311	1	0.73	4423	2	0.29	4	4	1.00	2111	1111	0.99	4212	1112	0.40	3123	1123	0.77	4124	1124	0.60	4025	1125	0.66
4312	1	0.72	4424	2	0.27	1111	4	0.64	2112	1111	0.73	4223	1112	0.24	3124	1123	0.67	4125	1124	0.48	4311	1125	0.06
4323	1	0.21	4425	2	0.48	1112	4	0.52	2123	1111	0.38	4224	1112	0.21	3125	1123	0.47	4011	1124	0.14	4312	1125	0.08
4324	1	0.12	1	3	0.63	1123	4	0.39	2124	1111	0.31	4225	1112	0.20	4111	1123	0.25	4012	1124	0.36	4323	1125	0.30
4325	1	0.32	2	3	0.81	1124	4	0.27	2125	1111	0.21	3111	1112	0.62	4112	1123	0.40	4023	1124	0.56	4324	1125	0.44
4411	1	0.73	3	3	1.00	1125	4	0.51	4211	1111	0.83	3112	1112	0.83	4123	1123	0.51	4024	1124	0.68	4325	1125	0.75
4412	1	0.72	4	3	0.67	2111	4	0.62	4212	1111	0.42	3123	1112	0.65	4124	1123	0.51	4025	1124	0.52	4411	1125	0.06
4423	1	0.12	1111	3	0.59	2112	4	0.45	4223	1111	0.25	3124	1112	0.65	4125	1123	0.48	4311	1124	0.12	4412	1125	0.10
4424	1	0.17	1112	3	0.49	2123	4	0.25	4224	1111	0.21	3125	1112	0.31	4011	1123	0.20	4312	1124	0.23	4423	1125	0.42
4425	1	0.33	1123	3	0.31	2124	4	0.19	4225	1111	0.24	4111	1112	0.52	4012	1123	0.31	4323	1124	0.36	4424	1125	0.47
1	2	0.53	1124	3	0.27	2125	4	0.50	3111	1111	0.95	4112	1112	0.52	4023	1123	0.50	4324	1124	0.61	4425	1125	0.78
2	2	1.00	1125	3	0.38	4211	4	0.65	3112	1111	0.65	4123	1112	0.34	4024	1123	0.55	4325	1124	0.44	1	2111	0.74
3	2	0.81	2111	3	0.59	4212	4	0.50	3123	1111	0.33	4124	1112	0.32	4025	1123	0.44	4411	1124	0.13	2	2111	0.52
4	2	0.45	2112	3	0.46	4223	4	0.39	3124	1111	0.38	4125	1112	0.24	4311	1123	0.19	4412	1124	0.26	3	2111	0.59
1111	2	0.51	2123	3	0.21	4224	4	0.31	3125	1111	0.20	4011	1112	0.47	4312	1123	0.22	4423	1124	0.51	4	2111	0.62
1112	2	0.40	2124	3	0.20	4225	4	0.33	4111	1111	0.75	4012	1112	0.31	4323	1123	0.45	4424	1124	0.71	1111	2111	0.99

HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast
1112	2111	0.70	4211	2112	0.48	3125	2123	0.50	4024	2124	0.81	4423	2125	0.45	1123	4212	0.29	4212	4223	0.87	4111	4224	0.18
1123	2111	0.42	4212	2112	0.40	4111	2123	0.21	4025	2124	0.61	4424	2125	0.50	1124	4212	0.35	4223	4223	1.00	4112	4224	0.28
1124	2111	0.32	4223	2112	0.21	4112	2123	0.48	4311	2124	0.08	4425	2125	0.83	1125	4212	0.34	4224	4223	0.76	4123	4224	0.40
1125	2111	0.20	4224	2112	0.15	4123	2123	0.66	4312	2124	0.23	1	4211	0.75	2111	4212	0.43	4225	4223	0.92	4124	4224	0.43
2111	2111	1.00	4225	2112	0.14	4124	2123	0.65	4323	2124	0.41	2	4211	0.53	2112	4212	0.40	3111	4223	0.23	4125	4224	0.44
2112	2111	0.69	3111	2112	0.65	4125	2123	0.57	4324	2124	0.72	3	4211	0.60	2123	4212	0.25	3112	4223	0.15	4011	4224	0.23
2123	2111	0.30	3112	2112	0.94	4011	2123	0.14	4325	2124	0.50	4	4211	0.65	2124	4212	0.33	3123	4223	0.24	4012	4224	0.40
2124	2111	0.24	3123	2112	0.72	4012	2123	0.30	4411	2124	0.07	1111	4211	0.83	2125	4212	0.33	3124	4223	0.35	4023	4224	0.41
2125	2111	0.14	3124	2112	0.66	4023	2123	0.66	4412	2124	0.25	1112	4211	0.48	4211	4212	0.69	3125	4223	0.42	4024	4224	0.55
4211	2111	0.87	3125	2112	0.28	4024	2123	0.71	4423	2124	0.60	1123	4211	0.21	4212	4212	1.00	4111	4223	0.28	4025	4224	0.60
4212	2111	0.43	4111	2112	0.59	4025	2123	0.54	4424	2124	0.81	1124	4211	0.18	4223	4212	0.87	4112	4223	0.19	4311	4224	0.26
4223	2111	0.25	4112	2112	0.64	4311	2123	0.11	4425	2124	0.51	1125	4211	0.11	4224	4212	0.56	4123	4223	0.35	4312	4224	0.36
4224	2111	0.20	4123	2112	0.41	4312	2123	0.20	1	2125	0.41	2111	4211	0.87	4225	4212	0.66	4124	4223	0.45	4323	4224	0.54
4225	2111	0.23	4124	2112	0.39	4323	2123	0.54	2	2125	0.41	2112	4211	0.48	3111	4212	0.42	4125	4223	0.48	4324	4224	0.76
3111	2111	0.99	4125	2112	0.25	4324	2123	0.65	3	2125	0.33	2123	4211	0.11	3112	4212	0.38	4011	4223	0.26	4325	4224	0.63
3112	2111	0.66	4011	2112	0.50	4325	2123	0.51	4	2125	0.50	2124	4211	0.13	3123	4212	0.24	4012	4223	0.21	4411	4224	0.28
3123	2111	0.32	4012	2112	0.31	4411	2123	0.10	1111	2125	0.21	2125	4211	0.09	3124	4212	0.37	4023	4223	0.46	4412	4224	0.41
3124	2111	0.34	4023	2112	0.45	4412	2123	0.19	1112	2125	0.41	4211	4211	1.00	3125	4212	0.39	4024	4223	0.49	4423	4224	0.66
3125	2111	0.18	4024	2112	0.44	4423	2123	0.60	1123	2125	0.65	4212	4211	0.69	4111	4212	0.46	4025	4223	0.58	4424	4224	0.78
4111	2111	0.81	4025	2112	0.19	4424	2123	0.62	1124	2125	0.67	4223	4211	0.53	4112	4212	0.31	4311	4223	0.36	4425	4224	0.67
4112	2111	0.47	4311	2112	0.54	4425	2123	0.46	1125	2125	0.98	4224	4211	0.41	4123	4212	0.30	4312	4223	0.32	1	4225	0.38
4123	2111	0.19	4312	2112	0.52	1	2124	0.20	2111	2125	0.14	4225	4211	0.44	4124	4212	0.30	4323	4223	0.51	2	4225	0.54
4124	2111	0.11	4323	2112	0.53	2	2124	0.26	2112	2125	0.32	3111	4211	0.87	4125	4212	0.32	4324	4223	0.56	3	4225	0.46
4125	2111	0.07	4324	2112	0.37	3	2124	0.20	2123	2125	0.64	3112	4211	0.47	4011	4212	0.40	4325	4223	0.58	4	4225	0.33
4011	2111	0.93	4325	2112	0.17	4	2124	0.19	2124	2125	0.65	3123	4211	0.14	4012	4212	0.25	4411	4223	0.41	1111	4225	0.24
4012	2111	0.51	4411	2112	0.53	1111	2124	0.31	2125	2125	1.00	3124	4211	0.26	4023	4212	0.32	4412	4223	0.40	1112	4225	0.20
4023	2111	0.20	4412	2112	0.49	1112	2124	0.61	4211	2125	0.09	3125	4211	0.18	4024	4212	0.35	4423	4223	0.70	1123	4225	0.36
4024	2111	0.17	4423	2112	0.37	1123	2124	0.85	4212	2125	0.33	4111	4211	0.73	4025	4212	0.32	4424	4223	0.72	1124	4225	0.48
4025	2111	0.07	4424	2112	0.32	1124	2124	0.98	4223	2125	0.48	4112	4211	0.38	4311	4212	0.57	4425	4223	0.72	1125	4225	0.56
4311	2111	0.92	4425	2112	0.14	1125	2124	0.68	4224	2125	0.53	4123	4211	0.14	4312	4212	0.55	1	4224	0.42	2111	4225	0.23
4312	2111	0.75	1	2123	0.13	2111	2124	0.24	4225	2125	0.57	4124	4211	0.06	4323	4212	0.50	2	4224	0.48	2112	4225	0.14
4323	2111	0.35	2	2123	0.30	2112	2124	0.57	3111	2125	0.11	4125	4211	0.06	4324	4212	0.43	3	4224	0.38	2123	4225	0.37
4324	2111	0.11	3	2123	0.21	2123	2124	0.88	3112	2125	0.23	4011	4211	0.86	4325	4212	0.44	4	4224	0.31	2124	4225	0.50
4325	2111	0.02	4	2123	0.25	2124	2124	1.00	3123	2125	0.52	4012	4211	0.45	4411	4212	0.61	1111	4224	0.21	2125	4225	0.57
4411	2111	0.91	1111	2123	0.38	2125	2124	0.65	3124	2125	0.55	4023	4211	0.16	4412	4212	0.62	1112	4224	0.21	4211	4225	0.44
4412	2111	0.72	1112	2123	0.77	4211	2124	0.13	3125	2125	0.90	4024	4211	0.16	4423	4212	0.64	1123	4224	0.43	4212	4225	0.66
4423	2111	0.10	1123	2123	0.96	4212	2124	0.33	4111	2125	0.12	4025	4211	0.10	4424	4212	0.56	1124	4224	0.62	4223	4225	0.92
4424	2111	0.09	1124	2123	0.89	4223	2124	0.47	4112	2125	0.25	4311	4211	0.95	4425	4212	0.51	1125	4224	0.51	4224	4225	0.85
4425	2111	0.01	1125	2123	0.71	4224	2124	0.66	4123	2125	0.59	4312	4211	0.81	1	4223	0.34	2111	4224	0.20	4225	4225	1.00
1	2112	0.29	2111	2123	0.30	4225	2124	0.50	4124	2125	0.64	4323	4211	0.46	2	4223	0.48	2112	4224	0.15	3111	4225	0.21
2	2112	0.38	2112	2123	0.74	3111	2124	0.19	4125	2125	0.87	4324	4211	0.21	3	4223	0.42	2123	4224	0.44	3112	4225	0.06
3	2112	0.46	2123	2123	1.00	3112	2124	0.47	4011	2125	0.10	4325	4211	0.13	4	4223	0.39	2124	4224	0.66	3123	4225	0.19
4	2112	0.45	2124	2123	0.88	3123	2124	0.77	4012	2125	0.47	4411	4211	0.97	1111	4223	0.25	2125	4224	0.53	3124	4225	0.27
1111	2112	0.73	2125	2123	0.64	3124	2124	0.71	4023	2125	0.51	4412	4211	0.84	1112	4223	0.24	4211	4224	0.41	3125	4225	0.42
1112	2112	0.97	4211	2123	0.11	3125	2124	0.46	4024	2125	0.46	4423	4211	0.33	1123	4223	0.34	4212	4224	0.56	4111	4225	0.29
1123	2112	0.78	4212	2123	0.25	4111	2124	0.09	4025	2125	0.74	4424	4211	0.24	1124	4223	0.45	4223	4224	0.76	4112	4225	0.21
1124	2112	0.63	4223	2123	0.34	4112	2124	0.36	4311	2125	0.04	4425	4211	0.18	1125	4223	0.47	4224	4224	1.00	4123	4225	0.38
1125	2112	0.41	4224	2123	0.44	4123	2124	0.52	4312	2125	0.09	1	4212	0.42	2111	4223	0.25	4225	4224	0.85	4124	4225	0.45
2111	2112	0.69	4225	2123	0.37	4124	2124	0.71	4323	2125	0.27	2	4212	0.48	2112	4223	0.21	3111	4224	0.19	4125	4225	0.55
2112	2112	1.00	3111	2123	0.25	4125	2124	0.52	4324	2125	0.46	3	4212	0.54	2123	4223	0.34	3112	4224	0.10	4011	4225	0.26
2123	2112	0.74	3112	2123	0.65	4011	2124	0.11	4325	2125	0.83	4	4212	0.50	2124	4223	0.47	3123	4224	0.33	4012	4225	0.27
2124	2112	0.57	3123	2123	0.89	4012	2124	0.38	4411	2125	0.04	1111	4212	0.42	2125	4223	0.48	3124	4224	0.33	4023	4225	0.43
2125	2112	0.32	3124	2123	0.69	4023	2124	0.68	4412	2125	0.11	1112	4212	0.40	4211	4223	0.53	3125	4224	0.41	4024	4225	0.46

HT1	HT2	Contrast
4025	4225	0.68
4311	4225	0.29
4312	4225	0.20
4323	4225	0.47
4324	4225	0.59
4325	4225	0.64
4411	4225	0.33
4412	4225	0.26
4423	4225	0.59
4424	4225	0.67
4425	4225	0.76
1	3111	0.73
2	3111	0.52
3	3111	0.59
4	3111	0.59
1111	3111	0.95
1112	3111	0.62
1123	3111	0.33
1124	3111	0.24
1125	3111	0.13
2111	3111	0.99
2112	3111	0.65
2123	3111	0.25
2124	3111	0.19
2125	3111	0.11
4211	3111	0.87
4212	3111	0.42
4223	3111	0.23
4224	3111	0.19
4225	3111	0.21
3111	3111	1.00
3112	3111	0.68
3123	3111	0.33
3124	3111	0.33
3125	3111	0.19
4111	3111	0.85
4112	3111	0.53
4123	3111	0.24
4124	3111	0.14
4125	3111	0.09
4011	3111	0.97
4012	3111	0.55
4023	3111	0.23
4024	3111	0.20
4025	3111	0.08
4311	3111	0.96
4312	3111	0.79
4323	3111	0.39
4324	3111	0.15
4325	3111	0.05
4411	3111	0.93
4412	3111	0.75
4423	3111	0.12
4424	3111	0.09
4425	3111	0.00
1	3112	0.25
2	3112	0.36
3	3112	0.45
4	3112	0.39
1111	3112	0.65
1112	3112	0.83
1123	3112	0.61
1124	3112	0.48
1125	3112	0.28
2111	3112	0.66
2112	3112	0.94
2123	3112	0.65
2124	3112	0.47
2125	3112	0.23
4211	3112	0.47
4212	3112	0.38
4223	3112	0.15
4224	3112	0.10
4225	3112	0.06
3111	3112	0.68
3112	3112	1.00
3123	3112	0.77
3124	3112	0.66
3125	3112	0.30
4111	3112	0.67
4112	3112	0.77
4123	3112	0.52
4124	3112	0.47
4125	3112	0.29
4011	3112	0.57
4012	3112	0.40
4023	3112	0.53
4024	3112	0.52
4025	3112	0.20
4311	3112	0.61
4312	3112	0.61
4323	3112	0.61
4324	3112	0.45
4325	3112	0.22
4411	3112	0.57
4412	3112	0.56
4423	3112	0.43
4424	3112	0.31
4425	3112	0.11
1	3123	0.14
2	3123	0.19
3	3123	0.14
4	3123	0.23
1111	3123	0.33
1112	3123	0.65
1123	3123	0.77
1124	3123	0.72
1125	3123	0.52
2111	3123	0.32
2112	3123	0.72
2123	3123	0.89
2124	3123	0.77
2125	3123	0.52
4211	3123	0.14
4212	3123	0.24
4223	3123	0.24
4224	3123	0.33
4225	3123	0.19
3111	3123	0.33
3112	3123	0.77
3123	3123	1.00
3124	3123	0.74
3125	3123	0.54
4111	3123	0.27
4112	3123	0.62
4123	3123	0.78
4124	3123	0.76
4125	3123	0.60
4011	3123	0.25
4012	3123	0.46
4023	3123	0.79
4024	3123	0.81
4025	3123	0.53
4311	3123	0.22
4312	3123	0.38
4323	3123	0.55
4324	3123	0.71
4325	3123	0.53
4411	3123	0.18
4412	3123	0.34
4423	3123	0.66
4424	3123	0.62
4425	3123	0.38
1	3124	0.25
2	3124	0.18
3	3124	0.31
4	3124	0.48
1111	3124	0.38
1112	3124	0.65
1123	3124	0.67
1124	3124	0.69
1125	3124	0.55
2111	3124	0.34
2112	3124	0.66
2123	3124	0.69
2124	3124	0.71
2125	3124	0.55
4211	3124	0.26
4212	3124	0.37
4223	3124	0.35
4224	3124	0.33
4225	3124	0.27
3111	3124	0.33
3112	3124	0.66
3123	3124	0.74
3124	3124	1.00
3125	3124	0.47
4111	3124	0.25
4112	3124	0.40
4123	3124	0.57
4124	3124	0.75
4125	3124	0.59
4011	3124	0.27
4012	3124	0.53
4023	3124	0.72
4024	3124	0.66
4025	3124	0.54
4311	3124	0.26
4312	3124	0.39
4323	3124	0.33
4324	3124	0.45
4325	3124	0.49
4411	3124	0.25
4412	3124	0.39
4423	3124	0.55
4424	3124	0.59
4425	3124	0.46
1	3125	0.45
2	3125	0.42
3	3125	0.35
4	3125	0.59
1111	3125	0.20
1112	3125	0.31
1123	3125	0.47
1124	3125	0.45
1125	3125	0.84
2111	3125	0.18
2112	3125	0.28
2123	3125	0.50
2124	3125	0.46
2125	3125	0.90
4211	3125	0.18
4212	3125	0.39
4223	3125	0.42
4224	3125	0.41
4225	3125	0.42
3111	3125	0.19
3112	3125	0.30
3123	3125	0.54
3124	3125	0.47
3125	3125	1.00
4111	3125	0.23
4112	3125	0.35
4123	3125	0.69
4124	3125	0.62
4125	3125	0.86
4011	3125	0.21
4012	3125	0.47
4023	3125	0.50
4024	3125	0.45
4025	3125	0.66
4311	3125	0.18
4312	3125	0.24
4323	3125	0.35
4324	3125	0.46
4325	3125	0.83
4411	3125	0.18
4412	3125	0.24
4423	3125	0.51
4424	3125	0.46
4425	3125	0.77
1	4111	0.57
2	4111	0.70
3	4111	0.78
4	4111	0.51
1111	4111	0.75
1112	4111	0.52
1123	4111	0.25
1124	4111	0.12
1125	4111	0.15
2111	4111	0.81
2112	4111	0.59
2123	4111	0.21
2124	4111	0.09
2125	4111	0.12
4211	4111	0.73
4212	4111	0.46
4223	4111	0.28
4224	4111	0.18
4225	4111	0.29
3111	4111	0.85
3112	4111	0.67
3123	4111	0.27
3124	4111	0.25
3125	4111	0.23
4111	4111	1.00
4112	4111	0.72
4123	4111	0.31
4124	4111	0.20
4125	4111	0.19
4011	4111	0.89
4012	4111	0.45
4023	4111	0.24
4024	4111	0.23
4025	4111	0.15
4311	4111	0.89
4312	4111	0.64
4323	4111	0.56
4324	4111	0.25
4325	4111	0.16
4411	4111	0.87
4412	4111	0.59
4423	4111	0.20
4424	4111	0.10
4425	4111	0.15
1	4112	0.35
2	4112	0.45
3	4112	0.58
4	4112	0.37
1111	4112	0.43
1112	4112	0.52
1123	4112	0.40
1124	4112	0.31
1125	4112	0.24
2111	4112	0.47
2112	4112	0.64
2123	4112	0.48
2124	4112	0.36
2125	4112	0.25
4211	4112	0.38
4212	4112	0.31
4223	4112	0.19
4224	4112	0.28
4225	4112	0.21
3111	4112	0.53
3112	4112	0.77
3123	4112	0.62
3124	4112	0.40
3125	4112	0.35
4111	4112	0.72
4112	4112	1.00
4123	4112	0.58
4124	4112	0.51
4125	4112	0.36
4011	4112	0.57
4012	4112	0.51
4023	4112	0.51
4024	4112	0.57
4025	4112	0.38
4311	4112	0.55
4312	4112	0.58
4323	4112	0.75
4324	4112	0.62
4325	4112	0.33
4411	4112	0.51
4412	4112	0.52
4423	4112	0.48
4424	4112	0.38
4425	4112	0.27
1	4123	0.23
2	4123	0.28
3	4123	0.27
4	4123	0.38
1111	4123	0.17
1112	4123	0.34
1123	4123	0.51
1124	4123	0.44
1125	4123	0.53
2111	4123	0.19
2112	4123	0.41
2123	4123	0.66
2124	4123	0.52
2125	4123	0.59
4211	4123	0.14
4212	4123	0.30
4223	4123	0.35
4224	4123	0.40
4225	4123	0.38
3111	4123	0.24
3112	4123	0.52
3123	4123	0.78
3124	4123	0.57
3125	4123	0.69
4111	4123	0.31
4112	4123	0.58
4123	4123	1.00
4124	4123	0.75
4125	4123	0.83
4011	4123	0.26
4012	4123	0.46
4023	4123	0.75
4024	4123	0.67
4025	4123	0.74
4311	4123	0.20
4312	4123	0.30
4323	4123	0.50
4324	4123	0.62
4325	4123	0.78
4411	4123	0.17
4412	4123	0.25
4423	4123	0.66
4424	4123	0.56
4425	4123	0.56
1	4124	0.17
2	4124	0.17
3	4124	0.21
4	4124	0.25
1111	4124	0.10
1112	4124	0.32
1123	4124	0.51
1124	4124	0.60
1125	4124	0.56
2111	4124	0.11
2112	4124	0.39
2123	4124	0.65
2124	4124	0.71
2125	4124	0.64
4211	4124	0.06
4212	4124	0.30
4223	4124	0.45
4224	4124	0.43
4225	4124	0.45
3111	4124	0.14
3112	4124	0.47
3123	4124	0.76
3124	4124	0.75
3125	4124	0.62
4111	4124	0.20
4112	4124	0.51
4123	4124	0.75
4124	4124	1.00
4125	4124	0.81
4011	4124	0.18
4012	4124	0.53
4023	4124	0.96
4024	4124	0.92
4025	4124	0.87
4311	4124	0.09
4312	4124	0.24
4323	4124	0.39
4324	4124	0.66
4325	4124	0.66
4411	4124	0.08
4412	4124	0.22
4423	4124	0.66
4424	4124	0.79
4425	4124	0.68
1	4125	0.30
2	4125	0.35
3	4125	0.30
4	4125	0.41
1111	4125	0.08
1112	4125	0.24
1123	4125	0.48
1124	4125	0.48
1125	4125	0.79
2111	4125	0.07
2112	4125	0.25
2123	4125	0.57
2124	4125	0.52
2125	4125	0.87
4211	4125	0.06
4212	4125	0.32
4223	4125	0.48

HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast
4224	4125	0.44	4123	4011	0.26	4312	4012	0.66	1	4024	0.11	2111	4025	0.07	4225	4311	0.29	4124	4312	0.24	4323	4323	1.00
4225	4125	0.55	4124	4011	0.18	4323	4012	0.24	2	4024	0.20	2112	4025	0.19	3111	4311	0.96	4125	4312	0.14	4324	4323	0.80
3111	4125	0.09	4125	4011	0.15	4324	4012	0.36	3	4024	0.16	2123	4025	0.54	3112	4311	0.61	4011	4312	0.80	4325	4323	0.44
3112	4125	0.29	4011	4011	1.00	4325	4012	0.52	4	4024	0.11	2124	4025	0.61	3123	4311	0.22	4012	4312	0.66	4411	4323	0.49
3123	4125	0.60	4012	4011	0.63	4411	4012	0.49	1111	4024	0.15	2125	4025	0.74	3124	4311	0.26	4023	4312	0.32	4412	4323	0.54
3124	4125	0.59	4023	4011	0.25	4412	4012	0.62	1112	4024	0.37	4211	4025	0.10	3125	4311	0.18	4024	4312	0.32	4423	4323	0.76
3125	4125	0.86	4024	4011	0.22	4423	4012	0.30	1123	4024	0.55	4212	4025	0.32	4111	4311	0.89	4025	4312	0.14	4424	4323	0.52
4111	4125	0.19	4025	4011	0.16	4424	4012	0.34	1124	4024	0.68	4223	4025	0.58	4112	4311	0.55	4311	4312	0.84	4425	4323	0.44
4112	4125	0.36	4311	4011	0.96	4425	4012	0.45	1125	4024	0.41	4224	4025	0.60	4123	4311	0.20	4312	4312	1.00	1	4324	0.12
4123	4125	0.83	4312	4011	0.80	1	4023	0.16	2111	4024	0.17	4225	4025	0.68	4124	4311	0.09	4323	4312	0.55	2	4324	0.41
4124	4125	0.81	4323	4011	0.42	2	4023	0.14	2112	4024	0.44	3111	4025	0.08	4125	4311	0.07	4324	4312	0.36	3	4324	0.24
4125	4125	1.00	4324	4011	0.17	3	4023	0.13	2123	4024	0.71	3112	4025	0.20	4011	4311	0.96	4325	4312	0.21	4	4324	0.09
4011	4125	0.15	4325	4011	0.11	4	4023	0.20	2124	4024	0.81	3123	4025	0.53	4012	4311	0.51	4411	4312	0.83	1111	4324	0.09
4012	4125	0.52	4411	4011	0.94	1111	4023	0.17	2125	4024	0.46	3124	4025	0.54	4023	4311	0.18	4412	4312	0.99	1112	4324	0.31
4023	4125	0.74	4412	4011	0.75	1112	4023	0.36	4211	4024	0.16	3125	4025	0.66	4024	4311	0.17	4423	4312	0.40	1123	4324	0 50
4024	4125	0.59	4423	4011	0.14	1123	4023	0.50	4212	4024	0.35	4111	4025	0.15	4025	4311	0.05	4424	4312	0.29	1124	4324	0.61
4025	4125	0.88	4424	4011	0.09	1124	4023	0.56	4223	4024	0.49	4112	4025	0.38	4311	4311	1.00	4425	4312	0.14	1125	4324	0.44
4311	4125	0.07	4425	4011	0.08	1125	4023	0.44	4224	4024	0.55	4123	4025	0.74	4312	4311	0.84	1	4323	0.21	2111	4324	0.11
4312	4125	0.14	1	4012	0.76	2111	4023	0.20	4225	4024	0.46	4124	4025	0.87	4323	4311	0.49	2	4323	0.56	2112	4324	0.37
4323	4125	0.32	2	4012	0.30	2112	4023	0.45	3111	4024	0.20	4125	4025	0.88	4324	4311	0.20	3	4323	0.42	2123	4324	0.65
4324	4125	0.51	3	4012	0.38	2123	4023	0.66	3112	4024	0.52	4011	4025	0.16	4325	4311	0.09	4	4323	0.29	2124	4324	0.72
4325	4125	0.92	4	4012	0.52	2124	4023	0.68	3123	4024	0.81	4012	4025	0.51	4411	4311	1.00	1111	4323	0.33	2125	4324	0.46
4411	4125	0.06	1111	4012	0.48	2125	4023	0.51	3124	4024	0.66	4023	4025	0.83	4412	4311	0.82	1112	4323	0.45	4211	4324	0.21
4412	4125	0.13	1112	4012	0.31	4211	4023	0.16	3125	4024	0.45	4024	4025	0.73	4423	4311	0.24	1123	4323	0.45	4212	4324	0.43
4423	4125	0.58	1123	4012	0.31	4212	4023	0.32	4111	4024	0.23	4025	4025	1.00	4424	4311	0.13	1124	4323	0.36	4223	4324	0.56
4424	4125	0.55	1124	4012	0.36	4223	4023	0.46	4112	4024	0.57	4311	4025	0.05	4425	4311	0.08	1125	4323	0.30	4224	4324	0.76
4425	4125	0.85	1125	4012	0.40	4224	4023	0.41	4123	4024	0.67	4312	4025	0.14	1	4312	0.72	2111	4323	0.35	4225	4324	0.59
1	4011	0.78	2111	4012	0.51	4225	4023	0.43	4124	4024	0.92	4323	4025	0.34	2	4312	0.43	2112	4323	0.53	3111	4324	0.15
2	4011	0.54	2112	4012	0.31	3111	4023	0.23	4125	4024	0.59	4324	4025	0.60	3	4312	0.49	2123	4323	0.54	3112	4324	0.45
3	4011	0.61	2123	4012	0.30	3112	4023	0.53	4011	4024	0.22	4325	4025	0.79	4	4312	0.57	2124	4323	0.41	3123	4324	0.71
4	4011	0.58	2124	4012	0.38	3123	4023	0.79	4012	4024	0.43	4411	4025	0.06	1111	4312	0.69	2125	4323	0.27	3124	4324	0.45
1111	4011	0.86	2125	4012	0.47	3124	4023	0.72	4023	4024	0.92	4412	4025	0.14	1112	4312	0.46	4211	4323	0.46	3125	4324	0.46
1112	4011	0.47	4211	4012	0.45	3125	4023	0.50	4024	4024	1.00	4423	4025	0.61	1123	4312	0.22	4212	4323	0.50	4111	4324	0.25
1123	4011	0.20	4212	4012	0.25	4111	4023	0.24	4025	4024	0.73	4424	4025	0.75	1124	4312	0.23	4223	4323	0.51	4112	4324	0.62
1124	4011	0.14	4223	4012	0.21	4112	4023	0.51	4311	4024	0.17	4425	4025	0.84	1125	4312	0.08	4224	4323	0.54	4123	4324	0.62
1125	4011	0.10	4224	4012	0.40	4123	4023	0.75	4312	4024	0.32	1	4311	0.73	2111	4312	0.75	4225	4323	0.47	4124	4324	0.66
2111	4011	0.93	4225	4012	0.27	4124	4023	0.96	4323	4024	0.56	2	4311	0.59	2112	4312	0.52	3111	4323	0.39	4125	4324	0.51
2112	4011	0.50	3111	4012	0.55	4125	4023	0.74	4324	4024	0.83	3	4311	0.66	2123	4312	0.20	3112	4323	0.61	4011	4324	0.17
2123	4011	0.14	3112	4012	0.40	4011	4023	0.25	4325	4024	0.52	4	4311	0.60	2124	4312	0.23	3123	4323	0.55	4012	4324	0.36
2124	4011	0.11	3123	4012	0.46	4012	4023	0.53	4411	4024	0.16	1111	4311	0.86	2125	4312	0.09	3124	4323	0.33	4023	4324	0.66
2125	4011	0.10	3124	4012	0.53	4023	4023	1.00	4412	4024	0.31	1112	4311	0.50	4211	4312	0.81	3125	4323	0.35	4024	4324	0.83
4211	4011	0.86	3125	4012	0.47	4024	4023	0.92	4423	4024	0.75	1123	4311	0.19	4212	4312	0.55	4111	4323	0.56	4025	4324	0.60
4212	4011	0.40	4111	4012	0.45	4025	4023	0.83	4424	4024	0.89	1124	4311	0.12	4223	4312	0.32	4112	4323	0.75	4311	4324	0.20
4223	4011	0.26	4112	4012	0.51	4311	4023	0.18	4425	4024	0.54	1125	4311	0.06	4224	4312	0.36	4123	4323	0.50	4312	4324	0.36
4224	4011	0.23	4123	4012	0.46	4312	4023	0.32	1	4025	0.31	2111	4311	0.92	4225	4312	0.20	4124	4323	0.39	4323	4324	0.80
4225	4011	0.26	4124	4012	0.53	4323	4023	0.43	2	4025	0.30	2112	4311	0.54	3111	4312	0.79	4125	4323	0.32	4324	4324	1.00
3111	4011	0.97	4125	4012	0.52	4324	4023	0.66	3	4025	0.27	2123	4311	0.11	3112	4312	0.61	4011	4323	0.42	4325	4324	0.64
3112	4011	0.57	4011	4012	0.63	4325	4023	0.60	4	4025	0.36	2124	4311	0.08	3123	4312	0.38	4012	4323	0.24	4411	4324	0.19
3123	4011	0.25	4012	4012	1.00	4411	4023	0.17	1111	4025	0.07	2125	4311	0.04	3124	4312	0.39	4023	4323	0.43	4412	4324	0.37
3124	4011	0.27	4023	4012	0.53	4412	4023	0.29	1112	4025	0.19	4211	4311	0.95	3125	4312	0.24	4024	4323	0.56	4423	4324	0.84
3125	4011	0.21	4024	4012	0.43	4423	4023	0.69	1123	4025	0.44	4212	4311	0.57	4111	4312	0.64	4025	4323	0.34	4424	4324	0.84
4111	4011	0.89	4025	4012	0.51	4424	4023	0.78	1124	4025	0.52	4223	4311	0.36	4112	4312	0.58	4311	4323	0.49	4425	4324	0.61
4112	4011	0.57	4311	4012	0.51	4425	4023	0.61	1125	4025	0.66	4224	4311	0.26	4123	4312	0.30	4312	4323	0.55	1	4325	0.32

HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast	HT1	HT2	Contrast
2	4325	0.45	4311	4325	0.09	3125	4411	0.18	2124	4412	0.25	2	4423	0.29	4311	4423	0.24	3125	4424	0.46	2124	4425	0.51
3	4325	0.30	4312	4325	0.21	4111	4411	0.87	2125	4412	0.11	3	4423	0.20	4312	4423	0.40	4111	4424	0.10	2125	4425	0.83
4	4325	0.39	4323	4325	0.44	4112	4411	0.51	4211	4412	0.84	4	4423	0.26	4323	4423	0.76	4112	4424	0.38	4211	4425	0.18
1111	4325	0.02	4324	4325	0.64	4123	4411	0.17	4212	4412	0.62	1111	4423	0.08	4324	4423	0.84	4123	4424	0.56	4212	4425	0.51
1112	4325	0.17	4325	4325	1.00	4124	4411	0.08	4223	4412	0.40	1112	4423	0.31	4325	4423	0.68	4124	4424	0.79	4223	4425	0.72
1123	4325	0.42	4411	4325	0.09	4125	4411	0.06	4224	4412	0.41	1123	4423	0.47	4411	4423	0.26	4125	4424	0.55	4224	4425	0.67
1124	4325	0.44	4412	4325	0.21	4011	4411	0.94	4225	4412	0.26	1124	4423	0.51	4412	4423	0.45	4011	4424	0.09	4225	4425	0.76
1125	4325	0.75	4423	4325	0.68	4012	4411	0.49	3111	4412	0.75	1125	4423	0.42	4423	4423	1.00	4012	4424	0.34	3111	4425	0.00
2111	4325	0.02	4424	4325	0.59	4023	4411	0.17	3112	4412	0.56	2111	4423	0.10	4424	4423	0.83	4023	4424	0.78	3112	4425	0.11
2112	4325	0.17	4425	4325	0.89	4024	4411	0.16	3123	4412	0.34	2112	4423	0.37	4425	4423	0.68	4024	4424	0.89	3123	4425	0.38
2123	4325	0.51	1	4411	0.73	4025	4411	0.06	3124	4412	0.39	2123	4423	0.60	1	4424	0.17	4025	4424	0.75	3124	4425	0.46
2124	4325	0.50	2	4411	0.59	4311	4411	1.00	3125	4412	0.24	2124	4423	0.60	2	4424	0.27	4311	4424	0.13	3125	4425	0.77
2125	4325	0.83	3	4411	0.66	4312	4411	0.83	4111	4412	0.59	2125	4423	0.45	3	4424	0.22	4312	4424	0.29	4111	4425	0.15
4211	4325	0.13	4	4411	0.62	4323	4411	0.49	4112	4412	0.52	4211	4423	0.33	4	4424	0.21	4323	4424	0.52	4112	4425	0.27
4212	4325	0.44	1111	4411	0.86	4324	4411	0.19	4123	4412	0.25	4212	4423	0.64	1111	4424	0.10	4324	4424	0.84	4123	4425	0.56
4223	4325	0.58	1112	4411	0.50	4325	4411	0.09	4124	4412	0.22	4223	4423	0.70	1112	4424	0.31	4325	4424	0.59	4124	4425	0.68
4224	4325	0.63	1123	4411	0.19	4411	4411	1.00	4125	4412	0.13	4224	4423	0.66	1123	4424	0.52	4411	4424	0.15	4125	4425	0.85
4225	4325	0.64	1124	4411	0.13	4412	4411	0.83	4011	4412	0.75	4225	4423	0.59	1124	4424	0.71	4412	4424	0.33	4011	4425	0.08
3111	4325	0.05	1125	4411	0.06	4423	4411	0.26	4012	4412	0.62	3111	4423	0.12	1125	4424	0.47	4423	4424	0.83	4012	4425	0.45
3112	4325	0.22	2111	4411	0.91	4424	4411	0.15	4023	4412	0.29	3112	4423	0.43	2111	4424	0.09	4424	4424	1.00	4023	4425	0.61
3123	4325	0.53	2112	4411	0.53	4425	4411	0.11	4024	4412	0.31	3123	4423	0.66	2112	4424	0.32	4425	4424	0.68	4024	4425	0.54
3124	4325	0.49	2123	4411	0.10	1	4412	0.72	4025	4412	0.14	3124	4423	0.55	2123	4424	0.62	1	4425	0.33	4025	4425	0.84
3125	4325	0.83	2124	4411	0.07	2	4412	0.43	4311	4412	0.82	3125	4423	0.51	2124	4424	0.81	2	4425	0.48	4311	4425	0.08
4111	4325	0.16	2125	4411	0.04	3	4412	0.49	4312	4412	0.99	4111	4423	0.20	2125	4424	0.50	3	4425	0.35	4312	4425	0.14
4112	4325	0.33	4211	4411	0.97	4	4412	0.58	4323	4412	0.54	4112	4423	0.48	4211	4424	0.24	4	4425	0.41	4323	4425	0.44
4123	4325	0.78	4212	4411	0.61	1111	4412	0.67	4324	4412	0.37	4123	4423	0.66	4212	4424	0.56	1111	4425	0.03	4324	4425	0.61
4124	4325	0.66	4223	4411	0.41	1112	4412	0.45	4325	4412	0.21	4124	4423	0.66	4223	4424	0.72	1112	4425	0.17	4325	4425	0.89
4125	4325	0.92	4224	4411	0.28	1123	4412	0.23	4411	4412	0.83	4125	4423	0.58	4224	4424	0.78	1123	4425	0.40	4411	4425	0.11
4011	4325	0.11	4225	4411	0.33	1124	4412	0.26	4412	4412	1.00	4011	4423	0.14	4225	4424	0.67	1124	4425	0.47	4412	4425	0.18
4012	4325	0.52	3111	4411	0.93	1125	4412	0.10	4423	4412	0.45	4012	4423	0.30	3111	4424	0.09	1125	4425	0.78	4423	4425	0.68
4023	4325	0.60	3112	4411	0.57	2111	4412	0.72	4424	4412	0.33	4023	4423	0.69	3112	4424	0.31	2111	4425	0.01	4424	4425	0.68
4024	4325	0.52	3123	4411	0.18	2112	4412	0.49	4425	4412	0.18	4024	4423	0.75	3123	4424	0.62	2112	4425	0.14	4425	4425	1.00
4025	4325	0.79	3124	4411	0.25	2123	4412	0.19	1	4423	0.12	4025	4423	0.61	3124	4424	0.59	2123	4425	0.46			

HT=Habitat type. The habitat type codes correspond to the habitat type name according to the following: Bare Land = 1, Bog = 2, Scrub & Stand remnant = 3, Water = 4, Birch regen = 1111, Birch sapling = 1112, Birch imm = 1123, Birch mat = 1124, Birch old = 1125, Birch-Fir regen = 2111, Birch-Fir sapling = 2112, Birch-Fir imm = 2123, Birch-Fir mat = 2124, Birch-Fir old = 2125, Black Spruce regen = 4211, Black Spruce sapling = 4212, Black Spruce imm = 4223, Black Spruce mat = 4224, Black Spruce old = 4225, Fir-Birch regen = 3111, Fir-Birch sapling = 3112, Fir-Birch imm = 3123, Fir-Birch mat = 3124, Fir-Birch old = 3125, Fir-G regen = 4111, Fir-G sapling = 4112, Fir-G imm = 4123, Fir-G mat = 4124, Fir-G old = 4125, Fir-M regen = 4011, Fir-M sapling = 4012, Fir-M imm = 4023, Fir-M mat = 4024, Fir-M old = 4025, Fir-Spruce regen = 4311, Fir-Spruce sapling = 4312, Fir-Spruce imm = 4323, Fir-Spruce mat = 4324, Fir-Spruce old = 4325, Spruce-Fir regen = 4411, Spruce-Fir sapling = 4412, Spruce-Fir imm = 4423, Spruce-Fir mat = 4424, Spruce-Fir old = 4425.

Appendix III. Habitat type reclassification AML.

```
/*****************************************************************************
~
/*
~
/* BAPCOVTYPE.BWN
/*
/* ===========================================================================
/*
/* Prepared for Western Newfoundland Model Forest, Corner Brook, Newfoundland
/*
/* ===========================================================================
/* PROGRAM DESCRIPTION
/*
/*  ---------------------------------------------------------------
/* PROGRAM HISTORY     :     original coding/design Richard Morash LU-CFMP April 1996
/*                     :     modified by Arnold Rudy May 2000, KBM Consultants
/*                     :     modified by Régis Pouliot, IQAFF, July 2000
/*
/* ===========================================================================
/* REQUIREMENTS
/*
/*   This program requires an INFORMIX connect file ($BAPHOME/files/dbconnect.bap)
/*
/* ===========================================================================
/* ROUTINES
/*
/*    SETUP       - checks for required files, adds items
/*
/*    SPECIFIC    - Specific habitat classification
/*
/*    BROAD       - Broad habitat classification
/*
/*    STANDSTAGE - Standstage habitat classification
/*
/*    MISC        - Misc. classification
/*
/*    EXIT        - Clean up electronic dustballs
/*
/*    BOMB        - In case of error -> bailout gracefully
/*
/*  ===========================================================================
/*  CALLS     :
/*
/*
/*  CALLED BY : $BAPHOME/amls/batchrun.mwi
/*
/*  ===========================================================================
/*  ARGUMENTS:
/*
/*       INVFILE     - the database file with the forest attributes
/*
/*       COVTYPEFILE - user defined $BAPHOME/files/covtype.dat file
/*
/*       OUTFILE     - INFORMIX output table
/*
/* ===========================================================================
```

```
&args INVFILE COVTYPEFILE OUTFILE

&severity &error &routine BAILOUT
&severity &warning &ignore

&message &off
&echo &off

&if [null %INVFILE%] or [null %COVTYPEFILE%] or [null %OUTFILE%] &then
 &do
  &return  Usage: &r $LAND/bapstats/bapcovtype <INVFILE> <COVTYPEFILE> <OUTFILE>
  &ty        i.e.    &r $LAND/bapstats/bapcovtype FORESTDATA covtype.dat ageclass.dat
bas1998-bap\
&end

&if ^ [exist $BAPHOME/files/%COVTYPEFILE% -file] &then
  &return $BAPHOME/files/%COVTYPEFILE% does not exist

&type                LAND COVER CLASS   Setting Up             %INVFILE%
&call SETUP

&type                LAND COVER CLASS   Specific               %INVFILE%
&call SPECIFIC

&type                LAND COVER CLASS   Broad Classification   %INVFILE%
&call BROAD

&type                LAND COVER CLASS   Class Determination    %INVFILE%
&call STANDSTAGE

&type                LAND COVER CLASS   Misc. Determination    %INVFILE%
&call MISC

&type                LAND COVER CLASS   Cleaning Up            %INVFILE%
&call EXIT

&return

/*****************************************************************************
/*
/* Setup routine to prepare the database file for the upcoming analysis
/*
/*****************************************************************************

&routine SETUP

&if %:PROGRAM% ne 'ARC' &then
  quit

/* Open the connect information file $BAPHOME/general/dbconnect.bap

&s FILELIST = $BAPHOME/files/dbconnect.bap
&s FILEUNIT = [open %FILELIST% openstat -read]

&if %openstat% ne 0 &then
 &do
```

```
  &type \ Ostat: %openstat% - Unable to open %FILELIST%
  &return
 &end

&s RECORD = [locase [read %FILEUNIT% readstat]]

&do &while %readstat% ne 102
 &if %RECORD% nc # or %RECORD% nc ' ' &then
  &s [unquote [before %RECORD% :]] = [unquote [after %RECORD% :]]
  &s RECORD = [read %FILEUNIT% readstat]
 &end

&s DUMMY = [close %FILEUNIT%]

&if [token [show connects] -find %BAPDBSERVER%] = 0 &then
  connect %BAPDBSERVER% %BAPCONNECTFILE%

/* add a few columns to current table....if they exist delete them and then add

&do COLUMN &list broad specific structstg stdstage swpct hwpct habitat
 &if [token [show columns %BAPDBSERVER% %OUTFILE%] -find %COLUMN%] > 0 &then
  dbmsexecute %BAPDBSERVER% ALTER TABLE %OUTFILE% DROP %COLUMN%
&end

dbmsexecute %BAPDBSERVER%
alter table %OUTFILE%
  add (
       broad char(3),
       specific char(4),
       structstg char(1),
       stdstage char(1),
       Firpct smallint default 0,
       Sprpct smallint default 0,
      Hwpct smallint default 0,
       habitat smallint default 0
);
end

&return

/*****************************************************************************
/*
/*  SPECIFIC - classifies each forested polygon as to its proper SPECIFIC class
/*
/*****************************************************************************

&routine SPECIFIC

&do LIST &list 900 905 906 907 910 915 920 925 930 940 950 951 960 961 962 970 980
990 991 992
dbmsexecute %BAPDBSERVER%
 update %OUTFILE%
  set HABITAT = Stand_id
    where Stand_id MATCHES [quote *%LIST%]
end
&end
```

```
/* identify all nonforest
dbmsexecute %BAPDBSERVER%
 update %OUTFILE%
  set HABITAT = -999
    where HABITAT = 0
end

/*
/*  Determination of group fir Percentages
/*

&do NUM = 1 &to 3
  dbmsexecute %BAPDBSERVER%
   update %OUTFILE%
    set FIRPCT = PERCENT%NUM% + FIRPCT
     where SPECIES%NUM% in ('bF','lP','rP','sP','wP')
     and HABITAT = -999 ;
  end
&end

/*
/*  Determination of group spruce Percentages
/*

&do NUM = 1 &to 3
  dbmsexecute %BAPDBSERVER%
   update %OUTFILE%
    set SPRRPCT = PERCENT%NUM% + SPRPCT
     where SPECIES%NUM% in ('bS','eS','eL','jP','jL','sS','tL','wS')
     and HABITAT = -999 ;
  end
&end


/*
/*  Determination of Non-Conifer Percentages
/*

&do NUM = 1 &to 3
  dbmsexecute %BAPDBSERVER%
   update %OUTFILE%
    set HWPCT = PERCENT%NUM% + HWPCT
     where SPECIES%NUM% in ('bP','jB','rM','tA','wB','yB')
           and HABITAT = -999 ;
  end
&end

/*
/* Start with the initial classification from SPECIES1
/*                                    hardwood types first.....
/*
/*                                                          Aspen
/*

dbmsexecute %BAPDBSERVER%
 update %OUTFILE%
  set SPECIFIC = [quct : wB],  HABITAT = 1100
```

```
    where HWPCT >= 75 ,
end

dbmsexecute %BAPDBSERVER%
 update %OUTFILE%
  set SPECIFIC = [quote wBbF], HABITAT = 2100
   where HWPCT >= 50 and HWPCT <= 75 and (FIRPCT + SPRPCT) >= 25 and (FIRPCT +
SPRPCT) <= 50 ;
end

dbmsexecute %BAPDBSERVER%
 update %OUTFILE%
  set SPECIFIC = [quote bFwB], HABITAT = 3100
   where (FIRPCT + SPRPCT) >= 50 and (FIRPCT + SPRPCT) <= 75 and HWPCT >= 25 and
WHPCT <= 50 ;
end

dbmsexecute %BAPDBSERVER%
 update %OUTFILE%
  set SPECIFIC = [quote bS], HABITAT = 4200
   where SPRPCT >= 75 ;
end

dbmsexecute %BAPDBSERVER%
 update %OUTFILE%
  set SPECIFIC = [quote bFM], HABITAT = 4000
   where FIRPCT >= 75 and (site = 'P' or site = 'M') ;
end

dbmsexecute %BAPDBSERVER%
 update %OUTFILE%
  set SPECIFIC = [quote bFG], HABITAT = 4100
   where FIRPCT >= 75 and (site = 'G' or site = 'H') ;
end

dbmsexecute %BAPDBSERVER%
 update %OUTFILE%
  set SPECIFIC = [quote bFS], HABITAT = 4300
   where FIRPCT >= 50 and FIRPCT <= 75 and SPRPCT >= 25 and SPRPCT <= 50 ;
end

dbmsexecute %BAPDBSERVER%
 update %OUTFILE%
  set SPECIFIC = [quote SbF], HABITAT = 4400
   where SPRPCT >=50 and SPRPCT <= 75 and FIRPCT >= 25 and FIRPCT <= 50 ;
end


&return

/*****************************************************************************
/*
/*  BROAD - classifies each forested polygon as to its proper BROAD class
/*
/*****************************************************************************

&routine BROAD
```

```
/*
/* Start categorizing into BROAD classes....
/*

dbmsexecute %BAPDBSERVER%
 update %OUTFILE%
  set BROAD = [quote HW]
   where HABITAT = 1100 ;
end

dbmsexecute %BAPDBSERVER%
 update %OUTFILE%
  set BROAD = [quote HWm]
   where HABITAT = 2100 ;
end

dbmsexecute %BAPDBSERVER%
 update %OUTFILE%
  set BROAD = [quote SWm]
   where HABITAT = 3100 ;
end

dbmsexecute %BAPDBSERVER%
 update %OUTFILE%
  set BROAD = [quote Sw]
   where HABITAT >= 4000 ;
end

&return

/*****************************************************************************
/*
/*  STANDSTAGE - classifies each forested polygon as to its proper class based
/*               on the ranges provided in the ASCII file $BAPHOME/files
/*               /covtype.dat.
/*
/*****************************************************************************

&routine STANDSTAGE

/*
/*  open the textfile with the standstage structure
/*

&set BAPCOVTYPE := [open  $BAPHOME/files/%COVTYPEFILE% openstat -read]

&if %openstat% ne 0 &then
   &return  Ostat: %openstat% - Unable to open %COVTYPEFILE%.

/*
/*  open up the repository file for the stand stage summary information
/*

&set RECORD := [unquote [read %BAPCOVTYPE% readstat]]

&do &while %READSTAT% = 0
```

```
   &s SPECIFIC :=  [translate [extract 1 %RECORD%]]
   &s REG      :=  [extract 2 %RECORD%]
   &s SAP      :=  [extract 3 %RECORD%]
   &s IMM      :=  [extract 4 %RECORD%]
   &s MAT      :=  [extract 5 %RECORD%]
   &s OLD      :=  [extract 6 %RECORD%]

   dbmsexecute %BAPDBSERVER%
     update %OUTFILE%
       set STDSTAGE = [quote R], HABITAT = HABITAT + 1
         where STAND_AGE >= %REG% and STAND_AGE <= %SAP% and SPECIFIC = [quote
%SPECIFIC%]
   end

   dbmsexecute %BAPDBSERVER%
     update %OUTFILE%
       set STDSTAGE = [quote S], HABITAT = HABITAT + 2
         where STAND_AGE > %SAP% and STAND_AGE <= %IMM% and SPECIFIC = [quote
%SPECIFIC%]
   end

   dbmsexecute %BAPDBSERVER%
     update %OUTFILE%
       set STDSTAGE = [quote I], HABITAT = HABITAT + 3
         where STAND_AGE > %IMM% and STAND_AGE <= %MAT% and SPECIFIC = [quote
%SPECIFIC%]
   end

   dbmsexecute %BAPDBSERVER%
     update %OUTFILE%
       set STDSTAGE = [quote M], HABITAT = HABITAT + 4
         where STAND_AGE > %MAT% and STAND_AGE <= %OLD% and SPECIFIC = [quote
%SPECIFIC%]
   end

   dbmsexecute %BAPDBSERVER%
     update %OUTFILE%
       set STDSTAGE = [quote O], HABITAT = HABITAT + 5
         where STAND_AGE > %OLD% and SPECIFIC = [quote %SPECIFIC%]
   end

   &s RECORD := [unquote [read %BAPCOVTYPE% readstat]]

   /* End of reading the stand stage file
&end

&sv closestat := [close %BAPCOVTYPE%]
&dv BAPCOVTYPE

/*
/* Use the Stand Stage classes to determine the Structural Stages
/*

dbmsexecute %BAPDBSERVER%
  update %OUTFILE%
    set STRUCTSTG = [quote D], HABITAT = HABITAT + 10
```

```
      where STDSTAGE in ('R','S');
end

dbmsexecute %BAPDBSERVER%
  update %OUTFILE%
    set STRUCTSTG = [quote F], HABITAT = HABITAT + 20
      where STDSTAGE in ('I','M','O');
end

&return

/*****************************************************************************
/*
/* MISC
/*
/*****************************************************************************

/***********************************************
/**********   TO BE VERIFY  (MISC) ************
/***********************************************

/*&routine MISC

/* assigns SPECIFIC,BROAD,STRUCTSTG and SPECIFIC codes to static 1111 values

/*dbmsexecute %BAPDBSERVER%
/* update %OUTFILE%
/*  set SPECIFIC = [quote AW], BROAD = [quote HW],
/*      STRUCTSTG = [quote O], STDSTAGE = [quote C]
/*   where HABITAT = 1111
/*end

/*&return

/*****************************************************************************
/*
/* General Housecleaning Duties - returning to the ARC: prompt, closing all
/*                                ASCII files, getting rid of electronic
/*                                dustballs, etc.
/*
/*****************************************************************************

&routine EXIT

&if [show program] ne ARC &then
  quit

&if [variable BAPCOVTYPE] &then
&do
  &sv closestat := [close %BAPCOVTYPE%]
  &if %CLOSESTAT% = 0 &then
    &dv BAPCOVTYPE
&end

&echo &off
&messages &on
```

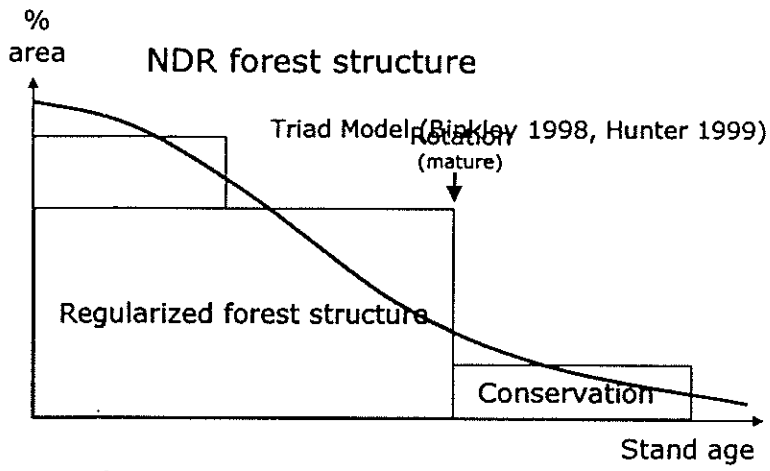
```
&return

/*****************************************************************************
/*
/* Bailout duties - don't want an endless loop - reset &severity and call exit
/*
/*****************************************************************************

&routine BAILOUT

&severity &error &ignore

disconnect %BAPDBSERVER%

&call exit

&return &error Bailing out of BAPCOVTYPE.AML
```

Forest management options

Forest management options

- Zoning is required when silviculture scenarios or spatial layout patterns of forest management activities differ.
- Zoning is usually driven by site, geography, forest resource potential and use, and regulations.

Forest management
(Ecosystem management)



Zoning - Intensive silviculture
(Where?)

- Near to the mill
- Productive sites
- Low vegetation and pest control costs
- Low operational costs
- Low soil and water quality deterioration risks
- Low road maintenance costs

Zoning - Intensive silviculture
(Silvicultural scenarios)

- Fiber (bF)
  - Shortening the rotation
  - Clearcutting with protection of regeneration
- Log (bF)
  - Shortening the rotation
  - Fertilization
  - Thinnings (pre-commercial & commercial)
- Production and pest-proofing
  - site preparation
  - plantation (wS, bS)

Zoning - Conservation
(Where?)

- No harvest regulated zones (Parks, reserves, protected areas, etc.)
- Heritage sites
- Water providing watershed
- Habitat of RTE species
- Fragile sites
- Uneconomical/unreachable stands

Zoning - Conservation
(Silvicultural scenarios)

- No harvest
- No harvest - habitat treatments
- No harvest - prescribed fire
- No harvest - stand health treatments

Zoning - Multiple-use
(Where?)

- Timber/wildlife
  - Outfitting
  - Traplines
- Wildlife/timber
  - Wildlife areas
- Conservation/timber
  - Conservation zones buffer
  - Protection forests (landslides, erosion avanlanches)

Zoning - Multiple-use
(Where?)

- Recreation/timber
  - Visually sensitive zone
  - Recreation corridor buffer
- Water/timber
  - Water body buffers
  - Water providing watershed
- Timber/ Disturbance proofing
  - Fire proofing
  - Pest proofing

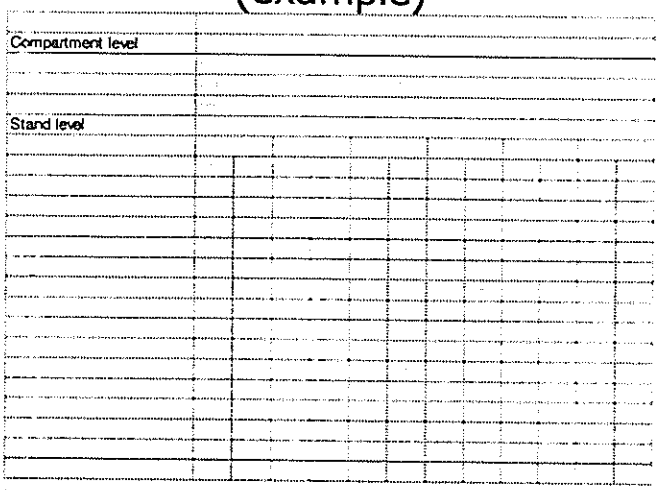
Zoning - Multiple-use
(How?)

- Habitat element retention
  (wildlife-tree, green-tree, snag, DWD)
- Green patch retention
- Longer rotation
- Permanent cover (Selective cutting)
- Habitat adjacency (wave-like/checkerboard)
- Patch size distribution
- Control of forest composition
- Road density control
- Minimum % in forest cover

Scripting scenarios

- A silvicultural scenario is defined
  - By vocation (zone resource priorization)
  - For each strata
    (target species, site quality)

Scripting scenarios
(example)



Potential problems and questions

- Actual stratification (no HW and MW)
- Dynamics of never-harvested active stands
- Composition curves (TSP in HW, MW)
- Site quality versus forest type?
- Projections horizons?
- Who runs the BAP analysis of the forest projections?

Proposed FM options

- BAU - Timber volume only
  - Basic constraints as ruled by regulations
  - Compartmentizing ruled by 1st entry
- Z1 - Basic zoning with
  - Intensive silviculture
  - Conservation
  - Timber/wildlife
  - Wildlife/timber
  - Water/timber
  - Recreation/timber

Hierarchical planning

- Forest level
- Compartment level
- Stand level

Top ↓ down

Up ↑ Bottom

Rules & Constraints

Hierarchical planning
(example)

- Forest level — 5% in OG
  Clearcut size
  Prot. of regen. CCutting
- Compartment level — Mostly T/W zone
  >1/3 forest stage
  Wave-like CCutting
  Minimize road density
  Year of 1st entry 2020
- Stand level — bF D2 70 Fr (G)
  Scenario 15: Spacing - 5, Thin30% - 40, CC >70
  Green tree retention (20/ha)
  Snag retention

Requirements for docking forest projections to the BAP analysis toolbox

- Active/non-active polygons
- Age (5 years class precision)
- Species composition (Sp1-3, P%1-3)
- Site quality
- Strata

Zone
Compartment level

Stand level

Strata	HW		MW		bF		bS		bFbS		bSbF	
Site	M	G	M	G	M	G	M	G	M	G	M	G
Site preperation												
Plantation												
Spacing												
Precommercial thinning												
Commercial thinning1												
Commercial thinning2												
Commercial thinning3												
Clearcut												
Clearcut with prot regen.												
Selective cutting												
Conversion cutting												
Green-tree retention												
Snag retention												
DWD retention												
Green patch retention												

Zone
Compartment level

Stand level

Strata	HW		MW		bF		bS		bFbS		bSbF	
Site	M	G	M	G	M	G	M	G	M	G	M	G
Site preperation												
Plantation												
Spacing												
Precommercial thinning												
Commercial thinning1												
Commercial thinning2												
Commercial thinning3												
Clearcut												
Clearcut with prot regen.												
Selective cutting												
Conversion cutting												
Green-tree retention												
Snag retention												
DWD retention												
Green patch retention												

Zone
Compartment level

Stand level

Strata	HW		MW		bF		bS		bFbS		bSbF	
Site	M	G	M	G	M	G	M	G	M	G	M	G
Site preperation												
Plantation												
Spacing												
Precommercial thinning												
Commercial thinning1												
Commercial thinning2												
Commercial thinning3												
Clearcut												
Clearcut with prot regen.												
Selective cutting												
Conversion cutting												
Green-tree retention												
Snag retention												
DWD retention												
Green patch retention												

Zone
Compartment level

Stand level

Strata	HW		MW		bF		bS		bFbS		bSbF	
Site	M	G	M	G	M	G	M	G	M	G	M	G
Site preperation												
Plantation												
Spacing												
Precommercial thinning												
Commercial thinning1												
Commercial thinning2												
Commercial thinning3												
Clearcut												
Clearcut with prot regen.												
Selective cutting												
Conversion cutting												
Green-tree retention												
Snag retention												
DWD retention												
Green patch retention												

Zone
Compartment level

Stand level

Strata	HW		MW		bF		bS		bFbS		bSbF	
Site	M	G	M	G	M	G	M	G	M	G	M	G
Site preperation												
Plantation												
Spacing												
Precommercial thinning												
Commercial thinning1												
Commercial thinning2												
Commercial thinning3												
Clearcut												
Clearcut with prot regen.												
Selective cutting												
Conversion cutting												
Green-tree retention												
Snag retention												
DWD retention												
Green patch retention												

Zone
Compartment level

Stand level

Strata	HW		MW		bF		bS		bFbS		bSbF	
Site	M	G	M	G	M	G	M	G	M	G	M	G
Site preperation												
Plantation												
Spacing												
Precommercial thinning												
Commercial thinning1												
Commercial thinning2												
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