Forest Regulation

Definitions

- Forest Regulation ~
  - In classic 'Sustained Yield Forestry', the determination of the amount of timber which can be harvested from a forest on a perpetual (sustainable) basis.

Definitions

- Forest Regulation ~
  - The application of planned forest operations to achieve a specific future forest condition which is usually defined in terms of species and age class distribution for even-aged forests and species and diameter class distribution for uneven-aged forests.
  - Forest regulation is specifically concerned with the calculation of the sustainable annual or periodic harvest level. AKA ~ the annual allowable cut (AAC)

Definitions

- Allowable Cut ~
  - The amount of timber which can be harvested from a forest under a given set of management conditions including specific silvicultural systems, specific land use limitations, and specific management objectives.
  - In classic ***sustained yield forestry***, this amount is equivalent to the annual growth (increment) of the ***normal*** forest.

Definitions

- Sustained Yield Forestry ~
  - The practice of forestry in a manner which ensures a predictable and uniform level of harvest in perpetuity.
    - Requisites for Sustained Yield Forestry
      - Access to the entire managed landbase
      - Forest suitable to make repeated harvests economically feasible
      - Adequate protection from Fire, Insect and Disease
      - Full Markets for wood products
      - Equitable taxation

Definitions

- Normal Forest ~
  - The Normal forest is a theoretical model of the forest which is used as a baseline for the purposes of describing the actual forest condition and as an ideal model of the forest in classic forest regulation under sustained yield management.

Definitions

The Normal Forest has the following characteristics:

- Normal Increment
  - The forest is growing at its best achievable rate within the limitations of the site
- Normal Age Class Distribution
  - There is an even distribution of age classes in the forest from 0 up to rotation age.
- Normal Growing Stock
  - The forest is fully stocked and therefore contains the best achievable volume of timber within the limitation of the site

Definitions

- Clearly the Normal forest is not very normal at all, in fact, other than perhaps in some small private tracts it is probably an unattainable ideal.
- In modern, sustainable forest management where the concern for outputs and conditions within the forest have broadened significantly. The normal forest is no longer even a reasonable "ideal"

Definitions

- *i.e. the normal forest*
  - Doesn't deal with features such as "old growth" (no forest is older than rotation age)
  - Doesn't deal with long term set-asides from harvest as required by pine marten and caribou guidelines
  - Never accepts the paradigm of less than thrifty forests growing at their maximum rates
  - Requires full market access for all forest products

Definitions

- in order to understand forest regulation one must first appreciate the concepts of even-aged vs uneven-aged management
- **Even-aged management** is characterized by Silvicultural Systems which harvest specific areas as either a single harvest event (i.e. clearcutting system) or in a series of harvests over a relatively short period of time (i.e. shelterwood system)

Definitions

- The net result of even-aged management must be that the regenerated forest arises as a single age (or within a narrow band of ages)
- Even-aged management is typically applied to forest stands/species which are mid-tolerant to intolerant; this system is typical of the boreal forest and is the most widely practiced system in Canada

Definitions

- **Uneven-aged Management** is characterized by Silvicultural Systems which perpetuate an uneven-aged (multiple-aged, or all aged) condition within forest stands.
- This is typified by the selection silvicultural system in which successive, periodic harvest entries occur on the same area of forest land and only a portion of the growing stock is removed each time

Definitions

- The net result of uneven-aged management must be that the forest is maintained perpetually in a state where there is a range of age classes from saplings to mature trees in each stand
- Uneven-aged management is typically applied to forest stands/species which are tolerant; this system is typical of the tolerant hardwoods in the Great Lakes-St. Lawrence forest

A quick review of the Selection System of Uneven-aged Management

- We will consider the uniform selection system as the paradigm of uneven-aged management ~ this is the case in Ontario for managing hardwoods in the central and southern part of the province

A quick review of the Selection System of Uneven-aged Management

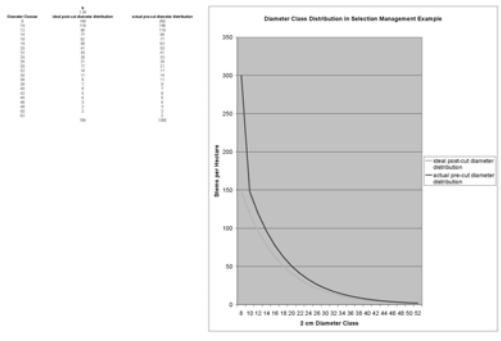
- All stands managed under the selection system are maintained or are directed towards a condition having all ages represented “uniformly” in a single stand
- Diameter classes of trees in the stand are an easily measurable proxy for age in tolerant forests

A quick review of the Selection System of Uneven-aged Management

- Stands are managed so that there is a declining number of trees in each from the smallest to the largest
- If we plot out the numbers of stems per hectare against diameter class a reverse “J” shaped curve is formed
- This distribution emulates the “gap phase” replacement of trees in naturally uneven-aged forests

A quick review of the Selection System of Uneven-aged Management

- The crop plan for a stand managed under uniform selection is governed by:
  - Residual basal area: basal area to be retained at the end of a harvest
  - Maximum tree diameter: the diameter class of the largest trees to be retained in the stand
  - Distribution curve of diameter classes governed by a “Q” factor which is the relationship between the number of trees in any given diameter class and the number of trees in the next smallest diameter class



A quick review of the Selection System of Uneven-aged Management

- The cutting cycle is also pre-determined based on the real increment of the forest and local experience
- It will generally be the minimum amount of time required to make a return harvest economically viable

Determining the Allowable Cut

- in classic forestry the allowable cut is determined through the use of formulae which are based on either area or volume
- allowable cut can be calculated for both even aged and uneven aged management systems

Determining the Allowable Cut
Forest Units

- the allowable cut is not calculated for the forest as a whole (except for small woodlot properties)
- rather it is based on subsets of the forest land base that are managed under a similar set of conditions
- these subsets are aggregates of area within the forest which are similar in terms of species, site quality, growth and yield characteristics and management intent

Determining the Allowable Cut
Forest Units

- these subsets of forest area are termed forest units, or a similar term indicating that they are the principle divisions for managing the forest

Determining the Allowable Cut in Even-aged Management Systems

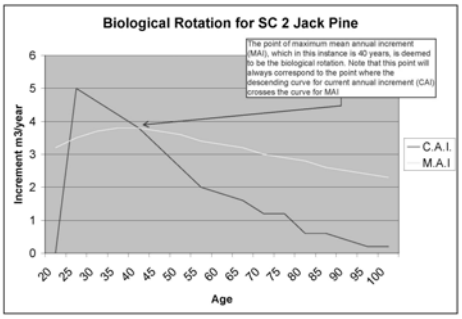
- in classic even-aged forest management each forest units will have a single, pre-determined *rotation age*
- the rotation age is the age at which stands or areas of trees will (ideally) be harvested

Determining the Allowable Cut in Even-aged Management Systems

- rotation age may be based on the products to be produced
- e.g. if the jack pine forest unit is being managed primarily for saw logs, then the rotation age could be set to the age when the jack pine has achieved a diameter and piece size which is ideal for the sawmill; this would be termed a product rotation

Determining the Allowable Cut in Even-aged Management Systems

- rotation age can also be based on maximizing stand productivity
- this age is calculated to be the point at which maximum Mean Annual Increment is achieved
- in order to calculate this "biological rotation age" reliable normal yield curves are required.



Determining the Allowable Cut in Even-aged Management Systems

- rotation age can be based on any number of other factors including species longevity and vigor, pathology, aesthetics or anything else but each management aggregate (i.e. forest unit) can only have one rotation age.

Determining the Allowable Cut in Even-Aged Forest Management

- once forest units and rotation ages are determined then the most basic method of calculating the allowable harvest is termed "simple area allotment"
- the annual allowable cut (AAC) is simply the area of the forest unit divided by the rotation age

Determining the Allowable Cut in Even-Aged Forest Management

- AAC = Forest Unit Area / Rotation Age
- Eg:

  40,000 ha of spruce lowland forest unit with a rotation age of 100 years will generate an AAC of 40,000/100 or 400 hectares per year

  The volume of harvest would then be predicted by multiplying the area by a value from a set of yield curves adjusted by conditions of the actual allocations such as stocking and average actual age

Determining the Allowable Cut in Even-Aged Forest Management

- Problems with simple area allotment
  - must account for all depletions (fire, insect, disease, land base removals) within the AAC i.e. a Maximum Allowable Depletion
  - areas (stands) should be allocated for harvest in proportion to the full range of timber and site qualities which are found in the forest; forest access and economic realities usually preclude this from happening
  - high-grading (harvesting the best areas first) results in a progressive reduction of available stand and site quality later in the rotation
  - Most forests will not begin with an age class distribution which easily facilitates harvesting the AAC from rotation age stands year after year

Determining the Allowable Cut in Even-Aged Forest Management

- Conceptually on a volume basis, the allowable cut should not exceed the annual increment of the forest
- There are many formulaic methods used to calculate this value

Determining the Allowable Cut in Even-Aged Forest Management

- Von Mantel's Method

$$AAC_v = 2 \times \frac{AGS}{r}$$

AAC_v ~ Annual Allowable Cut (volume)
AGS ~ Actual Growing Stock
r ~ rotation age

Determining the Allowable Cut in Even-Aged Forest Management

- Heyer's Formula

$$AAC_v = i + \frac{(AGS - NGS)}{x}$$

AAC_v ~ Annual Allowable Cut (volume)
AGS ~ Actual Growing Stock
NGS ~ Normal Growing Stock
x ~ selected adjustment period

Determining the Allowable Cut in Uneven-Aged Forest Management

- In uneven-aged management the idea of rotation age is less meaningful since conceptually the stands within the forest are kept perpetually in a state of uneven – agedness.
- What is important however is the cutting cycle which is the period of time between successive harvests on the same area of the forest

Determining the Allowable Cut in Uneven-Aged Forest Management

- AAC = Forest Unit Area / Cutting Cycle
- Eg:

  4,000 ha of beach/maple forest unit with a cutting cyle of 20 years will generate an AAC of 200 hectares per year

  The volume of harvest taken from this area will be the 20 year periodic increment times the areas of harvest

Determining the Allowable Cut in Uneven-Aged Forest Management

- Von Mantel's Method can also be used in uneven-aged management but to do so requires the establishment of a rotation age which in this case really refers to the age by which all trees will have achieved maximum diameter and will be harvested.
- Heyer's formula is also directly applicable to uneven-aged management