

NATIONAL FOREST SYSTEM WORKING CIRCLES: A question of size and ownership composition

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Changes in the size of working circles, or planning units, have been a traditional element in the management of the National Forests. Thirty years ago, the average working circle was the size of a National Forest ranger district. The present size of a working circle often coincides with that of a National Forest (Teeguarden 1974). This change over time has occurred in the absence of a stated rationale concerning the size of the working circle. Rather, it has taken place in response to changes in the technological and economic environment of timber production. As timber processing facilities have shifted and consolidated, the supply areas for stumpage flowing into mills have expanded. Similarly, technological improvements reducing transportation and processing costs have provided most wood processors a geographically wider range of suppliers.

As working circles beyond the size of a single National Forest have recently been considered, increasing attention is being given to the possibility of using the size of the working circles as a policy instrument. For the size of working circles to be considered a policy variable, analysis is required of the probable economic and political consequences. One consequence would be the effect on both the timber supply and the stability of local economies.

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FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE
P.O. BOX 245, BERKELEY, CALIFORNIA 94701

USDA FOREST SERVICE
GENERAL TECHNICAL
REPORT PSW- 16 /1976

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1976. National forest system working circles: A question of size and ownership composition. USDA Forest Serv. Gen. Tech. Rep. PSW-16, 8 p., illus. Pacific Southwest Forest and Range Exp Stn., Berkeley, Calif.

Allowable-cut (potential yield) levels on National Forest land are determined for planning units called working circles. The size of working circles has been increased over the past 30 years to the present scale which is often coincident with National Forest boundaries. Larger working circles have recently been considered because of the anticipated impacts on timber supply. A larger total potential yield could result from larger working circles. Alternatives for expansion of working circles must be assessed in light of present Forest Service timber management policy and the impacts of timber supply. These alternates include (a) combination of National Forests, (b) multi-ownership units, and (c) regional planning units. Present policy serves to limit the feasibility of larger working circles. Feasible alternatives would require a change in basic management policy.

Oxford: 615:624.1

Retrieval Terms: allowable-cut effect; decisionmaking; National Forest System; timber management policy; working circles.

Greater timber supplies may result from larger working circles because of the nature of the volume regulation constraints applied to a planning unit. As noted by Bell,¹ Forest Service planners have observed that a forest managed under some form of volume control with flow constraints may show a synergistic increase in the potential yield (allowable cut) when the landbases for the calculation (i.e., working circles) are combined. This phenomenon has been labeled by Schweitzer, Sassaman, and Schallau (1972) as the allowable-cut effect (ACE) and by Teeguarden (1973) as the timber inventory effect (TIE). Regardless of the name, one effect from enlarged working circles could be an increase in the allowable cut.

Larger working circles may also have repercussions on the economic stability of local communities. The economic viability of local communities has been a traditional concern and goal of Forest Service timber-management policies (U.S. Forest Service 1970). But the traditional orientation toward community-level economic stability has been questioned in recent years. Larger working circles may be consistent with recent interpretations of economic stability.

TIMBER SUPPLY

Many small timber processors in the Western United States have exhausted their own growing stocks and are becoming increasingly dependent upon Forest Service timber for their economic survival. Because of its responsibility for the welfare of local communities, and the pressure exerted by some industry factions, the Forest Service must seriously consider higher levels of cut from western National Forests as a policy alternative. Larger working circles would allow the Forest Service to harvest an increased flow of stumpage from the National Forests without deviating from the nondeclining even-flow policy. Thus, increasing the size of working circles could be considered as one administratively expedient means to increase the flow of stumpage from western National Forests. For an allowable-cut effect to be realized, however, several assumptions must be satisfied:

1. The cut is determined with volume regulation under sustained yield.
2. Allowable-cut determination is, at least in part, a function of the growth rates of the stands in the working circle.

¹ Bell, Enoch. 1975. *Timber harvesting policy issue report, effect of size of planning unit on allowable cut*. (Unpublished report, on file at Pacific Northwest Experiment Station, U.S. Forest Service, Portland, Oreg.)

3. Flow constraints are imposed on the allowable-cut determination. The more binding the constraints, the greater the allowable-cut effect, other factors being equal, e.g., even-flow will result in the largest ACE.

4. An existing reserve of mature timber is available within the augmented working circle.

All of these assumptions are satisfied on the western National Forests. This is no coincidence since ACE evolved as an investment guide for National Forest timber management in the Western United States.

The key to ACE lies in the productivity of the stands in the component land units, as reflected through the stand inventories (age-acre arrays). Roughly speaking, the greater the disparity in age-class distribution between the stands, the greater the potential allowable-cut effect. Under any type of volume regulation, the allowable cut may be increased by combining young, fast-growing stands with old-growth, slow-growing stands. The old-growth and young-growth stands complement each other when combined. As the age-class distribution is always improved through combining land units, if only minimally, ACE is theoretically always positive. But in similar stands, the allowable-cut effect of combining them may be negligible.

This so-called allowable-cut effect is not a biological phenomenon. Rather, it is due to the constrained nature of the harvest scheduling problem under even-flow, and to a lesser degree under less stringent flow constraints.

ECONOMIC STABILITY

Concern for the economic stability of timber-dependent communities first evolved from the era of "cut out and get out" harvesting and was formalized in spirit through the Sustained Yield Act of 1944. To date, the orientation toward stabilizing individual communities built around a central conversion/processing facility has not changed. But the socio-economic structure of most timber-based communities has significantly changed. The danger of communities stranded in the wake of transient timber industry no longer exists as it did in the early 1900's.

Some economists have argued that it is no longer appropriate to view economic stability in terms of individual communities (Schallau 1974). Regional economic stability may be better served through a reallocation of resources that could entail the shifting of entire communities. This approach would be a significant departure from the present Forest Service policy.

In addition, the use of a sustained or even-flow of stumpage to insure economic stability has been questioned. Kromm (1972) points out that an even-flow of raw material into processing facilities cannot insure economic stability (i.e., community employment) because of such factors as increased mechanization and worker productivity. Empirical work by Schallau, Maki, and Beuter (1969) supports this contention. They project that some timber-dependent communities in the Douglas-fir region will experience depopulation even with an increased harvest rate from National Forests.

Larger working circles might be more rational under the alternative orientation to economic stability. The stability of a subregion, rather than of an individual community, could be promoted more efficiently if the entire land base were managed in a single working circle. Teegarden (1974) suggests that larger working circles would also reduce the importance of maintaining an even flow of timber because of the increased diversity in the economic system of a larger geographic area.

In spite of the arguments for an alternative interpretation of economic stability, possible frameworks for expanding working circles must be assessed in terms of their impacts on stability, as currently interpreted by the Forest Service. One argument for a continued orientation toward individual community stability is the potentially high political costs of abandoning that policy. That a phasing out of a community is economically efficient from a regional point of view would not appease the people adversely affected.

ALTERNATIVES

The even-flow, nondeclining yield policy currently in effect on the National Forests serves to limit the number of feasible alternatives for expanding the size of the working circle. Even-flow nondeclining yield, as currently interpreted, requires that the allowable-cut levels not fall over time. The impact of this constraint depends on the age-class characteristics of the stands. Because of the abundance of old growth in the western National Forests, the even-flow policy acts as an upper constraint on the present allowable-cut level. To insure that future allowable-cut levels will not decrease when the old-growth is exhausted, the cut level for the present and next several decades must be suppressed below the silvicultural and economic optimal level. This projected drop in allowable harvests is known as the *allowable-cut falldown*.

Given this policy, a primary concern of National

Forest planners is to insure that a future falldown in cut levels does not occur. The necessity of insuring against a falldown is the key factor in limiting the number of feasible alternatives for increasing the size of the working circle.

Logically, an alternative is acceptable in terms of the even-flow premise if at least one of these two conditions is met: (a) The Forest Service has direct control over the inter-temporal scheduling of the harvest; or (b) in the absence of direct Forest Service control, the harvests from the working circle timber base can be expected to flow at a nonerratic, if not even, rate.

Alternative 1

Combinations of National Forests

Under the requirements generated by the even-flow policy, an obvious alternative for the expansion of working circles is to combine National Forest lands. Complete control over the scheduling process would be maintained and an even-flow harvest could be assured. Since no other land ownerships would be involved, the administrative costs of enlarging the working circle would be lower than those for expansion involving other ownerships.

Preliminary studies have been made in which trial allowable-cut levels were calculated for units comprised of several National Forests. In these tests, Timber RAM—a resource allocation model—was used to determine the allowable cut (Navon 1971). Varied allowable-cut effects have been observed. Price² combined the Klamath, Six Rivers, Umpqua, and Rogue River National Forests. He found that in the first decade, the allowable-cut effect exceeded 20 percent, but the effect was much smaller in subsequent decades. Bell¹ reported that an allowable-cut effect of 1.5 percent in the first decade was realized when the east- and west-side working circles of the Mt. Hood National Forest were combined. Navon³ found a 7.5 percent allowable-cut effect when he combined seven National Forests in northern California. Simonson⁴ combined the Malheur, Umatilla, and Wallowa-Whitman National Forests in Oregon

² Price, Frank. 1973. *Forest regulation study*. (Unpublished report, on file at Pacific Northwest Region, U.S. Forest Service, Portland, Oreg.)

³ Navon, Daniel. 1970. (Unpublished data, on file at Pacific Southwest Forest and Range Experiment Station, U.S. Forest Service, Berkeley, Calif.)

⁴ Simonson, J. 1974. (Unpublished data, on file at Pacific Northwest Region, U. S. Forest Service, Portland, Oreg.)

and estimated that the allowable cut for the aggregate unit was only 1 percent over the sum of the three individual allowable-cut levels for the first decade.

The generally insignificant allowable-cut effects may be explained by the nature of the comparative stand structures of the National Forests studied. With some exceptions, National Forests in the three Pacific Coast States show a predominance of old growth with insufficient level of young growth. The growth potential, as reflected through the age-acre arrays, of the National Forests is roughly equivalent. The magnitude of the allowable-cut effect is a function of the degree of similarity in stand composition of the component land units. Component land units with similar age-acre arrays, such as the western National Forests, tend to yield insignificant allowable-cut effects when combined.

Alternative 1 is also inadequate for meeting the criterion of community stability. Concern to promote community stability (as presently defined by the Forest Service) may, in fact, be an argument against multi-forest working circles. Two factors contribute to the potential for community instability under Alternative 1: (a) the spatial (geographic) arrangement of the National Forests; and (b) the probable nature of harvest schedules for multi-forest working circles.

The preliminary analyses indicate that harvest schedules for multi-forest working circles will produce a cutting pattern that involves the sequential, rather than simultaneous, harvesting of merchantable timber from the component National Forests. Cutting activity would tend to be concentrated on one forest at a time (*table 1*). Harvest levels on Forests within a multi-forest working circle would be highly erratic (*fig. 1*). Fluctuations in harvest patterns could be dampened by imposing scheduling constraints. But in doing so, the increases in total programed allowable cut would be diminished.

Because a multi-forest working circle would likely involve a relatively large geographic area encompassing more than one timbershed, the resulting sequential harvesting pattern (or highly fluctuating pattern in terms of a single National Forest) could lead to a severe stress on community stability. The periodic, major shifts in harvesting activity could force local timber industries to close down or drastically reduce output when cutting activity shifted away from their locality in the working circle. The high transportation costs of hauling a long distance would prevent outlying processors from being competitive in the bidding for stumpage.

Costs from the shifting in cutting activity would

Table 1—First decade allowable-cut levels before and after combining

National Forest	Individual calculations ¹		Combined calculation ¹	
	Mm Cu Ft	Mm Bd Ft	Mm Cu Ft	Mm Bd Ft
Malheur	342.38	2248.65	479.13	3156.18
Willowa-Whitman	367.11	2169.97	158.43	830.88
Umatilla	313.97	1843.26	396.63	2397.18
Total	1023.46	6261.88	1034.19	6384.24

¹ Computed using a 12-decade conversion period.

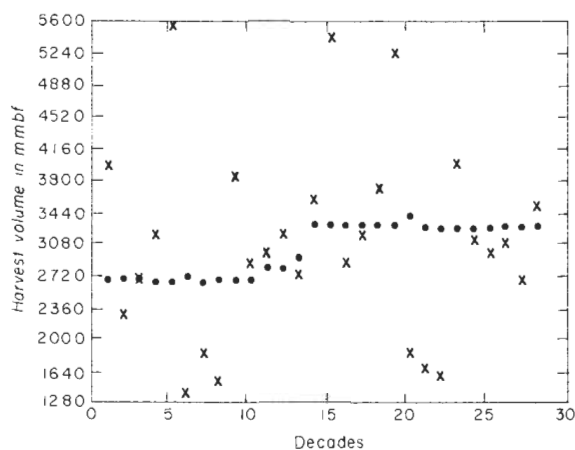


Figure 1—Hypothetical harvest schedules for the Klamath National Forest, California. • indicates allowable cut when the Klamath schedule is determined independently; x indicates allowable cut when the schedule is determined in conjunction with six other forests.

be realized in two manners. First, the economic base of many communities might be jeopardized when processing facilities are periodically forced to shut-down or reduce output. Second, shifts in cutting activity among component National Forests would force a rearrangement of Forest Service timber management personnel within the working circle. A normal timber management staff could not be justified on the National Forests during the years of little harvesting activity. In effect, the Forest Service would be adding to the "feast or famine" impact on dependent communities through its fluctuating personnel requirements.

Since funding for National Forests is, in part, a function of the level of harvest activities, shifts in these activities could jeopardize both nontimber management and timber investments. This would serve only to magnify an already existing problem of

deficiencies in the Forest Service funding process.⁵

The anticipated detrimental impacts of Alternative 1 outweigh the possible benefits. Costs incurred through community instability and budgetary disruptions could be significant. Benefits, in terms of an increased allowable cut, can be expected to be insignificant.

Alternative 2

Formal Multi-Ownership Working Circle

In recent years, multi-ownership units have again been proposed as a potential framework for timber management planning. Within the policy constraint of even-flow nondeclining yield, it seems likely that a formal and binding multi-ownership arrangement would be necessary. Without some form of contractual control over the timber harvest levels on non-National Forest land within the planning unit, even-flow, nondeclining yield could not reasonably be expected to be maintained.

Formal multi-ownership units were first proposed in the 1930's as a means to influence forest management practices on private lands (Adams 1952; Stevens 1958). In 1944, the efforts to impose Federal regulation culminated in the passage of Public Law 273—Sustained Yield Forest Management Act. The act empowered the Secretary of Agriculture to establish cooperative sustained yield units comprised of private and National Forest lands. The arrangement was designed to be mutually beneficial—management on the private land would be subject to Forest Service regulation and management standards, and the private landowners would have exclusive rights, at appraised price, to Forest Service timber sales within the unit.

Several cooperative sustained yield units in several Western States were proposed, but only one of the proposals survived the public hearing process required by law. Primarily, the criticism of cooperative units came from timber processors who claimed that such arrangements would create an unfair advantage (in terms of supply security) for the firms under the agreement. Small sawmill operators who owned no land also felt discriminated against because they were automatically precluded from entering into a cooperative arrangement. Communities near the proposed

cooperative units contended that the exclusionary effects of such units would jeopardize their economic well being by virtually drying up the source of stumpage for the sawmills that served as the primary source of employment.

The Shelton Cooperative Sustained Yield Unit, created in 1946, brought under joint management 111,000 acres of the Olympic National Forest and 226,000 acres of industrial forest land owned by the Simpson Timber Company in northwest Washington. The Federal land was predominantly old-growth and the Simpson land was essentially cutover. Simpson would have faced certain shutdown of mills in the area without the additional stumpage provided by the agreement.⁶

The joint annual allowable cut was eventually set at 135 million board feet. Mason and Henze (1959) point out that the annual allowable-cut levels on the National Forest and Simpson lands, if calculated independently, would have been 60 and 30 million board feet, respectively. The creation of the Shelton Unit generated an allowable-cut effect of 50 percent.

Criticism centering on the issues of equity and government regulation eventually served to cancel further consideration of cooperative sustained yield units. In spite of the potentially significant increases in allowable cut from this type of formal arrangement, there is no reason to assume that cooperative units would receive a more favorable public reaction than they did 25 years ago.⁷ It is unlikely that a private timber company willing to enter into such an arrangement could be found. In contrast to Alternative 1, the positive effects (in terms of allowable cut) of Alternative 2 would be significant, but the framework is neither socially acceptable nor politically feasible.

Alternative 3

Regional Planning Units

An alternative to larger working circles within the even-flow constraint is to establish regional planning units based on an informal multi-ownership administration. Regional planning units would be delineated by criteria, such as biological zones or government boundaries. For instance, a logical planning unit

⁵ Zivnuska, John. 1974. *Forestry investments for multiple uses among multiple ownerships types*. (Unpublished paper, on file at Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.) Worthington, Richard. 1975. *Some sustained yield issues*. (Unpublished paper, on file at Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.)

⁶ Adams, Thomas C. 1952. *Cooperative and federal sustained yield units—a problem in resource management*. (Unpublished Ph.D. dissertation, on file at University of Michigan, Ann Arbor.)

⁷ Personal communication with David Cox, Industrial Forestry Association, and with Russ Fredsell, Western Wood Products Association.

could be the Douglas-fir region of northern California.

Rather than an even-flow, nondeclining yield, National Forest harvests would contribute a planned proportion of the total cut from a planning unit. Planning of the cut could be on a 10-year basis, updated every 5 years. The process of determining the proportion of total cut contributed by the National Forests would combine inventory and productivity appraisal, market assessment, and political negotiation. On the basis of forecasts of private sector harvest activity, yield potential on National Forest land, and forecasts of demand, the Forest Service would propose the proportion of cut from its land within the planning unit for the next 10 years. Public response would be invited on the initial proposal. The Forest Service would then negotiate with the timber industry and municipalities within the planning unit to determine a mutually-acceptable harvest proportion.

Forest Service timber-management decisionmaking currently operates within this framework—in effect if not in design. While the even-flow constraint implies a rather rigid management position in theory, flexibility in Forest Service decisionmaking exists in response to case-specific circumstances. Regional planning units administered on an informal multi-ownership basis would explicitly incorporate flexibility and responsiveness to regional circumstances. In terms of timber supply, total harvests probably would increase because of the absence of an even-flow constraint and the high demand for stumpage.

The concept of informal regional planning units suffers from at least three significant weaknesses:

1. Difficulty in forecasting private sector harvest activity. Without direct control over private sector harvest activity, the Forest Service must rely on forecasts to determine the appropriate proportion of National Forest harvests. Accurate forecasting of private sector harvest activities has traditionally been a difficult if not unsuccessful task.

2. Socially inequitable distribution of risk. Given a multi-ownership land base and the absence of an even-flow constraint, timber management theory requires that the western National Forests supply most of the harvested timber until the old-growth is liquidated. Less timber would be scheduled for harvest from the industrial forests until they are restocked and reach maturity. The public, through the Forest Service, would be the dominant risk-taker, in terms of the available timber supply, after the National Forest old-growth is liquidated. There would be no assurances that industrial lands would be

adequately restocked, managed, and harvested during years when National Forests lacked enough merchantable timber.

3. Limited public acceptability of programed negotiation with the timber industry. An informal arrangement calling for a closer relationship between the Forest Service and the timber industry may meet considerable resistance on the part of environmentalists and other nontimber interest groups. Public acceptance of such an arrangement would probably be enhanced by provisions insuring adequate representation of nontimber viewpoints in the negotiation process.

Teeguarden (1974) discussed a formal regional planning framework first proposed by the National Academy of Sciences. The proposal is to establish public corporations to function as regional forest management agencies. Leased or contracted private land and public land would be managed under a coordinated planning-budgeting system. Allowable cuts would be determined on a multi-ownership land base so the total cut could be expected to be higher.

The proposal has advantages as well as disadvantages. Direct control of private sector harvest activities can be exercised, but program costs of leasing lands and establishing a public agency could be high. Other limitations include the complexities of resource regulation by a superagency with authority overlapping that of other agencies, and the trend toward centralized government planning.

AN ACE APPROACH TO OPTIMAL WORKING CIRCLES

An orderly, efficient transition to a new system of working circles depends upon the establishment of a criterion of optimality. A criterion that defines the optimum size of working circles, on a case by case basis, provides a rationale for change. In the absence of a definitive rationale, the determination of the size of a working circle reduces to an undirected response to external pressures and circumstances.

Alternatives 1 and 2 are oriented toward the capture of the allowable-cut effect as a motivation for larger working circles. With this orientation, a logical criterion for optimality is the maximization of the cumulative ACE subject to appropriate constraint considerations. Initially, the entire National Forest timber production land base must be delineated into a set of land units according to criteria such as stand composition. If not operating under Alternative 1, non-National Forest land would be included in the land base.

The objective is to partition the set of land units in such a manner as to maximize the total allowable cut (i.e., maximize the cumulative ACE) subject to constraints. The optimal partition defines the boundaries of the optimal set of working circles. A single working circle consists of one or more land units. The optimal partition must be defined such that no working circle boundaries overlap and the sum of all working circles is equal to the total of all land units.

Consistent with the traditional concept of working circles as planning units based around a marketing center (i.e., central processing facility and product distribution point), a requirement of the optimal partition must be that at least one marketing center be located in each working circle. Designation of all marketing centers within the total landbase reduces the number of feasible partitions. Other considerations influencing the optimal solution could include cost limits and supply requirements. Additional constraints serve to further limit the number of feasible partitions.

The most apparent attribute of this approach is that it would ascribe a more rational method to the gerrymandering of working circles under Alternatives 1 and 2. This approach would also maximize the allowable cut for the National Forests within the limits established by present timber management policies (i.e., even-flow). But this may not be considered meritorious by those who feel that Forest Service timber-management policies should be altered. But it must be construed as a least-resistance alternative from the point of view of Forest Service planners. The ACE approach suffers from the same shortcoming as Alternatives 1 and 2; it attempts to maximize allowable-cut levels by capitalizing on a harvest flow constraint (even-flow) that serves to hold down cut levels in the first place. It is a process of inherent suboptimization.

CONCLUSIONS

Further increases in the size of working circles would require a significant departure from present Forest Service timber-management policy. Present policy, as exemplified by even-flow, nondeclining yield, has a paradoxical impact on the issue of larger working circles. Although the primary justification for larger working circles—allowable-cut effect—is peculiar to present policy, requirements necessary to maintain even-flow make the timber supply effects virtually unattainable. Present policy could be maintained under Alternative 1, but the increase in timber

supply would be insignificant. Under Alternative 2, the potential impact on timber supply could be highly significant, but the contractual arrangements necessary to maintain present policy make the alternative infeasible. Harvest-level fluctuations brought on by larger working circles could foster instability in timber-dependent communities.

The Forest Service can either discontinue further consideration of changes in the present working circles structure, or it can alter present policy to enhance the feasibility of alternatives. The abandonment of both even-flow and the orientation toward community-level economic stability give rise to consideration of multi-ownership regional level planning units. Under a regional format, potential yield levels could be expected to be higher even though ACE would no longer be operating. A more drastic departure from present policy would involve the abandonment of the biological approach to timber management exemplified by the traditional sustained-yield format. Some economists⁸ have proposed replacing the biological approach with an economic approach.

In determining which option to pursue, the major consideration must be the cost of abandoning present timber-management policies. To date, the Forest Service has felt the costs to be restrictively high. An additional consideration is that, while there exists a theoretical potential for an increased allowable cut through alternative planning unit arrangements, the magnitude is mitigated by factors not previously considered. Western National Forests are indeed a virtual depository of old-growth, but accessibility to this stumpage is reduced by several obstacles. Limitations imposed by appropriated budgets have kept the actual harvest levels below the allowable levels. Given the present status of the National Forest road network and the costs of alternative transportation systems (i.e., helicopter logging), some old-growth stands will not be physically accessible for years. Accessibility is further reduced by land-use zoning. The timber production landbase is steadily declining as pressures increase to create wilderness and recreation areas. Other blocks of productive lands are being removed because of ecological or environmental restrictions. The net impact of these barriers is that increased harvests may be more a theoretical possibility than a field-level certainty.

⁸ Ledyard, John, and Leon Moses. 1975. *Dynamics and land-use: the case for forestry*. (Unpublished report, on file at Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.)

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