3.0 Maintenance and Enhancement of Forest Ecosystem Condition and Productivity

3.1 Factors Attributing to Current Forest Condition

As with other parts of Newfoundland's boreal forest, those of the Bonavista Peninsula have evolved in concert with a history of Fire, insects and wind throw. Human interventions in this forest have been extensive and widespread over the past four centuries, so much so that they have had a significant impact on current landscape patterns.

Landscape patterns determine the variety, integrity, and interconnectedness of habitats within a region (Perry 1994). Perry also stated that landscape patterns are a direct result of (1) the physical matrix of landforms and soils; (2) the disturbance history; and (3) the relationships among various species that make up the ecosystem communities. These factors, while listed separately for clarity, are unavoidably interrelated. Landscape patterns play a pivotal role in determining the current conditions and health of forest ecosystems. These variables are evaluated in terms of productivity, stability, and resilience.

Another important role determining the condition of a forest is change. Forests are an ever evolving entity, resisting stagnation, and constantly moving through its cycles of life, death, and renewal. The process of change over time is the essence of nature itself.

The main forces of change in our natural forest ecosystems are disturbance and succession. A definition of disturbance would indicate that it initiates a change in a community structure which often ends in the replacement of one set of species by another (Perry 1994). However, replacement is not always the end result (e.g., a species like Black Spruce is aided in germination by disturbances like forest fires).

Disturbances range from the fall of a single tree, to the burning of thousands of hectares by forest Fires. While disturbances may be very destructive, they can often rejuvenate ecosystems and diversify landscapes.

Succession involves changes in both community composition (e.g., plant and animal species), and in the ecosystem structure and process (Perry 1994). Succession is the orderly change whereby the dominate species is replaced by another species, then another and another until a new dominate species establishes a relatively stable community.

Since European settlement, the forests of District 02 have primarily experienced extensive high-grading and patch cutting, widespread fires, and periodic insect and wind throw damage as disturbances. Clear-cutting has become the most common form of human disturbance in the past decade. Following these disturbances, succession has favoured the development of pure Black Spruce stands (especially after fire) while Balsam Fir has been the prevalent regenerating species after other disturbances. However, in instances where tree regeneration is lacking, disturbed areas tend to develop toward seral stages dominated by dwarf shrub heath (eg. *Kalmia angustifolia*). This often occurs on the nutrient-poor, coarse-textured till that is prevalent through much of the district (Damman 1983).

3.2 Ecosystem Productivity, Resilience and Stability

3.2.1 Productivity

Productivity is the accrual of matter and energy in biomass. There are two phases of productivity. Primary productivity occurs when the sun's electromagnetic energy is collected and recycled through photosynthesis, a process which is achieved by plants containing chlorophyll. Secondary productivity occurs when a plant-eating organism digests plant tissue and incorporates a portion of that energy and matter into its own biomass. The primary producers in an ecosystem are green plants and the secondary producers are the animals and microbes that consume plant tissue. Earth's forests are the most highly productive ecosystems on the planet, because they contain more leaves per unit of land than other ecosystems. They also cover slightly less than 50% of the planet (Perry 1994). The Canadian Encyclopedia reports that at least 9 million square kilometers of forest land (an area the size of Europe) has been lost during the past 150 years.

Fundamentally, the level of productivity within the ecosystem is dependant upon the degree to which water, nutrients and solar energy are absorbed and transferred within the ecosystem. The products of growth within the ecosystem can be harvested by humans on a sustainable basis and even enhanced through various management practices (e.g., silviculture). However, the forest's inherent biological limits must be recognized in order to sustain these biological processes. In practice, it is next to impossible to measure the amount of biomass produced in an ecosystem, or the energy consumed in the process. Consequently, it is necessary to use indicators as a measure of forest ecosystem productivity.

The following indicators have been chosen for monitoring ecosystem productivity in the District. Information on these indicators will be reported during each planning period if available.

1. Mean Annual Increment (mai) in m^3/ha/yr by forest type and age class:

Permanent and temporary sample plots are being checked in District 02 during the 2005 field season. Updated data will be available for the wood supply analysis for the period January, 2006 to December, 2010. The Department's goal is to collect growth and yield information from individual Districts within 10 year intervals. A regional approach is used to determine growth and yield for the various stand types which occur within the District.

District 02 has developed a silvicultural strategy aimed at improving the mean annual forest growth, including:

1. Current and back-log commercial logging areas with inadequate regeneration are scheduled for reforestation. This will reduce the lag time between stand disturbance and forest re-establishment. It will also increase the stocking level on treated sites. This will have a positive impact on the average timber volume yield per hectare in the District.
2. Stands with low productivity (compared to their potential - generally due to repetitive highgrading and/or insect disturbances)

are targeted for stand removal and subsequent reforestation.

3. The harvest schedule for this planning period will target older/ unhealthy forest which would otherwise loose stand volume.
4. The District is actively pursuing a program to treat young balsam fir sites that are infested with balsam woolly adelgid.

2. Frequency of occurrence within selected indicator species:

(a) Moose population. Big game surveys for moose were not conducted in District 02 during the previous planning period. There were three moose management areas within the District. Area 47 (Random Island) last had a census completed during March, 2001 with population estimate of 550 or 2.17/km^2. Area 28 (Black River) had a census completed during February, 1997 with population estimate of 3090 or 0.83/km^2. (A section of moose management area 28 bounded by Black River on the south and the Trans Canada Highway on the north is located within Forest Management District 02). rea 29, which includes the Bonavista Peninsula and the remaining portion of the District, l ast had a census completed during March of 1989 with a population estimate of 3450 or 1.26/km^2. The overall average was 1.42 /km^2.

(b) Bear population. Bear surveys were not conducted in District 02 during the past f five years. However, anecdotal information indicates that bear populations have been increasing during the previous five years. In particular, there has been a dramatic increase in the number of complaints of bears foraging through solid waste disposal sites and residential areas. (This is a seasonal phenomenon which usually occurs during spring/early summer before wild berry crops are readily available). Random Island has shown the most pronounced increase in black bear activity. The number of bears foraging the local dumpsite has increased from 3-4 at the beginning of the previous planning period to an estimated twenty animals in 2005.

(c) Trout (kg of fish/area for selected watersheds). Creel surveys have not been conducted in Management District 02 during the previous planning period. District staff will promote the initiation of a creel survey program on select ponds during the current planning period. In particular, this program will target ponds and lakes that become easily accessible through DNR access road expansion. The intent will be to quantify the impact of increased fishing effort on local trout populations.

(d) Song bird populations. A series of song bird surveys have been conducted during the previous planning period at a number of sites in the District. Surveys of interior forest species have been conducted by District staff near Southwest River (Port Blandford) and the Plate Cove area during the early summer breeding season. Also, a song-bird breeding survey is conducted by the Canadian Wildlife Service along selected survey routes during the same period. Finally, a Christmas bird count is conducted by District staff, in co-operation with local bird-watchers. This survey focused on bird-feeders and waterfowl staging areas in an circle with a fifteen kilometre radius which stretched from Clarenville to Port Blandford to Lethbridge. Organized by the North

American Audobon Society, it is part of one of the longest running and largest wildlife surveys in North America. The results of these various surveys are provided in Appendix 2.0.

(e) Waterfowl population. During the previous planning period, the only survey which included a focus of waterfowl populations was the Christmas bird count. This survey monitored and will continue to monitor the relative abundance of migratory waterfowl that are using three local estuaries during late December. The survey focuses on the Little Shoal Harbour River estuary in Clarenville; the Shoal Harbour River estuary in Shoal Harbour; and the South West River estuary in Port Blandford. Results of the surveys are shown in Appendix 2.0.

(f) Furbearers (lynx, beaver, fox, and, in the western portion of the District, Newfoundland marten). Lynx pelt tagging and the rabies surveillance program show an extreme spike in Lynx population during 2001 and 2002 (normal response to the height of the hare cycle). The population crashed in 2003. Trappers licence returns indicated 64 lynx taken in 2001, 77 in 2002 and only 16 in 2003. The number of problem beaver complaints indicates a steady increase in the beaver population. However, this is not supported by trapper information, which fluctuated from 254 animals trapped during the 2001-02 season down to 184 during the following season and then up to 219 during 2003-04. Live trapping for Newfoundland marten is conducted in the Chance Harbour and Southwest River areas on an annual basis. Other areas throughout the District are targeted for live trapping, usually in response to reported sightings. One resident Newfoundland marten has been identified in the Chance Harbour area. Another was in the Musgravetown area for one and a half years. Tracks have been identified in the Southwest River valley.

3. Annual commercial and domestic wildberry blueberry/partridgeberry) production. The annual blueberry production for 18 years during the period 1976 to 2003 is shown in Appendix 3.0. Production has ranged from a low of 300,000 lbs in 2001 to a high of 3.538 million lbs in 1977. Annual production is strongly influenced by the frost incidents during late spring/early summer. Price fluctuations also impacts the annual harvest level.

Aquatic ecosystems within the forest also indicate the overall condition of the associated watersheds. Nutrient flow levels and stream flow rates are good indicators of changes in productivity levels. Changes in water quality will be evaluated using the following indicators:

(1) Water quality as measured by water chemistry, turbidity and other parameters for selected waterways.

(2) Trends and timing of events in stream flows from forest catchments for selected waterways. Stream flow data for a number of waterways in District 02 is provided in Table 3.2.

Average Stream Flow Data
Forest Management District 2

River	Data Range	Lowestt Yearly Mean (m3/s)	Highest Yearly Mean (m3/s)	2003 Mean (m3/s)	3-year average yearly mean (m3/s)	5-year average yearly mean (m3/s)	Average yearly mean m3/s)
Shoal Harbour	*1986-2003*	*1.96*	*3.97*	*2.93*	*2.76*	*3.07*	*3.13*
Come By Chance	*1961-2003*	*1.04*	*2.58*	*1.83*	*1.80*	*1.86*	*1.86*
Pipers Hole	*1952-2003*	*16.30*	*35.10*	*25.50*	*23.70*	*25.16*	*25.10*
Southern Bay	*1976-2003*	*1.22*	*3.14*	*1.94*	*1.97*	*2.22*	*2.13*
Salmon Cove (Champneys)	*1983-2003*	*1.66*	*3.04*	*2.36*	*2.60*	*19.36*	*19.80*
Average District Flow		***6.25***	***11.97***	***9.29***	***8.48***	***9.05***	***9.09***

Yearly means are averages of monthly means for that year
3-year and 5-year averages are for the respective 3 and 5 year periods prior to 2003
Average yearly mean includes all data in the data range

Table 3.2 Stream Flow Data for Selected Rivers in District 02

The district planners anticipate that a cooperative approach will be used in the collection of information for the parameters listed. Assessment of **changes** in ecosystem productivity during the planning period will be evaluated on these and any other relevant indicators.

3.2.2 Resilience

Ecosystem resilience is the ability of a forest to revitalize itself and rebound after a disturbance. Resilience is characterized by the forest's ability to stabilize vital soil processes and maintain successful succession whereby the system is returned to a community composition and the productivity level is consistent with the ecosystems' physical constraints.

To a large degree, a forest ecosystems' resilience is controlled by properties such as regional climate, soil parent materials, relief and flora (Jenny 1961, Major 1951). Some indicators to measure forest ecosystem resilience are:

1. Percent and extent of area by forest type and age class

This data normally becomes available when a District is re-inventoried. It is a responsibility of the Forest Ecosystem Management Division within the Department of Natural Resources to complete new forest inventory - on a District basis. The Departments goal is to

complete new District inventories on a ten year cycle. The reality is that it is completed in most Districts on a 15+ year cycle. The lag time is primarily a function of reductions in Provincial budgets. The Department is currently exploring ways to make the process more efficient.

A major part of completing a new forest inventory is interpretation of aerial photographs. The most recent forest inventory for District 02 was based on interpretation of 1989 aerial photography. This District is currently scheduled for re-inventory. New aerial photography will be flown and field work completed during the summer of 2005. Subsequently, the Department will undertake photo interpretation and then re-type the District's forest inventory. "The percent and extent of area by forest type and age class" will be updated when the new inventory is completed.

In the interim, DNR relies on soft updates, normally completed at five year intervals, to incorporate significant changes in the District's inventory. This is required for completion of the provincial wood supply analysis.

2. Percentage of disturbed area successfully regenerated naturally and artificially.

In Forest Management District 02, it is estimated that an average of 500 hectares of productive forest are removed through wind, fire or commercial harvest disturbance each year. It is assumed for wood supply analysis that satisfactory natural regeneration in this District occurs on 30% of the forest sites post disturbance. This equates to approximately 150 ha. The District has developed an aggressive reforestation program. An average of 346 hectares has been planted each year during the past three years.

The District has been successful in maintaining a high net percentage of natural and artificial regeneration compared to the annual amount of area that is subject to forest disturbance. However, the reforestation program has included some backlog area. A portion of current harvest areas cannot be planted due to operational constraints (rocky soils, steep slopes, etc). The District will attempt to implement alternative reforestation techniques to address this concern through the 2006-10 planning period.

Update information is difficult to gather in domestic cutting areas due to the nature of the disturbance (generally small patch cuts). However, regeneration is generally more successful on smaller patch-cuts than on larger clear-cuts due to the improved available seed source.

3.2.3 Stability

Nature is constantly changing and going through the unending processes of disturbance, growth, senescence and decay**.** Therefore, stability of a forest ecosystem does not refer to one fixed position without variation. Ecosystem stability is more accurately defined as the maintenance of ecosystem changes within certain boundaries and the functional continuation of important potentials and processes such as energy capture.

Perry (1994) examined and defined three levels of stability. These are species stability, structural stability and process stability. Species stability is the maintenance of viable populations or meta populations of individual species. Structural stability is the stability of

various aspects of ecosystem structure, such as food-web organization or species numbers. Process stability is the stability of processes such as primary productivity and nutrient cycling. To put stability into perspective, Perry also defined instability as a state that occurs when the system crosses some threshold from which recovery to a former state is either impossible (e.g., extinction) or, if possible, occurs only after long time periods or with outside subsidies of energy and matter (eg. loss of topsoil).

Indicators of stability to monitor are:

1. Area of forest converted to non-forest land use
This indicator will be evaluated after the District is re-inventoried)refer to (1.) above)

2. Area, percentage and representativeness of forest types in protected areas.
(Refer to Section 2.2.4. Table 2.1)

3. Percentage and extent of area by forest type and age class
Refer to (1) in Section 3.2.2 Resilience.

4. Changes in distribution and abundance of various fauna.

3.3 Incidence of Disturbance and Stress

This section deals with the frequency/severity of major disturbances and stress on the forest ecosystem. Depending on the timing, distribution and intensity of disturbances, the resultant stress may have positive, negative or neutral effects on ecosystem condition over time.

The forests of Newfoundland and Labrador form the eastern extent of Canada's boreal forest region. That region is characterized by dense, even-aged stands of conifers including Black and White Spruce, Balsam Fir and Tamarack, intermixed with hardwoods such as White Birch, Trembling Aspen and Red Maple. Natural disturbance patterns encompass a high incidence of wildfire combined with periodic outbreaks of insect infestations, disease and wind throw. Human disturbance has historically been in the form of large-scale timber harvesting, forest fires due to human causes, and forest removal for residential, agricultural, and/or industrial developments.

The Bonavista Peninsula is very representative of these disturbance patterns. Historical records reveal that virtually all of the forest area has been swept by wildfires. Most of the District 02 productive timberlands in existence at the turn of the century were destroyed by large forest Fires which occurred during the late 1880's and early 1900's (1907) . This accounts for the large black Spruce component of the forest which re-seeded on many burnt sites. The remaining unburned portions have to some degree been affected by one or more periods of high insect populations during the late 1970's and early 1980's. The Forestry and Wildlife Branch reports that in excess of 12,900 hectares of productive forest were affected by the episodic highs of Spruce Budworm *Choristoneura fumiferana* and to a lesser extent Hemlock Looper *Lambdina fiscellaria* infestations during that period. The forests most heavily damaged by extremely high budworm populations are located near Ocean Pond, Canning's Cove, and Deer Harbour just

north of Sunnyside. Hemlock looper damage was concentrated in the Ocean Pond and Burgoyne's Cove area**.**

Wind damage has been witnessed to occur infrequently in naturally developing stands that have not had other disturbance impacts. The frequency and scale of wind disturbance in these type stands is anticipated to increase as the older portion of the District's forest moves through senescence. Insect damage during the late 1970's and early 1980's and the widespread practice of partial stand cutting has contributed to subsequent wide-spread wind throw throughout much of the District. The majority of wind throw areas exist as small-sized openings, most of which regenerate naturally to Balsam Fir. The most prevalent forest pathogen in District 02 is heart rot which is common to selected mature Balsam Fir stands. Sap rot and root rot are also present in these forests, but are much less common.

Human disturbance on the Bonavista Peninsula and surrounding area has been characterized by decades of extensive patch cutting, frequent man-caused Fires and to a lesser extent forest clearing for residential and agricultural development. The Bonavista Peninsula area is one of the earliest settled portions of North America, colonies having been established by the English about the year 1600 (Wilton and Lewis, 1956).

Prior to the twentieth century, the principal occupation of the population involved some aspect of the fishery. Consequently, the only harvesting of timber was for use in the fishery for boat building, stores, stages, housing materials and for fuelwood. The wood for these requirements was taken from forests as close as possible to the coast.

After the turn of this century, forest harvesting activities increased as selective logging and patch clear-cutting were conducted to obtain boat timbers and pulpwood for export, sawlogs and firewood for domestic use and mining timbers . Patch clear-cutting was prominent near waterways to supply sawlogs to several water-powered sawmills. These mills, which were prevalent in the lumbering communities of Musgravetown, Bloomfield and Lethbridge, operated up to the 1950's, and depended heavily on the coastal forests subsequently alienated as a result of the creation of the Terra Nova National Park in 1957. Other industries utilizing smaller-diameter, sub-merchantable timber, such as biscuit box and barrel manufacturing plants were also established and flourished during this period. Since the majority of the existing timber resource included immature stands, these were the dominant source supplying these industries.

Between 1950 and 1970 the water-powered sawmills, biscuit box and barrel manufacturing plants were phased out. During the later part of this period, forest stands established prior to 1930 began to produce merchantable size sawlogs. This contributed to development of the District's current small sawmill industry. The sawmills of the Peninsula were characterized until recently by small family affairs operated by two to three men. The layout of the remaining mills of this type is essentially the same today as they were when the industry was established, consisting of a hand-operated push table, or a mechanical log carriage. Over the past ten years, several modern sawmills have been established. These are heavily dependant on raw material from outside District 02. From the earliest beginnings, operators of the small mills predominantly practiced selective logging, or highgrading (i.e., cutting individual trees or small groups of trees). Consequently, it was necessary to cover a large area to obtain a sufficient annual harvest. This practice, as employed by in excess of 500 sawmillers over many decades has led to a widespread disturbance pattern throughout the district. As a

result, the forest structure is quite broken with a much higher level of small openings or clearings than would be seen in naturally developing undisturbed stands. The many small openings present in the forest in District 2 has created ideal conditions for the spread and establishment of kalmia. Kalmia is an invasive ericaceous shrub that quickly dominates a site given favourable conditions and prevents the normal development of the forest. It can seriously impede the ability of the forest ecosystem to provide many social and economic values. Over the past two decades this disturbance pattern has been somewhat modified through the implementation of silviculture site rehabilitation projects and increased commercial clear-cutting.