Temperate Mountain Forests: Common-Pool Resources with Changing, Multiple Outputs for Changing Communities

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Originally published in NATURAL RESOURCES JOURNAL
30 NAT. RESOURCES J. 685 (1990)

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ABSTRACT

This paper broadens the concept of common-pool resources with reference to forests, which supply many joint products whose relative importance to different communities has changed over time. Case studies refer to forests in the Swiss Alps and Colorado Rocky Mountains. For each region, two levels of analysis are developed. These concentrate on outputs of wood, recreation and protection from natural hazards, and consider: 1) policy development for the two regions and a study area within each; and 2) the changing supply of forest outputs from the study areas within the context of changing policies and demands on the forests.

INTRODUCTION

One of the principal frameworks for research into resource management systems is based on the concept of common-pool resources.[1] This concept is roughly equivalent to, and has been used interchangeably with, those of common-property resources[2] and commons.[3] The literature discussing the management of common-pool resources began with papers consid-

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**The author would like to thank Kathleen Miller, Raymond Prince, Franz Schmithüsen, Anthony Scott, and Roger Sedjo for their helpful comments and suggestions on a draft of this paper. This research was supported in part by the Swiss Man and the Biosphere Program, the U.S. National Science Foundation, the University of Colorado, and the Colorado Mountain Club Foundation.

1. Ostrom, *Issues of Definition and Theory: Some Conclusions and Hypotheses*, Proceedings of the Conference on Common-Property Management 599 (1986) (Board of Science and Technology for International Development). Ostrom defines a common-pool resource as "a natural or man-made facility that produces a flow of use units per unit of time (or several flows of different types of use units) where exclusion from the resource is difficult or costly to achieve and the resource can potentially be utilized by more than one individual or agent simultaneously or sequentially." *Id.* at 604.

2. *See* Ciriacy-Wantrup & Bishop, *"Common Property" as a Concept in Natural Resources Policy*, 15 Nat. Res. J. 713 (1975), who make the important distinction between a common-property resource (*res communes*), where a number of owners are co-equal in their rights to use a resource, and an unowned, or open-access, resource (*res nullius*).

3. *See* McCay and Acheson, *Human Ecology of the Commons*, in The Question of the Commons (B. McCay & J. Acheson eds. 1987).

ering fisheries in the mid-1950s.[4] However, the concept was not widely used until the publication of Hardin's "The Tragedy of the Commons."[5] Hardin's theme was that a pasture, available to all members of a community for grazing their livestock would, in the absence of enforced rules defining grazing rights, inevitably become exhausted as a result of population pressure. Though Hardin emphasized only one facet of the management of common-pool resources, and his idea was not new,[6] it rapidly gained wide success.

By 1979, Hardin's idea of tragedy was described as "the dominant framework within which social scientists portray environmental and resource issues."[7] It has formed the basis for a vast amount of research and discussion, much of which has questioned the theory's validity for resource management.[8] In addition to fisheries and pastures, other resources analyzed as common-pool have included forests, parks, groundwater supplies, public highways, oilfields, and wildlife,[9] genetic resources,[10] outer space, the oceans, weather and climate, Antarctica,[11] the radio spectrum, and geosynchronous orbits.[12]

In the substantial literature on common-pool resources which now exists,[13] such resources are generally treated as having one or very few outputs supplied to a well-defined community. An example is the fishery, where one marketable species is studied and the community is that of local fishermen. However, each species of fish occupies a specific niche in an ecosystem—or many ecosystems if it migrates or lives in the littoral zone—so that population changes will necessarily affect other species in the food and decomposition chains.[14] Loss of a species, or even a local population, results in the irreversible loss of genetic information. Equally,

4. Gordon, *The Economic Theory of a Common-Property Resource: The Fishery*, 62 J. Pol. Econ. 124 (1954); Scott, *The Fishery: The Objective of Sole Ownership*, 63 J. Pol. Econ. 116 (1955).

5. Hardin, *The Tragedy of the Commons*, 162 Sci. 1243 (1968).

6. G. Baden & J. Hardin, Managing the Commons, Preface (G. Hardin & J. Baden eds. 1977).

7. Godwin & Shepard, *Forcing Squares, Triangles and Ellipses into a Circular Paradigm: The Use of the Commons Dilemma in Examining the Allocation of Common Resources*, 32 W. Pol. Q. 265 (1979).

8. Board of Science and Technology for International Development, Proceedings of the Conference on Common-Property Management (1986) [hereinafter BOSTID]; B. McCay & J. Acheson, The Question of the Commons, *supra* note 3; Berkes, Feeny, McCay, & Acheson, *The Benefits of the Commons*, 340 Nature 91 (1989).

9. *See* BOSTID, *supra* note 8, at 13; Oakerson, *A Model for the Analysis of Common Property Problems*, Proceedings of the Conference on Common-Property Management, *supra* note 1.

10. Sedjo, *Property Rights and the Protection of Plant Genetic Resources*, in Seeds and Sovereignty 293-314 (J. Kloppenburg ed. 1988).

11. The Global Commons (H. Cleveland and L. Burdette eds. 1988).

12. Soroos, *The Commons in the Sky: The Radio Spectrum and Geosynchronous Orbit as Issues in Global Policy*, 36 Int'l Org. 665 (1982).

13. F. Martin, Common Pool Resources and Collective Action: A Bibliography (1989).

14. *See* Regier & Baskerville, *Sustainable Development of Regional Ecosystems Degraded by Exploitive Development*, in Sustainable Development of the Biosphere 86-93 (W. Clark & R. Munn eds. 1986).

loss of marketable fish species may well lead to the decline of a fishing village, whose inhabitants will tend to look to the larger national community for assistance for their continued survival.

The treatment of common-pool resources as providing limited outputs to well-defined communities undoubtedly simplifies analysis and modelling.[15] However, the use of every resource is ecologically and economically tied to the use of other resources, so that no resource should be regarded in isolation. In addition, historical changes in the relative importance of a resource's joint products[16] are ignored. These products may continue to be supplied to an easily-defined community over long periods of time.[17] Alternatively, the community of users may change over time and vary between outputs. The objective of this paper is to broaden the concept of common-pool resources with reference to temperate mountain forests,[18] which supply many joint products whose relative importance to many communities has changed over time. The case studies are drawn from the forests of two temperate mountain regions, the Alps and the Rocky Mountains.

JOINT PRODUCTS FROM TEMPERATE MOUNTAIN FORESTS

Temperate mountain forests provide a wide range of outputs, which are summarized in Table 1. These joint products may be classified as private (market), impure public, and pure public goods. The classification depends on two factors: the ability to provide values for these goods in real or simulated markets, and the size of community which can benefit from their use. These factors are highly variable so that, in reality, the values of forest outputs to different communities should be placed along a continuum, rather than in the discrete categories shown in Table 1.

Many forest outputs are market goods[19] such as timber, forage, Christmas trees, and other tree products. Forage from shrubs, forbs, and grasses can be valued in terms of the value added to grazing animals.[20] Similarly,

15. *See* Haveman, *Common Property, Congestion, and Environmental Pollution*, 87 Q. J. Econ. 278 (1973); Muhsam, *An Algebraic Theory of the Commons*, 1-2 J. Peace Res. 97 (1973); C. Howe, Natural Resource Economics (1979); Runge, *Common Property and Collective Action in Economic Development*, in BOSTID, *supra* note 8; Ostrom, *supra* note 1, Townsend & Wilson, An Economic View of the Commons, in The Question of the Commons, *supra* note 3.

16. R. Cornes & T. Sandler, The Theory of Externalities, Public Goods, and Club Goods (1986).

17. *See* R. Netting, Balancing on an Alp (1981); BOSTID, *supra* note 8; B. McCay & J.Acheson, *supra* note 3.

18. The temperate zone includes the mid latitudes between the tropics and the Arctic and Antarctic Circles. Hence, temperate mountain ranges include the Rocky Mountains, the Alps, the Caucasus, the Pyrenees, the Carpathians, the southern Andes, and the southern Alps.

19. Market goods are those sold in commercial markets at prices determined by the interaction of supply and demand.

20. In this case, value added refers to the incremental increase in the commercial price of animals which derives from their increased weight, a result of eating forage.

TABLE 1.
Classification of Joint Products of Forests

OUTPUT	TYPE OF GOOD		
	PRIVATE (MARKET)	IMPURE PUBLIC	PURE PUBLIC
ECOSYSTEM DIVERSITY			Option/ existence
FISH	As input to economy (sold)	Recreational use	
FORAGE	Grazing permits sold on open market	Community use (Local public good)	
GAME	As input to economy (sold)	Recreational use	
GENETIC DIVERSITY			Option/ existence
HAZARD PROTECTION		Individuals' life, property, safety	Public land, facilities
LANDSCAPE		Limited access viewpoints	Public access viewpoints
RECREATION	Developed: ski areas, private campgrounds, etc.	Undeveloped: trails, campsites, picnic areas	
WATER QUALITY	Industrial, municipal, domestic use	Recreational use	Perception
WATER QUANTITY	Industrial, irrigation, municipal use	Recreational use (type of craft)	Perception
WILDERNESS		Perceived environment for recreation	Existence value
WOOD	Sold on market: stumpage fees, market products	Community use (Local public good)	Long-term security of supply

the water used for irrigation can be valued in terms of the value added through increased crop yields. Game animals and fish may also be valued in terms of their contribution to the economy as a source of food. Finally, the use of developed recreational facilities, such as ski areas or private campgrounds, takes place within the market economy.

Many of the joint products of forests cannot be valued in the marketplace; they are non-market goods. In addition, some of the outputs mentioned above display non-market characteristics, and their value in real

markets may be changed by various types of market intervention, such as taxes and subsidies. These goods, found at the other end of the spectrum from market goods, are pure public goods. Pure public goods are those for which each individual's consumption has no effect on any other individual's consumption.[21] A number of forest outputs fall into this category. One instance is protection from fires, floods, or avalanches, which exemplifies the fact that the avoidance of a public bad, such as the destruction of property by an avalanche, is a public good. Another public good is the value of knowing that a particular forest landscape, wilderness area, or clean, free-flowing stream exists.[22] In this case, as with the value of preserving a landscape or the gene pool of a forest ecosystem, consumers do not have to be present in either space or time to derive benefits. An option value[23] is associated with the preservation of a resource for future benefits, whether known or unknown.

Between market goods and pure public goods are a wide range of other goods, whose characteristics have recently been summarized by Cornes and Sandler.[24] These may be described as impure public goods. The characteristics of such outputs are that their benefits are partially rival, partially excludable, or both. These concepts are best described with reference to the example of the use of forests for recreation and as wilderness. Up to a certain level of use, the benefits of use are equal for all consumers. However, beyond this level, one or more individuals perceive that congestion is occurring, meaning that the social carrying capacity[25] has been reached. Thus, one person's use affects another's use (rival benefits). To avoid congestion, fees or permits can be used to limit use (excludable benefits).[26] Most forest outputs, in some sense, are impure public goods, including water quantity, which may limit the use of a river to certain types of craft, landscapes which can be viewed only from viewpoints with limited access, and hazard protection which benefits individuals' lives, safety, and property rather than public facilities.

Exclusion can also be a function of the scale at which benefits occur, in which case the output is a local public good. One example is the use

21. Samuelson, *The Pure Theory of Public Expenditure*, 4 Rev. Econ. Statistics 387 (1954).

22. Existence value; *see* J. Krutilla & A. Fisher, The Economics of Natural Environments (2d. ed. 1985).

23. *Id.* Option value refers to the value of the possibility of realizing benefits at some time in the future. For instance, if a land owner makes a decision to undertake an action that results in irreversible loss of outputs, the option value of these outputs has been lost. An example is the decision to log an area of forest, resulting in the loss of associated outputs, such as landscape and ecosystem and genetic diversity.

24. R. Cornes & T. Sandler, *supra* note 16.

25. Heberlein, *Density, Crowding and Satisfaction*, in Proceedings of River Recreation Management and Research Symposium (USDA Forest Service General Technical Report NC-28, 1977).

26. Exclusion may be accomplished directly, for instance by the price of permits or membership fees, or randomly, for instance through the use of a lottery.

of a forest for timber by members of a specific community, in contrast to use by the highest bidder in a market situation. In the latter case, the forest would supply a private good, with an economic value determined in the marketplace. In the former case, it is very difficult to put such a value on the output. At the smallest spatial scale, the availability of a public good may be reflected in private values. One example would be a privately owned hunting and fishing lodge on an unpolluted stream, adjacent to a wilderness area, and protected by public hazard protection programs. The value of this property would clearly reflect the local, joint availability of these public goods.

This brief summary, drawn primarily from the literature of microeconomics, provides the theoretical basis of the paper, and shows some of the complexities of defining the comparative values of forest outputs in order to make forest management decisions. The following section describes the paper's analytical framework and introduces the three forest outputs chosen for detailed study within this framework.

ANALYTICAL FRAMEWORK

The case studies in this paper are drawn from the forests of the Swiss Alps and the Colorado Rocky Mountains. For each region, the supply of joint products from these forests are analyzed in two ways. First, the development of policies for the forests of the region as a whole and for a study area within each region is analyzed. Second, the changing supply of forest outputs from each study area, within the context of changing policies and demands on the forests, is considered. As each region exhibits a considerable diversity of physical conditions and human history, the study areas cannot be said to be representative in terms of these characteristics. Rather, each area was chosen because its history displays many characteristics typical of the region and, furthermore, good documentation was available.[27]

Particular emphasis is placed on three outputs—wood, recreation, and protection from natural hazards. Each was chosen to represent one of the three classes shown in Table 1, and was identified in policy and practice as important during the period considered in this paper.[28] Wood was chosen as an example of a market good, recreation as an impure public good, and protection (from natural hazards and of watersheds) as a pure public good.

27. M. Price, Mountain Forests as Common-Property Resources: Management Policies and Their Outcomes in the Colorado Rockies and the Swiss Alps (1988) (unpublished Ph.D. thesis in the library of the University of Colorado, Boulder).

28. The period of study extends to the present, and as far back as records are available: from the early sixteenth century in Switzerland, and from the mid-nineteenth century in Colorado.

CASE STUDIES

Swiss Alps

The Swiss study area is the Aletsch test area, selected for research within the Swiss Man and the Biosphere program.[29] It is comprised of 12 communes in the Canton of Valais, on the north side of the Rhone, and just west of its headwaters. The communes own 72 percent of the forest area; the remainder is privately owned. Forests were central within the traditional Swiss mountain economy, providing wood for fuel (usually the primary use), construction, all aspects of agriculture, and fodder for grazing animals.[30]

The designation of the communal forests early in this millenium clearly identified them as common-pool resources, to which all members of the commune had usufructuary rights. However, from 1515 onwards, communal orders were made to limit the uses of these forests.[31] The reason for these, as for similar orders in other parts of Switzerland, was to ensure a continued supply of wood for the commune's members, and also to protect settlements and fields from floods, avalanches, and rockfall.[32] The imposition of these orders showed that members of the local community recognized a need to protect the flows of two local public goods for their continued use.

The communal orders were not entirely successful in attaining their goals because of inadequate policing[33] and, from the late eighteenth century, increasing demands for wood and charcoal for new industries in towns further down the Rhone.[34] Valais was the first mountain canton to recognize that forests were common-pool resources not only for individual communes, for whom they supplied wood, but also for the citizens of the canton as a whole.[35] The outputs in question were wood and protection from natural hazards. These forest values were recognized by Valais in a series of cantonal laws passed between 1803 and 1836.[36] These laws

29. P. Messerli, Mensch und Natur im alpinen Lebensraum: Risiken, Chancen, Perspektiven (1989).

30. Schuler, *Forstgeschichte in forstlicher Planung und Tätigkeit*, 132 Schweizerische Zeitschrift für Forstwesen [Schw. Zeit. Forst.] 243 (1981).

31. Other communes in Valais had made orders protecting forests as early as 1298. *See* C. Perrig & A. Fux, Recueil des Lois, Décrets, Arrêtés et Instructions du Canton du Valais concernant l'économie forestière 1803-1943 (1945).

32. *See* Tromp, Bannwälder, 56 Mitteilungen der eidgenössischen Anstalt für das forstliche Versuchswesen [Mitt. EAFV] 324 (1980); A. Schuler, Wald- und Holzwirtschaftspolitik der alten Eidgenossenschaft (Beiheft zu den Zeitschriften des Schweizerischen Forstvereins Nr. 68, 1980).

33. Tromp, *Hundert Jahre forstliche Planung in der Schweiz*, 56 Mitt. EAFV 253 (1980).

34. A. Kempf & H. Scherrer, Forstgeschichtliche Notizen zum Wallisen Wald 43 (Eidgenössische Anstalt für das forstliche Versuchswesen, Bericht Nr. 243, 1982).

35. C. Wuilloud, Zur Geschichte des Forstrechtes im Wallis (1981) (unpublished Diplomarbeit in the library of the Institut für Wald- und Holzforschung, ETH-Zürich).

36. *See* C. Perrig & A. Fux, *supra* note 31.

limited wood cutting and sales and encouraged tree planting to minimize danger from natural hazards and to protect roads.[37]

These laws, like the communal orders preceding them, did not attain their goals. In the 1820s and 1830s, many of the Aletsch forests were clearcut, and parts of the communal forests were sold to private interests.[38] From the 1840s onward, the Swiss Forestry Association (SFA: *Schweizerischer Forstverein*) stressed the national importance of the mountain forests, primarily for protection against natural hazards.[39] These statements were amplified by the results of severe floods in 1868.[40] In 1874, as a result of the floods and the SFA's lobbying efforts in persuading Swiss citizens of the forests' national importance, the constitution was amended.[41] Superintendence over the mountain forests was transferred from the cantonal governments to the federal government, recognizing that the forests were common-pool resources supplying public goods to the national community. This policy was codified in the 1876 Forest Police Law (*Forstpolizeigesetz*),[42] whose main tenet was that the nation's forested area should not decrease.[43] This law, revised somewhat in 1902,[44] remains the basis for the management of the forests of the Swiss Alps.

One requirement of the Forest Police Law was that forests should be managed for sustained yields of wood according to plans based on detailed surveys.[45] Plans for the management of the Aletsch forests were made between 1885 and 1895. The sustained yields were set below the volume of recent harvests—in some cases, at less than half.[46] This disparity suggests that harvests in the 1870s and 1880s had exceeded the growth increment, meaning that more wood had been removed than had been added by the growth of trees. Therefore, future harvests had to be reduced to permit the forests to supply the public goods recognized in the law.

In the first decades of the twentieth century, although prescribed yields were set for the Aletsch forests, actual harvests from these forests exceeded the prescribed yields by up to 25 percent, with logging concentrating on the few areas with good access.[47] While the principal use of

37. Price, *Legislation and Policy for the Forests of the Swiss Alps*, 5 Land Use Pol'y 314 (1988).

38. C. Wuilloud, *supra* note 35, at 80.

39. Schuler, *Sustained-Yield Forestry and Forest Functions, As Seen by Swiss Foresters in the Nineteenth Century*, in History of Sustained-Yield Forestry (H. Steen ed. 1984).

40. These floods caused over 14 million francs in damage and 50 deaths. *See* G. Bloetzer, Die Oberaufsicht über die Forstpolizei nach schweizerischen Bundesstaatsrecht (Zürcher Studien zum öffentlichen Recht Nr. 2, 1978).

41. Bundesverfassung [BV] art. 24, SR 101; Bundesblatt [BB] vom 29.5.1874, AS 1, 38.

42. Bundesgesetz betreffend die eidgenössische Oberaufsicht über die Forstpolizei im Hochgebirge vom 24.3.1876, AS 2, 353 [hereinafter FPL 1876].

43. Price, *supra* note 37.

44. Bundesgesetz betreffend die eidgenössische Oberaufsicht über die Forstpolizei vom 11.10.1902, SR 921.0.

45. FPL 1876, *supra* note 42, art. 16.

46. M. Price, *supra* note 27, at 200.

47. *Id.* at 203.

the wood was for fuel, most of the harvested trees were of sawtimber size.[48] Almost all of the wood was used locally.[49] This level of harvesting contravened the Forest Police Law and the cantonal laws passed pursuant to it[50] but, as in previous centuries, policing was insufficient to stop excessive harvesting. Between 1924 and 1942, new surveys were undertaken, providing the data for management plans in which sustained yields were set even lower than in the previous plans.[51] However, throughout the 1930s and 1940s, high demand led to large harvests to provide wood for sale.[52] Thus, until 1947, harvests were typically higher than the sustained yields (Figure 1). Subsequently, harvests declined until 1970. The next decade was marked by very low harvests; in two-thirds of the communes, no logging occurred in at least half of these years.[53]

These trends suggest that local community concern for ensuring the protection of settlements and infrastructure from natural hazards had been overridden by local economic concerns. Until 1950, most people derived their livelihood from agriculture and forestry, as they had for centuries.[54] Wood sales were one of the few means of supplementing limited agricultural incomes, particularly during the winter season when agricultural activity was minimal.

Subsequently, the basis of the local economy changed to tourism, due to the construction of cable-cars to the alpine terrace high above the Rhone Valley. This area had previously been used only for summer grazing in the traditional pattern of transhumance land use.[55] A substantial tourism infrastructure grew rapidly, as did the number of visitors to the area, both in summer and for the winter skiing season (Figure 2). As elsewhere in Switzerland, little work was done in the Aletsch forests because greater recompense was available from other activities, agriculture was declining or being rationalized, alternative sources of fuel had become available, and new transportation networks meant that cheaper wood for construction was available from non-local sources.[56] For example, many of the "Swiss" chalets in the area were prefabricated in Finland and erected by Finnish workers.[57]

48. *Id.* Sawtimber (*Baumholz*) trees are those with a diameter at breast height (d.b.h.) greater than 20 centimeters.

49. *Id.* at 204.

50. *See* C. Perrig & A. Fux, *supra* note 31.

51. M. Price, *supra* note 27, at 205.

52. *Id.* at 205. This trend took place throughout the Swiss Alps. *See* Auer, *Die volkwirtschaftliche Bedeutung des Gebirgwaldes*, 107 Schw. Zeit. Forst. 319 (1956); Leibundgut, *Das Problem des Gebirgshilfe*, 107 Schw. Zeit. Forst. 297 (1956).

53. M. Price, *supra* note 27, at 205.

54. F. Mattig & H. Zeiter, Der touristiche Wachstumsprozess im MAB-Testgebiet Aletsch (1984).

55. Messerli, Mattig, Zeiter & Aerni, *Socio-economic Development and Ecological Capacity in a Mountainous Region*, 35 Geographica Helvetica 153 (1980).

56. Price, *Tourism and Forestry in the Swiss Alps: Parasitism or Symbiosis?*, 7 Mountain Res. Dev. 1 (1987).

57. M. Price, *supra* note 27, at 209.

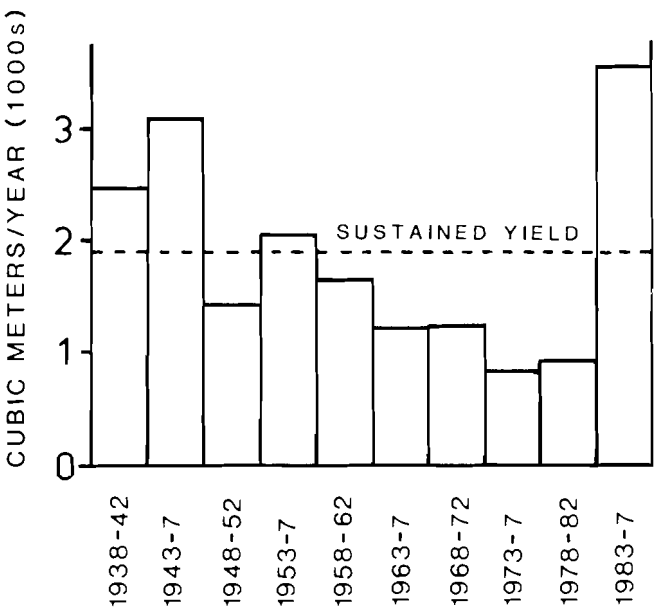

FIGURE 1.
Aletsch Study Area: Five-year Average Annual Harvests, 1938-1947.

Dashed line shows sustained yield set in 1924-1942 management plans.

SOURCE: M.F. Price, Mountain Forests as Common-property Resources: Management Policies and Their Outcomes in the Colorado Rockies and the Swiss Alps 1988 (unpublished Ph.D. thesis in the library of the University of Colorado, Boulder).

The rapid growth of tourism meant that the public goods provided by the forests became even more important. As the infrastructure for recreation, transportation, and settlement grew, its protection from natural hazards became more significant. Another public good critical to the tourism industry is the alpine landscape, described as the "capital" of tourism by Krippendorf,[58] of which forests are an integral part. Undeveloped recreation became more important as tourists used the many trails through the forests for hiking and skiing.

All of these public goods were recognized in the major 1965 revision of the Forest Police Law regulations,[59] and also in the 1985 Valais Forest

58. Krippendorf, *The Capital of Tourism in Danger*, in The Transformation of Swiss Mountain Environments (E. Brugger, G. Furrer, B. Messerli & P. Messerli eds. 1984).

59. Vollziehungsverordnung zum Bundesgesetz betreffend die eidgenössiche Oberaufsicht über die Forstpolizei vom 1. Oktober 1965, SR 921.01.

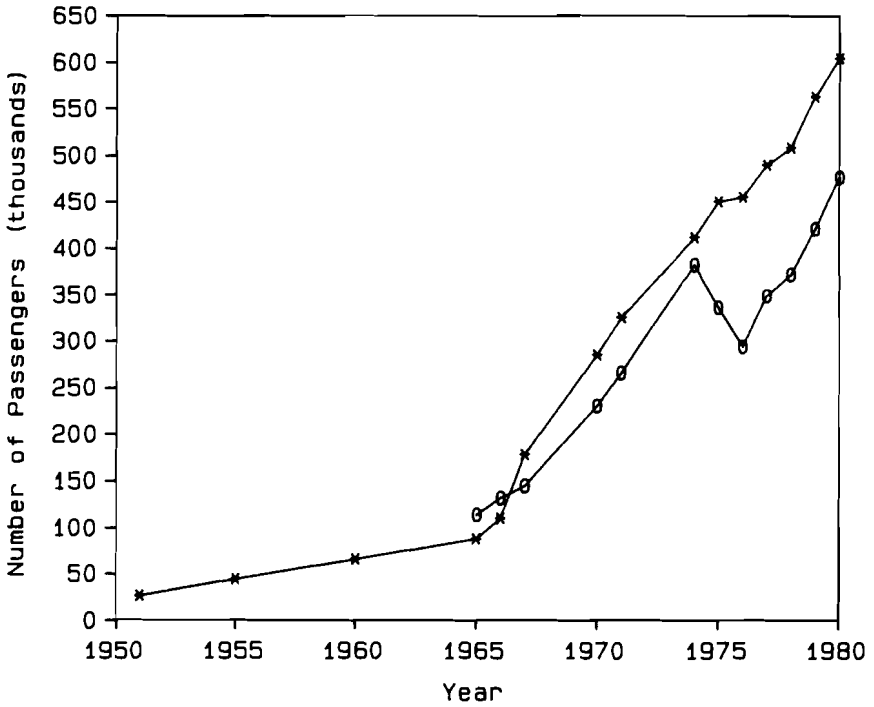

FIGURE 2.
Aletsch Study Area: Number of Passengers Carried by Cable-cars.

—*— to Riederalp, 1951-1980
—O— to Bettmeralp, 1965-1980 (no data 1954-1964).

SOURCE: F. Mattig & H.-P. Zeiter, Der touristiche Wachstumsprozess im MAB-Testgebiet Aletsch (1984).

Law (*Forstgesetz*),[60] which replaced a 1910 law,[61] almost identical in content to the Forest Police Law. The primary aims of the 1985 law are to preserve the forests and to ensure their maintenance for the safeguarding and improvement of protective and welfare functions.[62] Secondary aims are to increase the potential yield of the forests and encourage their management in the interests of owners and the public, and to maintain and preserve the cultural landscape and a healthy environment.[63] While

60. Kantonale Forstgesetz vom 1. Februar 1985; Loi forestière du 1. fevrier 1985 [hereinafter VFL 1985].
61. Forstgesetz vom 11 Mai 1910; Loi forestière du 11. mai 1910.
62. VFL 1985, *supra* note 60, art. 1.
63. *Id.*

these policies clearly recognize that the forests are common-pool resources supplying a wide range of public goods to communities at all levels from the local to the international, they are not yet able to ensure the long-term provision of these goods in the Aletsch area. A total of 62 percent of the area's forests has been classified as important for protection from avalanches, rockfall, erosion, landslides, or flash floods, yet 34 percent is classified as unstable, requiring active management within 20 years.[64] This instability can be traced to the forest use patterns over the past century, which have left most stands dominated by trees of one size class.[65] There is little regeneration, and sawtimber trees, mainly spruces, predominate.[66] Spruces at this stage in their life-cycle are highly susceptible to bark beetles and disease.[67]

As shown in Figure 1, harvests have increased significantly since 1982. The principal reason is that the federal government has provided substantial subsidies for the removal of trees affected by insects, disease, and air pollution.[68] This recognition of the forests' protective function is further indicated by government subsidies of over 90 percent for the construction of avalanche control structures.[69]

Arguably, the public goods supplied by these activities primarily benefit the local community. However, the financial condition of the communes is far too weak to permit them to underwrite these activities, and the national and cantonal governments recognize that the dominant tourist economy in the Alps depends strongly on a safe infrastructure and coherent forest cover. Forest management (logging, thinning, and often reforestation) is therefore essential to diversify the age structure of the forests.[70] This is necessary to ensure the continued supply of all of the public goods provided by these forests, now widely recognized as common-pool resources crucial for the welfare of the nation, and not only local communities. At the national level, this recognition was most recently exemplified by the federal government's introduction of a new forest law in 1988.[71]

In sum, the recorded history of the forests of the Swiss Alps spans many centuries. It shows a gradual evolution of policies from the local

64. S. Bellwald & H. Graf, Der Wald im Aletschgebiet: Zustand und Entwicklungstendenzen 71 (Schlussbericht zum schweizerischen MAB-Programm Nr. 17, 1985).

65. *Id.* at 40.

66. *Id.* at 41.

67. H. Leibundgut, Unsere Waldbäume (1984).

68. Wandeler, *Die Revision der eidgenössischen Forstgesetzgebung: Stand und Schwerpunkte*, 136 Schw. Zeit. Forst. 657 (1985).

69. M. Price, *supra* note 27, at 217.

70. Ott, *Wie ist die Frage der Ueberalterung für unsere Schweizer Gebirgswälder zu beurteilen?*, 136 Schw. Zeit. Forst. 931 (1985); Ott & Schönbächler, *Die Stabilitätsbeurteilung im Gebirgswald als Voraussetzung für die Schutzwald-Ueberwachung und -Pflege*, 137 Schw. Zeit. Forst. 725 (1986).

71. Anon, *Neues Waldgesetz in Griffnähe*, 70 Wald und Holz 384 (1989).

to the national level, with increasing recognition of the vital importance of these forests for both mountain and national economies. In contrast, the recorded history of Colorado's forests extends back only to the beginning of European settlement, in the mid-nineteenth century. Yet recognition of the public goods provided by Colorado's forests evolved rapidly so that, as in Switzerland, the forests were subject to federal jurisdiction as the twentieth century began and, in some ways, subsequent policy development has proceeded farther than in Switzerland.

Colorado Rocky Mountains

The Colorado study area is Summit County. Although this area is on the west slope of the Continental Divide, it contains two large reservoirs which supply water through tunnels to Colorado's main urban areas, along the eastern foothills of the Rocky Mountains, less than 100 miles distant. The principal settlements in Summit County are small towns which were founded in the mining era, which started in 1859 with the discovery of placer gold. Previously, the area had been used by Ute Indians and, from 1812, by trappers.[72]

By 1860, with a mining boom underway, Summit County's population had grown to 8,000.[73] At that time, the area's forests were part of the public domain, meaning that they were open-access resources, or *res nullius*.[74] Wood was essential in the mining economy for fuel, construction, and all aspects of mining. The forests were viewed as inexhaustible resources, essentially as pure public goods, although fires began to decrease their area. Many fires were deliberately set, often to ease access to rock for mining.[75] The first mining boom was over by the mid-1860s; by 1870, the area's population had dropped to 258.[76]

In 1878, Congress passed the federal Free Timber Act,[77] essentially regarding the forests of the public domain as the source of a local public good: wood. The act allowed residents of various western states, including Colorado, to cut dead trees on mineral lands for building, agricultural, mining, or other domestic purposes. The act was hardly enforced by the few available agents, and its main effect was to permit unrestrained logging, particularly since "mineral lands" were never defined.[78] Summit

72. M. Gilliland, Summit: A Gold-rush History (1980).

73. 1883 U.S. Census Office, Statistics of the Population of the United States at the 10th Census, at 80.

74. For a definition of *res nullius*, see Ciriacy-Wantrup & Bishop, *supra* note 2.

75. C. Kutzleb, Timber Management Plan, Dillon Working Circle (unpublished report, Dillon Ranger District, Arapaho National Forest, Colorado, USDA Forest Service 1947).

76. Census Office, *supra* note 73, at 80.

77. Timber and Minerals Act, Ch. 150, 20 Stat. 88 (1878).

78. J. Ise, The United States Forest Policy 65 (1920).

County, where a second mining boom began in 1878 with the discovery of gold and silver ore, was no exception.

In the early 1880s, two railroads were built into the area. These substantially increased the demand for wood, not only for ties and fuel, but also for export for mining or (as charcoal) smelting to other parts of Colorado. The second boom lasted into the 1890s. Between 1878 and 1902, many fires were recorded in the area.[79] No attempt was made to put them out unless they threatened private property or towns.[80] Some were started in order to supply dead trees which could then be removed legally under the Free Timber Act.[81] Huge volumes of wood were cut for timber and charcoal.[82] By the turn of the century, about half of the area's forests had been logged, burned, or both. The remaining stands of mature timber were near timberline and in the mountains in northern Summit County, where there had been little mining and access was limited.[83]

The advent of European settlement, often linked to mining booms and railroad construction, occurred throughout the Rocky Mountains with similar results to those in Summit County.[84] The rapid depletion of the public domain forests aroused regional and national fears that the forests might become unable to supply wood in the long term, and also that water supplies might be endangered. When Colorado became a state in 1876, the constitutional convention recognized the forests as common-pool resources supplying the public goods of wood, water for irrigation, and protection against floods.[85] However, the legislature did not act on this awareness until 1885 when, at the urging of the newly-founded state forestry association, a Forest Commissioner was appointed and local officials were exhorted to limit the destruction of the forests.[86]

Despite this promising beginning, the Colorado legislature provided few words and scant funds in support of any policies or activities related to forestry. In 1890, the Forest Commissioner resigned, and became a leader in the movement instrumental in forcing national recognition of the importance of the public domain forests for protecting watersheds

79. M. Price, *supra* note 27, at 272.

80. USDA Forest Service, Supplement to 1960 Land Management Plan for Dillon Working Circle (1968).

81. J. Ise, *supra* note 78.

82. J. Martin, Leadville: Information (unpublished report, Pike National Forest, USDA Forest Service 1915).

83. M. Price, *supra* note 27, at 274.

84. Veblen & Lorenz, *Anthropogenic Disturbance and Recovery Patterns in Montane Forests, Colorado Front Range*, 7 Physical Geography 1 (1986); Loope & Gruell, *The Ecological Role of Fire in the Jackson Hole Area, Northwestern Wyoming*, 3 Quaternary Research 425 (1983).

85. H.R. Misc. Doc. No. 146, 44th Cong., 1st Sess. (1876).

86. E. Ensign, Report for the Year 1885 of the Forest Commissioner of the State of Colorado (1885). Edgar Ensign was a founding member of the Colorado State Forestry Association, and Forest Commissioner of the State of Colorado from 1885 to 1890.

and wood supplies.[87] By the end of the century, the federal Forest Reserve Act[88] and the Organic Act[89] had been passed, with the intention of providing a statutory basis for the management of the public forests. To some extent, these laws owed their passage to political legerdemain.[90] However, they show that many sections of the American and Colorado public realized that the public domain forests should be recognized as common-pool resources providing public goods to the national community.[91]

Under the provisions of the Organic Act, all of the public domain forests in Colorado were designated National Forests by 1908.[92] Summit County's forests were designated part of the Leadville National Forest in 1905, and transferred to the Arapaho National Forest in 1929.[93] In 1900, the area's population was 2,744[94]—this century's highest level until the early 1970s. Most of the mining camps had disappeared, though some hardrock mining continued, and dredging took place until 1942.[95] The local economy centered upon ranching, with some logging for local use and, until the railroad closed in 1937, for railroad ties and to supply mining uses at Leadville and Climax, to the south of the area.[96]

Figure 3 shows the harvests recorded in the area from 1905 to 1987. Not included in these figures is "free use"—the removal of wood for local use—which may have been as high as the recorded harvests until the 1950s.[97] The forests were surveyed in the 1920s, and sustained yields recommended. However, harvests stayed well below these sustained-yield levels throughout this period, even during the Second World War, when demands for mining timbers increased and prices were high.[98] Forest Service employees spent much of their time constructing trails and roads for fire prevention and control, the primary emphasis of forest management in Colorado.[99] Improved access to the area and within it also allowed

87. Morrill, *Forestry*, in History of Colorado (1927).

88. Timber Culture Repeal Act, ch. 561 § 24, 26 Stat. 1095, 1103 (codified at 16 U.S.C. § 471 (1988)).

89. Appropriations Act, ch. 2 § 1, 30 Stat. 34, 36 (codified at 16 U.S.C. § 473 (1988)).

90. J. Ise, *supra* note 78; H. Kirkland, The American Forests, 1864-1898: A Trend Toward Conservation (1971) (unpublished Ph.D. thesis in the library of Florida State University).

91. J. Ise, *supra* note 78; H. Kirkland, *supra* note 90; G. McCarthy, Hour of Trial (1977); J. Miller, Congress and the Origins of Conservation (1973) (unpublished Ph.D. thesis in the library of the University of Minnesota); H. Wengert, A. Dyer & H. Deutsch, The "Purposes" of the National Forests—A Historical Interpretation of Policy Development (1979).

92. Shoemaker, *National Forests*, Colo. Mag., May 1944, at 182.

93. *Id.*

94. 1901 U.S. Census Office Report, vol. I, pt. 1, 12th Census of the United States.

95. S. Pritchard, Southern Summit: A Geographer's Perspective (1984).

96. M. Price, *supra* note 27, at 279.

97. *Id.*

98. *Id.* at 280.

99. USDA Forest Service, Fire Prevention in the Western United States, Proceedings, Priest River Fire Meeting (1941).

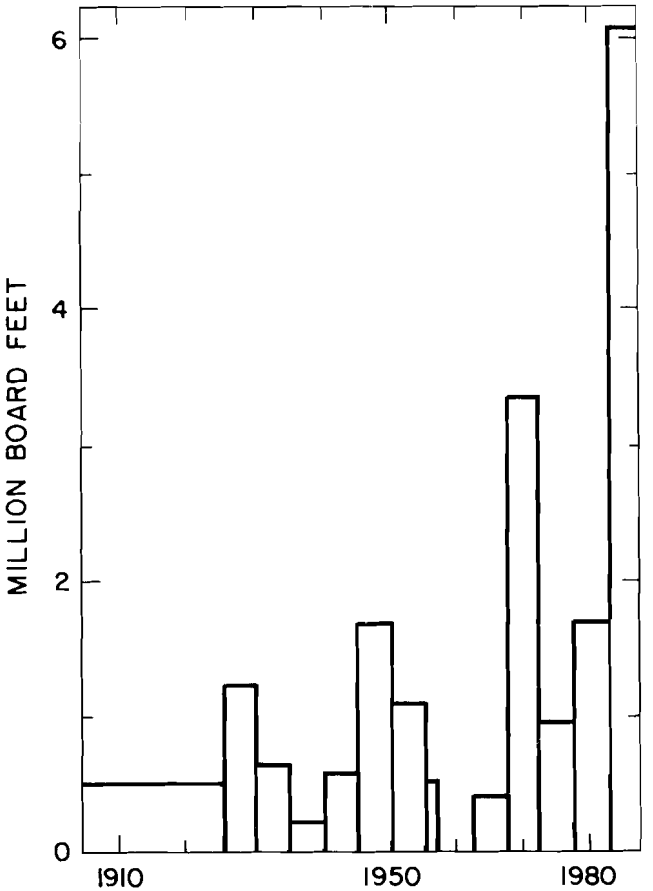

FIGURE 3.
Summit County Study Area: Average Annual Harvests, 1905-1987.

SOURCE: M.F. Price, Mountain Forests as Common-property Resources: Management Policies and Their Outcomes in the Colorado Rockies and the Swiss Alps 1988 (unpublished Ph.D. thesis in the library of the University of Colorado, Boulder).

summer recreation to become a noticeable use of the forests in the 1930s. During this decade, various recreational facilities were built by the Civilian Conservation Corps (CCC).[100]

For the first half of this century, the area's forests were primarily regarded by the local community and Forest Service officials as a source

100. M. Price, *supra* note 27, at 280. The CCC also thinned about 5,000 acres of trees which had regenerated since the mining era.

of one local public good: wood. Forest Service legislation and policies at the national and regional levels recognized the forests' importance as common-pool resources supplying a variety of public goods.[101] First among these was the protection of watersheds and of a secure wood supply; both were primary reasons for the emphasis on fire prevention. While these public goods were identified in legislation, others were mentioned only in policy. Recreation was recognized as a public good provided by the forests in regional policies from at least 1915,[102] and in national policy from 1919.[103] An additional public good provided by the forests was wilderness, first recognized in national-level policies (as Primitive Areas) in 1926.[104] Part of Summit County in the Gore Range, one of the areas essentially unaffected by mining, was established as a Primitive Area in 1933.[105]

The 1950s were a turning point for Summit County and its forests, as for much of the Rocky Mountains. Within a few years, Summit County's economy changed from one primarily dependent on ranching to one based on tourism. One reason for the decline of ranching was that much of the best agricultural land was flooded by two reservoirs, completed and filled in the early 1940s and 1960s.[106] The reservoirs not only decreased the land base and helped inflate land prices—they also provided a significant summer recreational resource.[107] At the same time, the area's excellent potential for downhill skiing was recognized. The first area opened in 1946; there are now four. Figure 4 shows the increase in skier visits through 1989. Summer recreation has shown a similar, though less rapid trend, and winter has become the dominant season. These trends are linked to improved access from Colorado's rapidly growing cities and other regional-scale and national-scale "fueling factors," such as increases in population, income, and leisure time, and improved transportation facilities.[108]

Thus, recreation became the main emphasis of forest management in the area, with watershed protection also mentioned in the planning undertaken after the passage of the 1960 Multiple-Use Sustained-Yield Act (MUSY).[109] This act explicitly recognized that the National Forests should

101. C. Wilkinson & H. Anderson, Land and Resource Planning in the National Forests (1987).

102. M. Price, *supra* note 27, at 163.

103. C. Wilkinson & H. Anderson, *supra* note 101, at 161.

104. *Id.*

105. C. Kutzleb, Timber Management Plan, Middle Park Working Circle, (unpublished report, Dillon Ranger District, Arapaho National Forest, Colorado, USDA Forest Service 1947).

106. J. Clawson, A Boomtown Situation (1984) (unpublished graduate research paper, Department of Anthropology, University of Denver).

107. USDA Forest Service, Supplement to 1960 Land Management Plan for Dillon Working Circle (1969).

108. Clawson, *Outdoor Recreation: Twenty-five Years of History, Twenty-five Years of Projection*, 7 Leisure Sci. 73 (1985).

109. Multiple-Use Sustained-Yield Act of 1960, Pub. L. No. 86-517, 74 Stat. 215 (codified at 16 U.S.C. §§ 528 to 531 (1988)).

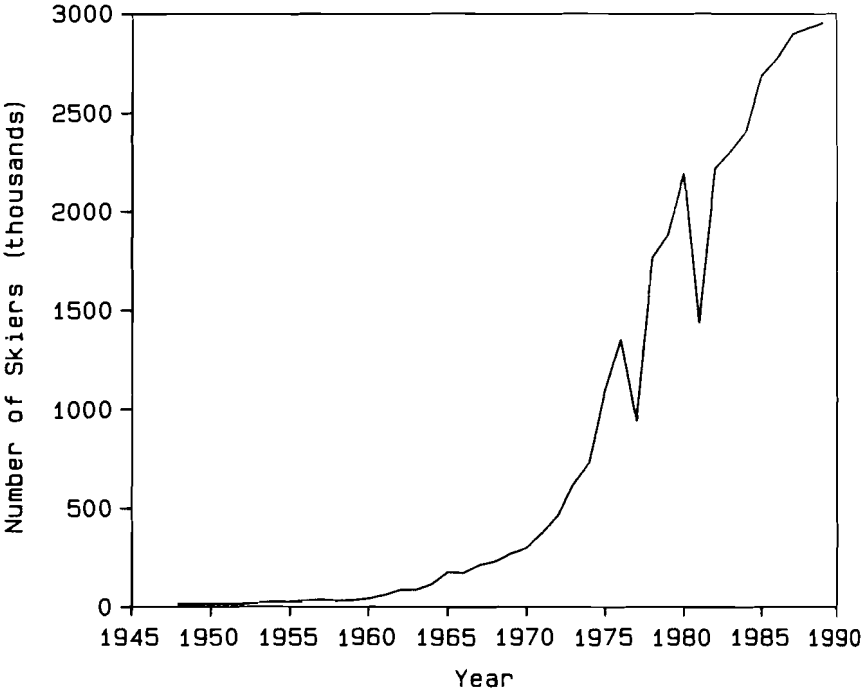

FIGURE 4.
Summit County Study Area: Numbers of Skiers, 1948-1989.

SOURCE: Unpublished data in the files of Colorado Ski Country USA, Denver, Colorado.

be managed to provide a variety of public goods, including recreation, watershed protection, fish, and wildlife, together with timber and forage.[110] Wilderness was also mentioned in the MUSY Act, but was not a primary concern until the passage of the 1964 Wilderness Act.[111] In the 1969 National Environmental Policy Act,[112] aesthetic quality was recognized as a significant product of federal lands, including National Forests. With the passage of the 1974 Forest and Rangeland Renewable Resources Planning Act[113] and the 1976 National Forest Management Act,[114] all of the remaining impure and pure public goods—air and water

110. *Id.* at § 1.

111. Wilderness Act of 1964, Pub. L. No. 88-577, 78 Stat. 890 (codified at 16 U.S.C. §§ 1131 to 1136. (1988)).

112. National Environmental Policy Act of 1969, Pub. L. No. 91-190, 83 Stat. 852 (codified at 42 U.S.C. §§ 4321, 4331 to 4335, 4341 to 4347 (1988)) [hereinafter NEPA].

113. Forest and Rangeland Renewable Resources Planning Act of 1974, Pub. L. No. 93-378, 88 Stat. 476 (codified as amended at 16 U.S.C. §§ 1601 to 1614 (1988)) [hereinafter RPA].

114. National Forest Management Act of 1976, Pub. L. No. 94-588, 90 Stat. 2949 (codified as amended in scattered sections of 42 U.S.C. and 16 U.S.C. (1988)) [hereinafter NMFA].

quality, ecosystem and genetic diversity—supplied by the National Forests were recognized in federal legislation.[115]

This legislation resulted in a great increase in planning for the forests of Summit County, culminating in the 1984 Land and Resource Management Plan for the White River National Forest.[116] This plan identifies wilderness, undeveloped recreation, and wildlife habitat as the main uses of the forests of the north half of the area. The southern forests, which harbor the ski areas and settlements, are mainly designated for recreational use. Timber harvesting is proposed for several locations. Of the total area designated for harvesting, approximately 75 percent is to be cut to control mountain pine beetles in lodgepole pine stands. Most of the rest is in spruce-fir forests which require harvesting to improve forest health and increase diversity.

As shown in Figure 3, recorded timber harvests increased from the late 1960s. However, this increase may not reflect a real increase in harvests, since "free use" had declined substantially as other sources of fuel and timber for construction became available. Little local timber has been used in the construction boom, which has taken place since the mid-1960s, to supply recreational facilities and housing for a rapidly-growing local population.[117]

Several factors have contributed to the recent increase in timber harvests.[118] In the late 1960s, logging was undertaken to supply timber for a sawmill north of the area, in line with the Forest Service's community stability policy.[119] The clearing of the right-of-way for Interstate Highway 70 and of ski runs also required considerable logging, though much of the wood was burned on-site since no markets could be found.[120] These projects were carefully planned with aesthetic criteria in mind, to conform to new agency policies.[121] In the 1980s, substantial spraying, thinning, and logging operations took place to control an epidemic of mountain pine beetles in lodgepole pine stands, which account for half the forests' area.[122]

115. RPA, *supra* note 113, § 4(5)(C) recognized water and air quality; NFMA, *supra* note 114, § 6(g)(3)(B), recognized ecosystem and genetic diversity as forest outputs.

116. USDA Forest Service, Land and Resource Management Plan, White River National Forest (1984). The White River National Forest has administered the public forests of Summit County since 1973.

117. In the 1970s, the area's population finally exceeded the levels of the nineteenth-century mining booms. 1983 U.S. Census Report, vol. I, pt. A, 1980 Census of Population, at 20.

118. M. Price, *supra* note 27.

119. 36 C.F.R. § 221.3 (a) (3) (1986). *See generally* Schallau & Alston, *The Commitment to Community Stability: A Policy or Shibboleth?*, 17 Envtl. L. 429 (1987).

120. M. Price, *supra* note 27, at 290.

121. USDA Forest Service, The Visual Management System (1974) (Agriculture Handbook No. 462).

122. M. Pearson, A Summary of the Timber Management Program on the Dillon District, 1982-1986 (1986) (unpublished report, Dillon Ranger District, Arapaho National Forest, Colorado, USDA Forest Service).

This epidemic, foreseen since the 1960s, can largely be traced to the results of interactions of people with the forests over the past century. The loss of a large proportion of the forest cover from 1860 to 1900, followed by decades of protection, has resulted in stands with a limited range of age classes and limited regeneration.[123] Such stands account for nearly half of the area's forests; most of the remainder is comprised of stands with a wide range of age classes, but little regeneration. In general, these latter stands were unaffected by the activities of the mining era.[124] In the lodgepole pine stands, which occur in both categories, the effect of protection from fire has been the growth of many trees which, because of their stand structure and age, are highly susceptible to insect epidemics and disease.[125] Thus, one result of the fire prevention program, originally intended to provide a public good, may be a paradoxical increase in the likelihood of the public bad it was designed to minimize.

In summary, legislation and policies for the National Forests now recognize them as common-pool resources supplying a range of public goods to a wide range of communities. These extend from the local to the national, and even international in the case of recreation, wilderness, and ecosystem and genetic diversity. In Colorado, recreation is recognized as the primary public good provided by the National Forests.[126] Summit County's forests are mainly managed for recreation, in terms of supplying recreational facilities and a high-quality landscape, with watershed protection as another important goal. In current planning and management, timber harvesting is principally regarded as a tool to ensure the long-term provision of these public goods; as elsewhere in Colorado, hardly any timber sales make a profit.[127]

An alternative management technique is prescribed burning,[128] which is effective for controlling mountain pine beetle populations,[129] and often achieves the same results at less cost than timber harvesting.[130] Essentially,

123. M. Price, *supra* note 27, at 293.

124. *Id.* at 296.

125. W. Cole & G. Amman, Mountain Pine Beetle Dynamics in Lodgepole Pine Forests Part I: Course of an Infestation (1980) (USDA Forest Service General Technical Report INT-89); F. Hawksworth & O. Dooling, Lodgepole Pine Dwarf Mistletoe (1984) (U.S. Dep't of Agriculture, Forest Insect and Disease Leaflet No. 18).

126. D. Getches, A Review of Effects of Below-Cost Timber Sales on Outdoor Recreation and Related Tourism, Below-Cost Timber Sales (1987).

127. R. Rice, The Uncounted Costs of Logging, at A-1 (Wilderness Society, National Forests: Policies for the Future, vol. 5, 1989).

128. Prescribed burning refers to the intentional ignition of forest vegetation under predetermined conditions, as a means of implementing forest management objectives. *See* USDA Forest Service, Report of the Task Force on Prescribed Fire Management Criteria (1989).

129. M. McGregor & D. Cole, Integrating Management Strategies for the Mountain Pine Beetle with Multiple Resource Management of Lodgepole Pine Forests (1985) (USDA Forest Service, General Technical Report INT-174).

130. O'Toole, *When Are Below-Cost Sales Justified?*, Forest Plan. 9 (May 1985).

prescribed burning represents the reintroduction of an ecological process—fire—which is the principal natural agent of change in Colorado's forests.[131] However, opportunities for prescribed burning are currently limited by a number of factors. These include the location of many homes and recreational facilities in the forests, budgetary constraints, and limited opportunities for safe burning because of Colorado's dry climate.[132] An additional factor is the public perception, fostered by the United States Forest Service for decades, that forest fires are bad.[133] Nevertheless, prescribed burning may well be the most effective technique for ensuring that the area's forests continue to reliably supply a wide range of public goods into the future.

CONCLUSION

The case studies presented above show that the forests of the Swiss Alps and Colorado Rocky Mountains are common-pool resources supplying many joint products to a variety of communities. In both regions, two outputs were recognized in early policies: wood, a local public good; and protection, a pure public good. In Colorado, these joint products were recognized from the 1870s; in Switzerland, in local policies from the thirteenth century and in cantonal policies from the early nineteenth century.

One primary activity of early foresters in both regions was emphasizing the importance of forest management for supplying public goods, particularly protection of watersheds, to the national community. By the end of the nineteenth century, these activities had resulted in federal legislation which stipulated that the forests should be managed according to the principles of sustained-yield forestry. In effect, the production of sustained yields of timber was regarded as the most efficient method of ensuring the supply of public goods in both Switzerland and Colorado. However, until the 1950s, harvesting levels tended to be based on the needs of local communities rather than the sustained yields derived from surveys of the forests. Harvesting patterns were very uneven in both space and time as a result of three interacting factors: demands for wood and other forest products required for primary economies, possibilities for selling wood outside the community, and levels of access to the forests.

After the Second World War, the basis of the economies of the two

131. Peet, *Forest Vegetation of the Colorado Front Range: Composition and Dynamics*, 45 Vegetatio 3 (1981).

132. Letter from G. Cargill, Regional Forester, Rocky Mountain Region, USDA Forest Service (Nov. 2, 1989).

133. S. Pyne, Fire in America (1982); Taylor & Mutch, *Fire in Wilderness: Public Knowledge, Acceptance, and Perceptions*, Proceedings, National Wilderness Research Conference: Current Research (1986) (USDA Forest Service, General Technical Report INT-212).

regions changed rapidly from primary activities to tourism. Populations, which had been declining, began to increase. Yet, although national policies were beginning to recognize that the forests provided many public goods to national communities, forest management activities in mountain areas received less emphasis than in previous decades, and harvests tended to decline. In Summit County, increasing emphasis was placed on planning and other activities related to the growing use of the forests for recreation. In the Aletsch area, the growth of tourism provided new employment, especially in the traditional winter logging season, thus helping to reduce harvests. In both areas, demands for wood also declined because cheaper sources of fuel and construction materials became available. These trends apply not only to the study areas, but to the two regions as well.[134]

By the 1980s, legislation for the forests of both regions recognized their importance to national, and even international, communities. Legislation in the United States recognized a wider range of public goods than in Switzerland, including ecosystem and genetic diversity, which are supplied not only to current but to future generations. At the same time, the long-term ability of the forests to supply all of the expected joint products began to become limited, as a result of the legacy of human interactions with the forests. Forests in both regions had a large proportion of stands composed of trees of few species, with a narrow range of age classes. The trees were also in the stage of their life-cycles when they were becoming increasingly susceptible to insect infestation and disease.

While these problems had often been predicted for decades, neither local (in Switzerland) or national communities (the federal governments) had been willing to invest in the management activities necessary to increase the forests' diversity in order to decrease their susceptibility to natural and man-made stresses and ensure their ability to supply the expected public goods. When insect epidemics began, however, federal governments acted relatively quickly to limit their effects. To date, these actions have mainly been prophylactic—a legislated or policy basis for the forest management activities necessary to ensure the long-term provision of all of the public goods identified in legislation still does not exist in either region.

In Colorado, the necessary evolution of policy may require a considerable reorientation of the legislation and policies driving the management of the National Forests,[135] together with an increased emphasis on prescribed burning as a management tool. In Switzerland, the new forest law introduced by the federal government in 1988 is likely to be passed

134. M. Price, *supra* note 27; *id.* at 56.

135. *See* R. O'Toole, Reforming the Forest Service (1988).

in the early 1990s. This recognizes that a minimal level of management in the mountain forests is necessary if they are to continue to provide all of the joint products expected by local and national communities.

In sum, it is crucial that local communities support the management of adjacent forests. While these forests are also important to national communities, the future of local communities is most closely tied to the future of these forests. Future legislation and policies for their management should recognize that these forests provide a wide range of public goods and that, since their structure has been strongly influenced by human activities, continued human intervention in natural ecological processes is essential for the forests to continue to provide these joint products.