ROTATIONS, PUBLIC PERCEPTIONS, AND YIELDS

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ABSTRACT

Forest management practices in the Pacific Northwest evolved over three quarters of a century of improving scientific knowledge and changing economic and social conditions. Practices well justified in the past create major problems today. Adoption of longer rotations can help defuse conflicts and can provide improved aesthetic, wildlife, and watershed values as well as higher quality timber. Available evidence indicates that moderate extension of rotations combined with increased emphasis on thinning would not reduce long-term timber production and would probably increase value production. We do not know how far rotations can be extended in systematically thinned stands before yield reductions become serious, but this limit is considerably beyond rotation ages common in the recent past and beyond the ages for which we have experimental data.

Keywords: DFSIM, rotations, mean annual increment, ORGANON, Pacific Northwest, SPS, silviculture, thinning.

INTRODUCTION

Lately we hear a lot about "new forestry," "alternative silviculture," "new perspectives," and "ecosystem management." Much of this is rather fuzzy, but the common element is a shift in emphasis from timber production as the primary management objective toward increased consideration of other values and efforts to reduce conflicts between competing land uses. This workshop is concerned with one particular strategy.

HISTORICAL OVERVIEW

A brief review of the history of forest management in the coastal Pacific Northwest may provide some perspective.

Our history began with a period of unplanned liquidation, in which the forest was viewed as a static resource to be mined. This period lasted from the 1850s to some time around the early 1920s.

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Fire suppression became effective in the 1920s and early 1930s. In this period people also came to realize the enormous productive capacity of northwestern forests as expressed in the early yield tables of McArdle and Meyer (1930) and Meyer (1937). Together, these made planned forest management possible.

With the new awareness of the potential of northwestern forests came a period of experimentation with regeneration techniques in the 1920s and 1930s:

- The seed tree system was one of the first tried. This was much like the "green-tree retention" cuts we see today, although the motivation was different. Leave trees did indeed supply some seed (and snags); few survived for long (Isaac 1940).

- In the mid 1930s, there was a serious effort to apply selective cutting in old-growth Douglas-fir on the National Forests (Kirkland and Brandstrom 1936). Some skeptics put in permanent plots to find out what actually happened. The results showed that widespread stand deterioration followed selective cutting, and the effort was quietly abandoned (Munger 1950; Isaac 1956; Smith 1970).

- Meanwhile, many of the old liquidation cuts, now protected from fire, had regenerated well. Exceptions were areas repeatedly burned and areas with vigorous brush and hardwood competition.

- Serious research on regeneration requirements was undertaken in the 1920s and extended through the early 1940s (Isaac 1938, 1943). This research led to adoption of the so-called "staggered setting" system. Staggered settings were simply moderate-size clearcuts, generally burned for slash disposal, with adjacent areas of uncut old timber providing the seed source (Lavender and others 1956). They were widely used in the late 1940s and early 1950s, with results that were sometimes satisfactory. The 1946 Washington Forest Practice Act required that 5 percent of the area be left in seed blocks on all clearcuts, a clearly inadequate requirement that provided little improvement over scattered seed trees in either seed supply or residual tree survival.

- The 1950s saw a general shift to artificial regeneration. This shift provided quick and dependable stand establishment and removed the need for seed blocks on clearcuts.

- In subsequent decades there was a shift to increasingly short rotations--to as short as 40 to 50 years in some ownerships today.

Along with these changes came the development of clearcutting dogma. Because the combination of clearcutting, burning, and planting proved cheap, simple, and effective in establishing regeneration in most situations, there was a tendency to apply it everywhere. Thus, it was only a short step to the belief that this sequence was the only way to do things.

There was a concomitant shift in attitudes toward commercial thinning. In the 1950s many foresters--still thinking in terms of relatively long rotations--thought commercial thinning was the wave of the future (Worthington and Staebler 1961). But initial financial returns were marginal (particularly when compared to those from speedy conversion of remaining old-growth), and, as rotations were shortened, most owners abandoned commercial thinning in favor of precommercial thinning and early harvest.

CONSEQUENCES FOR THE PRESENT

Much of this progression represents the constructive evolution of forest practices and the accumulation of knowledge over the past three-quarters of a century. But the most recent phase--large clearcuts combined with very short rotations--has been a political and social disaster.

In round numbers, it takes 10 years for a cut area to green up and begin to look like a forest again. A 40-year rotation means that 25 percent of the landscape is perpetually in a freshly cut condition, with the other 75 percent in uniform stands of relatively small trees. The visual effects create horrendous public relations and political problems with huge costs that are not included in traditional financial analyses. These visual effects are a major--perhaps <u>the</u> major--cause of many of our present problems.

The urban public driving down the road and flying into Portland and SeaTac sees clearcuts spread everywhere across the landscape. Most of these people know nothing of the long history of forestry in the region and have little understanding of what is actually going on or the reasons for it. They do not like the looks of it, and their gut reactions provide fertile ground for propagandists who depict this as irresponsible destruction.

Propaganda aside, there are also serious scientists who have doubts about some aspects of current practices. And these doubts are not limited to the northern spotted owl controversy.

We must find ways to defuse these conflicts. One aspect of this must be an effort to reduce the visual impacts of forestry operations.

The Forest Service has been the organization most severely affected by these conflicts, but other organizations have been and will be drawn into them. In reality, Forest Service operations have probably been the least obtrusive among those of the major landowners. But the public pays little attention to property lines, and the Forest Service is the organization most exposed to public scrutiny and political pressures.

There have been major changes in the Forest Service's timber management practices, and more are coming. Some are probably improvements and some will probably create more problems than they solve. A general shortcoming is that, for many of the practices involved, we have little or no basis for quantitative estimates of the long-term results.

EXTENDED ROTATIONS

This workshop is concerned with extended rotations, one of many proposed changes in forest practices. Although discussion is centered on public lands, the ideas involved are also applicable to other owners. Furthermore, this is one option for which we do have some basis for estimating the consequences.

Possible advantages of extended rotations include:

- less land in regeneration and early development stages (more appealing landscapes, less slash burning, less herbicide use),

- larger trees, wood of higher quality,

- more naturally occurring snags and down wood, better habitat for some wildlife, perhaps greater long-term site productivity,

- increased carbon storage (related to climatic change).

In comparison with some alternatives, even-aged management based on long rotations has the great advantages of (1) simplicity and (2) relative predictability of results. The associated thinning and regeneration methods are well established, and we can estimate the physical and economic consequences through straightforward extensions of existing procedures (even though some additional data will be needed). Extending rotations is probably the least disruptive of possible changes in management practices on public lands, which still contain much old timber.

Extended rotations imply a renewed interest in and widespread application of commercial thinning. Feasibility of these rotations also depends partly on their effect on timber yields. These effects can be readily presented and discussed in terms of patterns of mean annual increment (MAI).

MAI is simply average production per year--volume produced divided by stand age. The MAI curve has a characteristic shape (Figure 1). The maximum point (culmination, at which it intersects the current annual increment curve) represents the harvest age that gives maximum production in whatever units are used on the vertical axis. Economists traditionally take this maximum and discount financial yields at some assumed interest rate to arrive at a shorter financial rotation. This latter rotation usually ignores non-timber outputs and political factors, as well as longer-term biological considerations such as maintenance of site productivity.

The National Forest Management Act of 1976 says that rotations in the National Forests shall approximate culmination age. This requirement implicitly assumes that

MAI patterns and age of culmination (maximum MAI) are fixed and well-understood characteristics of a species. But, culmination age varies not only with species and site, but also with the units in which yield is measured and with management regime. Much of our thinking has been shaped by old normal-yield tables that do not represent either the growth patterns of managed stands or the effects of value differences associated with size and wood quality.

Many people assume that intensive management and high production necessarily mean short rotations. This is an unwarranted assumption.

Most of our northwestern species are very long-lived and can maintain rapid growth to advanced ages. Development patterns and age of culmination are influenced by management, although our understanding of these relationships is incomplete, and we do not know the precise shape of the MAI curve at advanced ages in stands grown under any sort of systematic management.

We can attempt to estimate the results of long-rotation management by either (1) extrapolating existing stand models or (2) examining results of those studies in which stands under some form of density control have been carried to fairly advanced ages. Unfortunately, existing models satisfactorily represent only a limited range in ages, and such data as exist for older stands have not been assembled and adequately evaluated.

All the same, the information that we do have is indicative--and certainly better than that for many of the alternatives that have been proposed.

TREE GROWTH SIMULATORS

The normal-yield table of McArdle and others (1930, 1961) was the bible for foresters in the Douglas-fir region for many years. We now think that their height-growth curves were incorrectly shaped. A reworking with newer widely used curves (King 1966) indicates a later culmination and considerably flatter MAI curves, more nearly resembling those produced by newer simulators (Curtis 1992).

Figure 2 compares predictions of a number of commonly used simulators (Arney 1985; Curtis and others 1981; Hann and others 1992) for a single initial condition and a single management regime involving systematic thinning (Curtis and Marshall 1993). Three characteristics stand out: (1) predictions are in reasonable agreement up to about age 60, the upper limit of adequate data underlying several of the simulators; (2) the predicted age of culmination corresponds roughly to the point at which each simulator runs out of data (around 70 years for DFSIM and SPS, 100+ years for ORGANON); and (3) collectively, the curves indicate that there is a considerable range of ages that will give more or less the same production rates (MAI's). This last point is also consistent with the old normal-yield tables (after adjustment to modern height-growth curves).

Comparative runs with various simulators and other data (Worthington and Staebler 1961) suggest that, in comparison with the unmanaged stands depicted in normal-yield tables, consistent thinning tends to delay culmination and prolongs the period of near-constant MAI.

EMPIRICAL DATA

From the late 1930s through the early 1950s, there was much interest in thinning of intermediate-aged stands, and a considerable number of trials were established. With the subsequent shift to short rotations, owners lost interest and many of these trials were dropped in the 1970s. Much of these data and some of these field installations still exist. Although the existing data have not been adequately examined, we do have some examples that are certainly suggestive (Curtis and Marshall 1993).

One of these examples is the Mt. Walker thinning trial (see Figure 3), established in 1935 on site IV land (Worthington 1966). Today the stand is in good shape, and MAI is still increasing at age 117.

Another example is a site II stand at Black Rock (see Figure 4) that is part of a series of commercial thinning trials established by Al Berg of Oregon State University in the 1950s. This 1-acre plot was heavily thinned at age 48 and is now about 80 years of age. MAI has not culminated (as is also true of others in the series), and current growth is accelerating.

Other examples show similar trends. We have not yet clearly observed culmination in systematically thinned stands free from major damage from wind or disease.

SUMMARY

1. Available information indicates that rotations can be considerably extended without materially reducing long-term volume yields; indeed, such yields might well increase. We do not know how far rotations can be extended without serious losses in yield.

2. Extended rotations will reduce user conflicts and increase non-timber values.

3. Systematic thinning will probably delay culmination and extend the period of near-constant production rates.

4. The biggest practical problem in any shift to long-rotation management is not the effect on long-term yield, but the short-term effect on timber flow.

5. Needs for timber, maintenance of forest health, and provisions of wildlife habitat will result in greatly increased emphasis on thinning. We do not have good estimates of the production possible from thinnings in older stands or of the thinning regimes most appropriate to meet the need for timber and the need to provide snags and other

structural features favorable to wildlife.

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Figure 1--Schematic graph showing the relation of the mean annual increment (MAI) and periodic annual increment (PAI) curves.

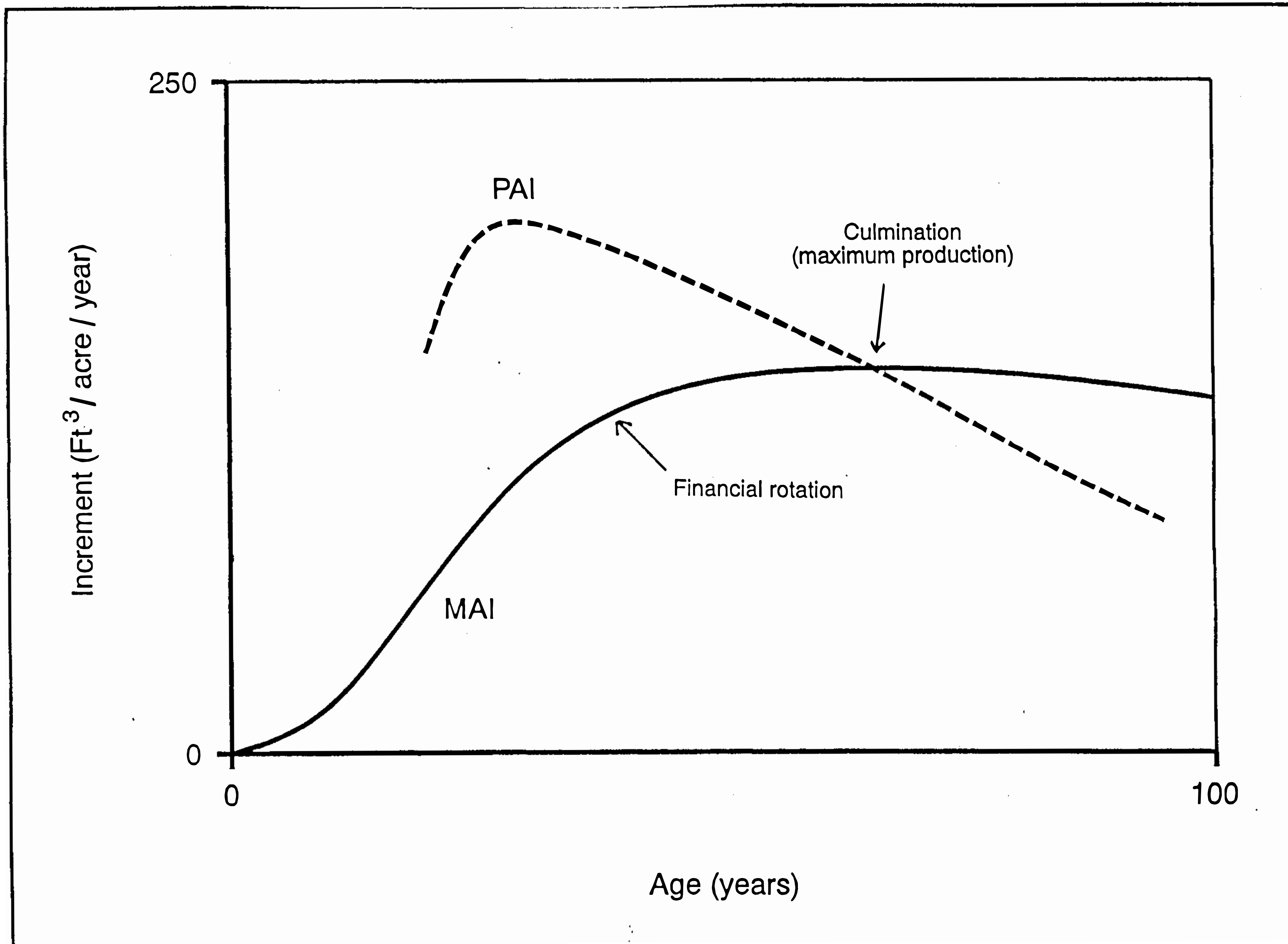

Figure 2--Mean annual increment curves generated by several simulators for a site III stand precommercially thinned to 355 stems per acre, with repeated later commercial thinning.

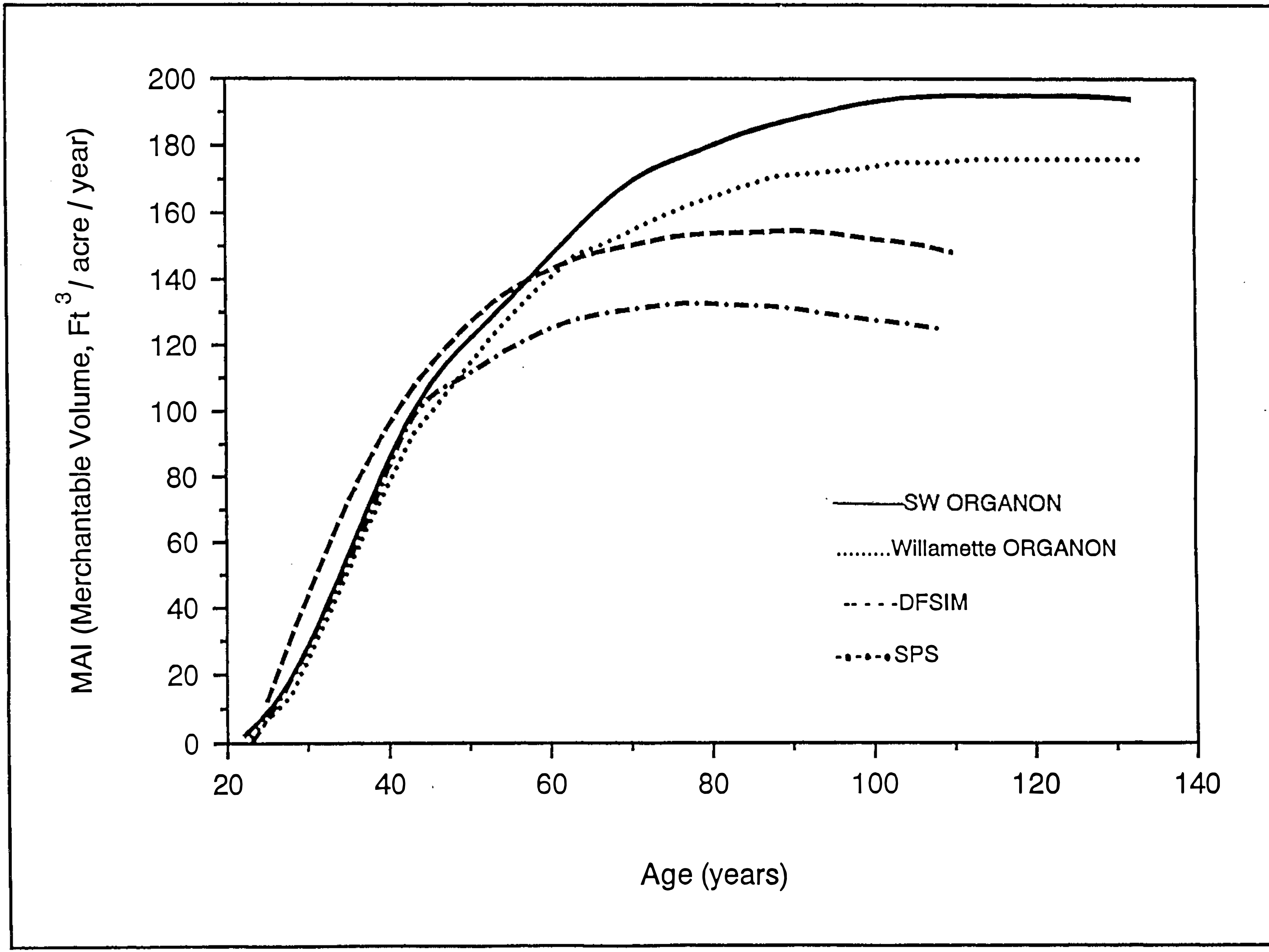

Figure 3--Observed mean annual increments on thinned and unthinned plots in the Mt. Walker thinning study.

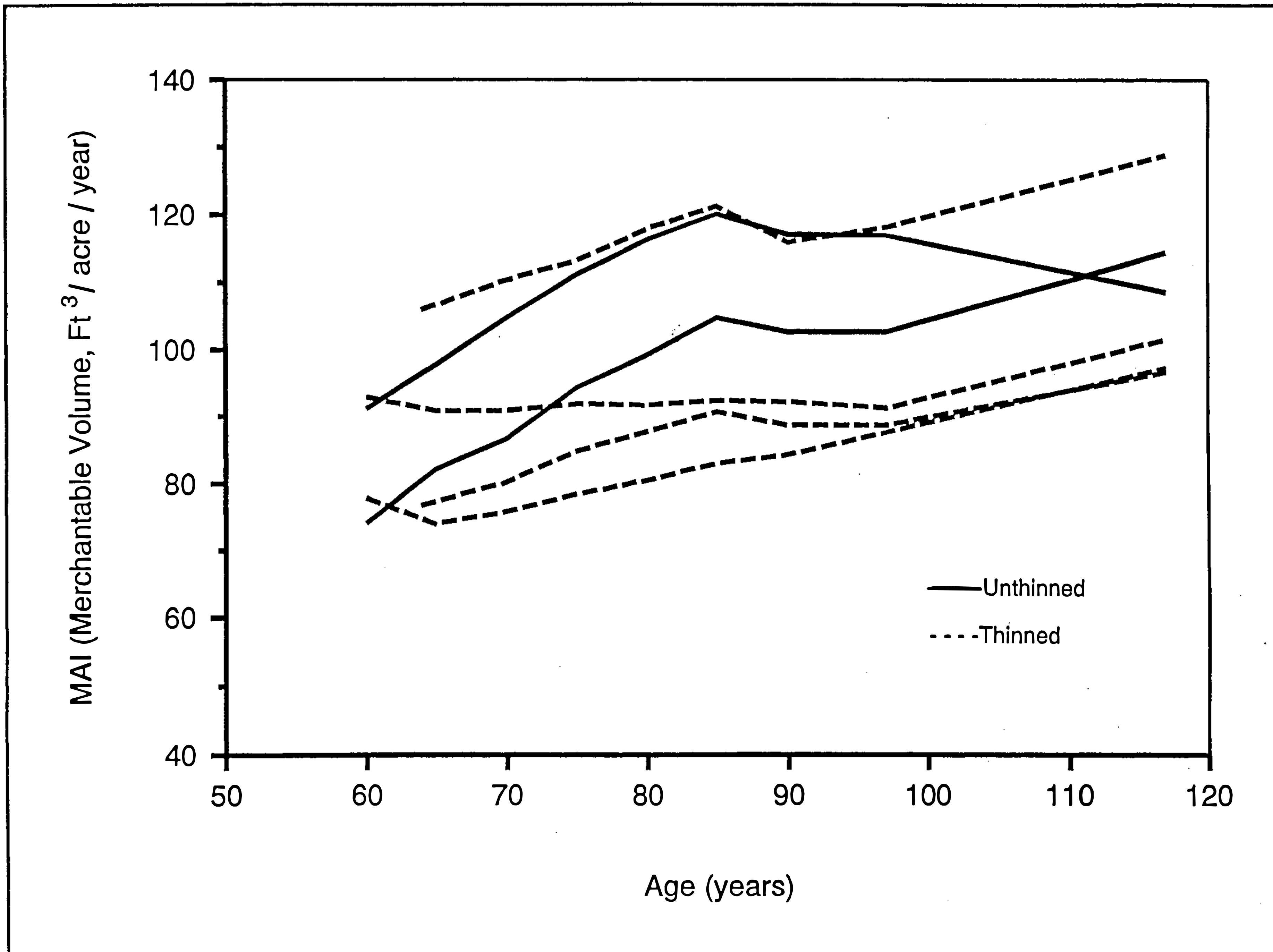

Figure 4--Mean annual and periodic annual increments of a site II stand after heavy thinning at age 48.