Monitoring of our Forest Resources with Continuous Forest Inventory (CFI)

What is CFI?

Continuous Forest Inventory (CFI) is a series of uniformly spaced permanent sample plots that are measured periodically to quantify forest conditions and changes. About every 10 years, the 1/5 acre plots are measured to determine what tree species are present, how much young forest has been established (regeneration) and how much existing tree growth and mortality has occurred since the last inventory. There is one plot for about every 160 acres of state land administered by the DCR - Division of State Parks and Recreation.

Why have CFI?

Foresters use CFI as an information tool to ultimately make forest management decisions. The inventory provides information on insect and disease trends or how the forest was affected by major environmental events such as hurricanes or ice storms. Long term measurements can also reveal the effects of pollution and climate change on the forest environment.

Data from the inventory helps us to make decisions on how much sustainable harvesting can take place in the forest. Responsible sustainable forestry requires that harvesting removes no more than what grows and dies in the forest each year. Harvest levels are set at or below the ***net growth*** after analyzing the CFI data.

When is CFI measured in Massachusetts?

The Massachusetts CFI was instituted in 1957 with establishment of 93 plots and has now expanded to nearly 1900 permanent plots. Most plots have been measured three times since their establishment. A new measurement of plots began in the summer of 2010. Prior to 2010, the most recent measurement took place in 2000.

How does "Long Term Ecological Monitoring" work with CFI?

Recently, Massachusetts began establishing Forest Reserves through the forest management planning process. Forest Reserves are areas excluded from active forest management. They have been established on the Bureau of Forestry, Water Supply Protection, and the Division of Fish and Wildlife forest lands. With the assistance of the University of Massachusetts, these three agencies have committed to monitoring the long term ecological condition of the reserves.

On Bureau of Forestry lands, new CFI plots will be established in reserves adjacent to actively managed forest. Data collected from the permanent plots within the reserves will

be used to track the reserve condition and compare that condition to actively managed forests.

What does CFI tell us about Massachusetts state forest land?

Below are some forest statistics generated from the measurements of the CFI plots. These are a sampling of a significant volume of statistics that are available from the CFI measurements.

Generally, what these statistics tell us is the forest that is established on state lands today is maturing from the land practices of agricultural and subsequent abandonment in the late 19th century. The forests on state land are composed of significant amounts of oak, white pine and "northern hardwoods" (beech, birch, and maple). Most of the forest (76%) is in a medium or high density classification and generally large trees (40% are greater than 11" diameter). The woods have a large amount of standing dead and down dead woody material (coarse woody debris). And, the age classes measured in 2000 indicate that 81% of the forest in now nearly 70 years old or older.

Of particular note in regards to forest management of state lands is the comparison of harvest levels over the 21 year period 1980 – 2000. The Bureau of Forestry on state lands harvested 17% of the net growth during that period.

Some of the data below has helped craft the recently approved Forest Resource Management Plans. Using the CFI data, the harvest levels were set at approximately 25 - 40% of the annual net growth in each respective forest management district. In other words, harvest levels are set significantly below the sustainable level.

Acres of Tree Species on Massachusetts State Lands*

Species Group	Acres	Percent
White pine	51423	18.5
Hemlock	33859	12.2
Spruce-Fir	12585	4.5
Pitch pine – Oak	12051	4.3
Beech-Birch-Maple	67424	24.2
Grey Birch – Red Maple	19523	7.0
Oak-hardwoods	70539	25.3
Scarlet Oak	11168	4.0
Total	**278572**	**100**

*Statistics are from 2000 CFI measurements

Forest Density and Tree Sizes on Massachusetts State Lands*

	Acres							
Density	Sapling	%	Pole	%	Sawtimber	%	Total	%
High			43539	15.5	51823	18.6	93562	34.2
Med			73190	26.3	43490	15.6	116681	41.9
Low	317	.1	14629	5.3	6053	2.2	20999	7.6
Sparse	1727	.6	12704	4.6	7881	2.8	22312	8.0
Not Stocked	1108	.4	9834	3.5	1108	.4	12050	4.3
Other							11168	4.0
Total	**3152**	**1.1**	**153897**	**55.2**	**110355**	**39.6**	**278572**	**100**

Sapling (1.0 - 5.0" diameter) Pole (5 – 11" diameter) Sawtimber(>11" diameter)

*Statistics are from 2000 CFI measurements

Coarse Woody Debris on Massachusetts State Lands*

	Status 3	**Status 4**	**Status 5**	**Status 6**	**Status 7**	**Status 8**
Hundreds of Cubic Feet	80164	200362	244189	31317	131197	227064
Tons	132856	333688	407814	51507	219531	377947

Status 3 - dead sound **Status 4** - dead – partially decayed **Status 5** - dead decayed
Status 6 - dead down sound **Status 7** - dead down partially decayed
Status 8 - dead down decayed

*Statistics are from 2000 CFI measurements

Total Growth 1980 – 2000 over all Forest Management Districts*

	Net Growth	
District	**CCF**	**MBF**
Northern Berkshires	8738.07	5718.95
Central Berkshires	4964.73	6876.49
Southern Berkshires	6812.48	7684.58
Western CT Valley	8133.30	5630.30
Eastern CT Valley	12494.80	5826.37
Mid State	8379.39	6936.22
Northeast	6794.03	5558.39
Southeast	18186.63	6260.02
Total	**74503.44**	**50491.32**

*Statistics are from 2000 CFI measurements

Net Growth = previous growth measurements + new growth measurements - measured mortality.

CCF = 100 cubic feet
MBF = 1000 board feet

Age Class by % on Massachusetts State Lands*

Age Class	0	1-15	16-25	25-35	36-45	46-55	56-65	66-75	76-85	86-95	>95	Total
Percent	4.4	.5	1.2	2.3	3.4	7.5	17.8	20.4	18.9	11.4	12.4	100

*Statistics are from 2000 CFI measurements

Some summary CFI Statistics 1980 - 2000:

- Growth of trees – 143,404,932 cubic feet (ft^3) (25.7 ft^3/acre/year)
- Mortality and removal of trees – 68,901,497 ft^3 (12.4 ft^3/acre/year)
- 21 year net increase in volume = 74,503,435 ft^3 or 3,547,783 ft^3/year (12.8 ft^3/acre/year)
- 21 year harvest volume = 13,004,000 ft^3 or 619,238 ft^3/year (2.2 ft^3/acre/year)
- Bureau of Forestry harvested 17% of the net increase in volume during this time period.