8 / Mobility as a Factor Limiting Resource Use on the Columbia Plateau

EUGENE S. HUNN

Native Americans have lived along the Columbia River in the great plateau east of the Cascade Mountains for at least 10,000 years, judging by archaeological evidence from sites such as Wakemap Mound near The Dalles and Windust Cave up the Snake River from its junction with the Columbia (fig. 8.1).[1] Whether the people who gathered roots and berries, fished, and hunted there 10,000 years ago spoke a language directly ancestral to the Sahaptin spoken today by Yakama, Warm Springs, and Umatilla tribal elders cannot be known for certain. The Sahaptin language today, however, has words for more than 500 local plant and animal species and more than 1,000 places scattered across these tribes' traditional territory.[2] This suggests a very long and continuous occupation.

The drastic environmental changes that followed Euro-American settlement of the plateau after 1850 force us to ask, how was it possible for these Indian people to live there for 10,000 years and not degrade their environment? They did not exterminate the salmon or the bitterroots or the black mountain huckleberries they harvested so abundantly each year in season. Did they simply lack the ability to do much harm, armed as they were with just digging sticks, baskets, hemp nets, and bows and arrows? Or were they simply too few ever to have had a significant environmental impact? If so, why did their numbers not increase after 400 generations? Perhaps it had more to do with motives than with means. Perhaps they saw the need to conserve their natural resources long before this was popular among Euro-American settlers.

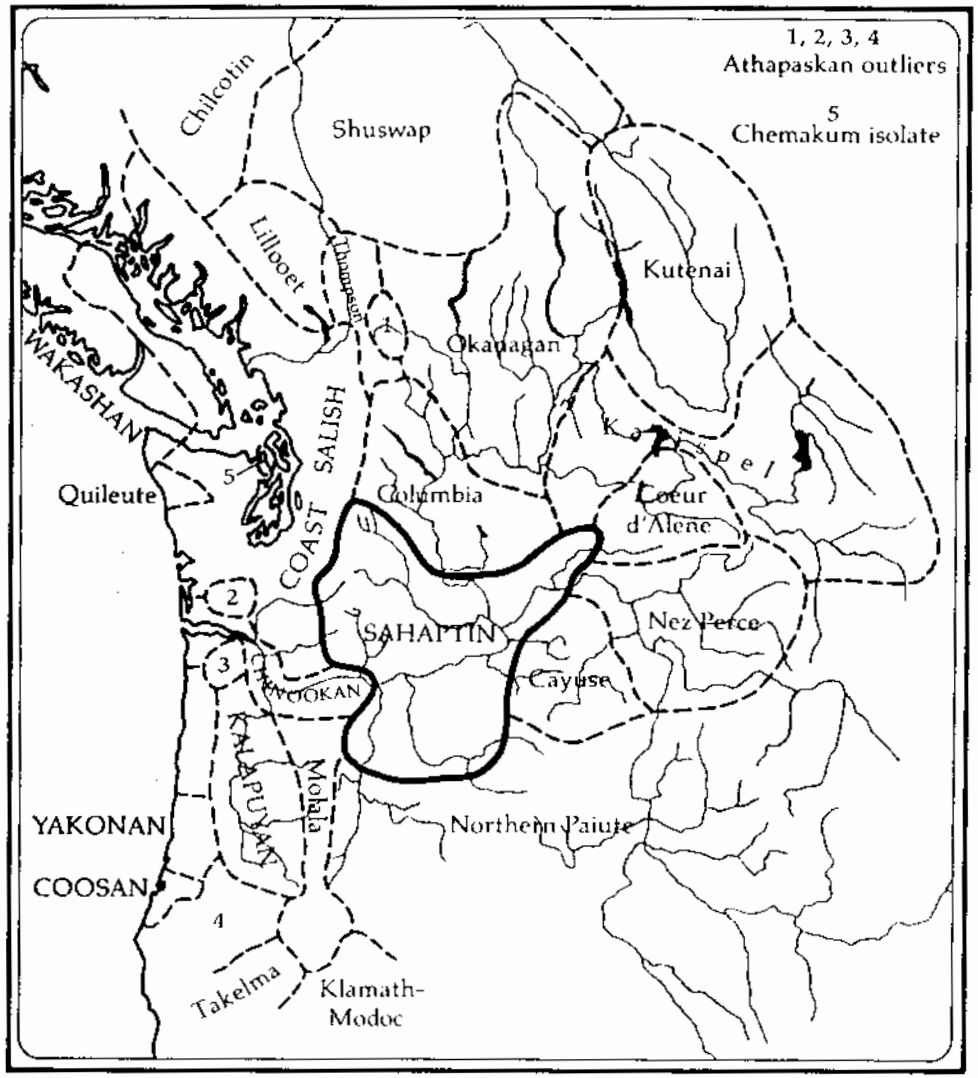

FIG. 8.1. The Pacific Northwest, showing the territory utilized by Sahaptin-speaking people (source: Hunn, *Nch'I-Wana*).

Perhaps they felt no need to harvest more than was required to sustain themselves and their families through the next winter, with a modest surplus to exchange with distant relatives and trading partners.

I address these issues by considering the evidence that Plateau Indians systematically managed their natural resources (such evidence is scant). The mid–Columbia River Indians appear never to have exceeded the capacity of the land to support them, even after 10,000 years. How were they able to maintain this enviable balance with nature for such a long time? Did they recognize the danger of excessive harvests and enforce rules to prevent "overkill"? Or was their life organized in such a way that conscious conservation measures were unneeded? In conclusion, I compare Plateau Indian societies with those on the nearby Pacific coast, where Indian populations were denser and conflict over resources was more intense.

SUBSISTENCE STRATEGIES IN THE COLUMBIA PLATEAU

The native subsistence economy was based on the harvest of anadromous fish and several species of roots, supplemented by resident fish, other vegetal products, and game, primarily mule deer (*Odocoileus hemionus*), in varying proportions.[3] Though there is evidence for some intensification of resource use and consequent population increase during this time,[4] the same basic resource types have been exploited throughout this long period. The local adoption of the horse after 1750 no doubt heightened mobility, but its major effects seem to have been more social than economic.[5] The basic plateau subsistence round was probably little affected by these changes.

At European contact the Columbia basin was home to Salishan and Sahaptin speakers. Ethnobiological research with contemporary Sahaptin informants conducted by David French and me has demonstrated the critical importance of plants as staple food sources, with root "crops" estimated to have provided on average more than 60 percent of local caloric needs.[6] The salmon harvest contributed on average some 30 percent of caloric needs and an abundance of protein.[7] At least 100 plant species were regularly used as food, suggesting the breadth of the human ecological niche in the plateau.

The following is a summary of patterns of resource use by Sahaptin-speaking people of the John Day and Umatilla areas; these patterns illustrate many features characteristic of subsistence patterns throughout the plateau region. The summary is organized by native categories of resources, roughly

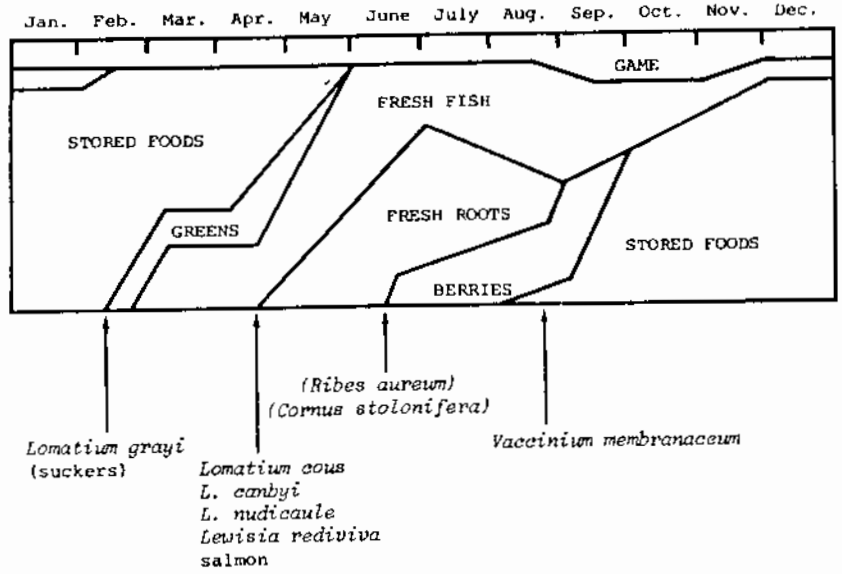

FIG. 8.2. Seasonal patterns of food utilization by Sahaptin-speaking people.

in the order of their harvest in the seasonal round. This information is illustrated schematically in figure 8.2.

Indian Celeries

"Indian celeries" is the English phrase used by contemporary Sahaptin speakers to refer to a set of plants that provide fresh edible sprouts, stems, and shoots. The first to appear is Gray's lomatium (*Lomatium grayi* C. and R.), with sprouts harvested as early as the first weeks of February. This perennial species is most abundant on talus slopes and along rocky stream courses at low elevations. The harvest season is limited to a few weeks at a given elevation, since the sprouts are considered worth digging only before the plants leaf out. The high cultural value assigned to this food is indicated by the fact that several longhouse congregations—the institutional focus of Native American religious expression in the plateau today—hold a thanksgiving feast to mark its first harvest. Other Indian celeries, in particular the bare-stemmed lomatium (*Lomatium nudicaule* [Pursh] C. and R.), are also important.[8]

"Foods which are dug" constitute a named group of plants characterized by the action involved in their harvest. Most plants in this group are perennials with edible underground storage organs such as tuberous roots, corms, or bulbs. These plants provided the bulk of the carbohydrate sources of the aboriginal diet.[9] Such plants are most effective as food sources after the completion of vegetative growth and the annual reproductive cycle. Yet actual harvest periods represent a compromise with other considerations affecting harvestability. The three primary staples (considering the Sahaptin range as a whole) each represent a somewhat different compromise. Bitterroot (*Lewisia rediviva* Pursh) is harvested early in its cycle, shortly after the leaves first appear. By the time the buds open, the bitter skin of the root will no longer peel readily and the plants are deemed not worth harvesting. Canby's lomatium (*Lomatium canbyi* C. and R.), with its congener cous (*Lomatium cous* [S. wats.] C. and R.), is one of the earliest sprouting plants of the region. However, the tuberous roots are quite "soft" at this time and are not considered "mature" and harvestable until the petals have fallen. The plants then quickly dry and the "tops" blow away, dispensing seed but making the plants invisible until early the following spring.

A third staple that is "dug" is camas (*Camassia quamash* [Pursh] Greene), a lily with an edible bulb. Bitterroot and the lomatiums are spatially widespread but temporally restricted. By contrast, camas, having a less ephemeral "top," may be harvested at any time between early June and late September but is abundant at only a few favored wet meadow sites. These sites attracted large multi-"tribal" collocations from a wide surrounding area. If the early fur trader Alexander Ross is to be believed, upwards of 10,000 Indians were encamped in the Kittitas valley, digging camas, racing horses, and gambling in early June 1814.[10] Concentrations of more than 1,500 are reported for the Nez Perce–Sahaptin collocation at a camas prairie near present-day Moscow, Idaho.[11] These camas harvest gatherings typically lasted one to several weeks and provided a year's supply of this staple for the attending families.

Initial low-elevation root harvests were conducted from winter village or fishing camp as a home base.[12] The major root harvest season might be extended from early April through June if harvesters followed the upslope advance of spring. Root digging was suspended briefly at the peak of the spring Chinook salmon (*Oncorhynchus tschawytscha*) passage at Celilo Falls during late April and early May, since women's labor was essential then to clean, dry, and otherwise prepare the salmon harvested by the men. Following the spring

salmon harvest, families moved in loose association through a series of camps at increasing elevation. For example, Umatilla and John Day Sahaptins continued to harvest bitterroot and cous until late June at elevations above 1,500 meters in the Blue Mountains of Oregon, some 80 kilometers from their winter villages. Large quantities of roots in excess of immediate needs were either cached, dried whole or as prepared cakes, or baked underground, depending on the species and variety involved. Transporting root stores exceeding 1,000 kilograms per family from root gathering sites to the winter villages must have been a major tactical problem of plateau subsistence prior to the adoption of the horse.

Fish

Although salmon provided the bulk of fish consumed, a variety of other species of fish were also important. Particularly notable are the suckers (or "mullet"), *Catostomus columbianus* and *C. macrocheilus*, which were harvested in large quantities from late February through April over much of the plateau.[13] These spawned conveniently in small streams tributary to the Columbia River adjacent to many winter village sites. The critical role of suckers as a fresh fish resource available two months prior to the spring Chinook salmon run was ritually and mythologically marked.[14]

The variety, predictability, abundance, and time of arrival of salmon varied dramatically within the region. The narrow, obstructed course of the Columbia River between The Dalles and Celilo Falls provided prime dipping and spearing sites. Runs there were probably relatively consistent year to year because all upstream populations of a river basin of 600,000 square kilometers, extending over 10 degrees of latitude, contributed to them.[15] Spring Chinook salmon passed quickly but in great abundance. After a hiatus of high water in late May and June came summer and fall Chinook runs, sockeye salmon (*O. nerka*) in late June, silver salmon (*O. kisutch*) in September, and some chum salmon (*O. keta*) in October, to provide salmon fishing along the middle Columbia River from July through October. Lewis and Clark, during their descent of the river on October 11–20, 1805, found Sahaptin people busily engaged in drying spawned-out salmon.[16] Not everyone was so engaged, however; whole villages were absent from the river, their residents occupied in hunting or other economic pursuits. Thus there were strategic choices available in the allocation of time and effort.

Above Celilo Falls there were numerous additional fishing sites at rapids

on the Columbia or its major tributaries. Yet as one progressed upriver, the runs were delayed and the fat content of the migrating fish was progressively depleted.[17] Some runs were absent altogether from certain tributaries, and the increased dependence on a few localized breeding populations increased the likelihood of significant annual fluctuations in yield. The Dalles–Celilo Falls area therefore remained a center where surplus dried salmon could be obtained in trade for products of the hinterlands, such as dried roots and root products, Indian hemp (*Apocynum cannabinum* L.), and skins; later horses, bison robes, and slaves became important, since trade in these items was greatly enhanced by equestrian mobility. At Celilo and The Dalles, the resident population of a few hundred people might swell to 3,000 at the peak of the salmon harvest.[18] Lewis and Clark found the Indians at The Dalles still in possession of large quantities of dried salmon from the previous season in mid-April 1806,[19] indicating the value of this Columbia River entrepôt as a "hedge" against local shortages.

Other fish such as steelhead (*O. mykiss*) and whitefish (*Prosopium williamsoni*) were available nearly year-round, providing limited fresh winter rations. The abundance and reliability of the fishery is further indicated by the exercise of cultural preferences. The Sahaptins, for example, disdained sturgeon (*Acipenser transmontanus*),[20] an important food fish on the lower Columbia and Fraser Rivers.

Foods Which Are Picked

"Foods which are picked" is a Sahaptin food category that might be glossed as "fruits and berries" except that it also includes a lichen reminiscent of Spanish moss, which is "picked" from the branches of forest trees. The moss is rich in several mineral nutrients but requires elaborate processing.[21] Low-elevation species such as the early fruiting golden currant (*Ribes aureum* Pursh) and dogwood (*Cornus stolonifera* Michx.), available in June, and the chokecherry (*Prunus virginiana* L.), serviceberry (*Amelenchier alnifolia* Nutt.), and blue elderberry (*Sambucus cerulea* Raf.) were harvested in conjunction with summer salmon fishing. Sahaptins, however, generally placed greater emphasis on the various huckleberry and blueberry species (*Vaccinium* spp.), which are most abundant near timberline in the Cascade Mountains. Most families forsook salmon fishing in favor of berrying from mid-August through September. French reports that at least in the Mount Hood and Mount Jefferson region, systematic burning was practiced to open up montane areas and improve huckleberry yields.[22] Many fruits were dried for storage over winter.

Hunting engaged the men while the women gathered huckleberries. The late summer upslope movement of human beings seeking fruits paralleled the migration of their major ungulate prey, the mule deer.[23] Hunting was practiced year-round, as fishing-and-root-and-berry-oriented population movements allowed. The timing and techniques of hunting were as varied as the prey, which ranged from diminutive Townsend's ground squirrels (*Citellus townsendii*), extracted from their burrows in spring by being twisted on a willow stick, and cottontail rabbits (*Sylvilagus nuttallii*), the object of cooperative net drives, to black bear (*Ursus americanus*), bearded in their winter dens.

In sum, the plateau provided abundant and varied subsistence resources to people willing and able to range seasonally over an extensive area of diverse habitat, from desert basins to the alpine zone. Stockpiling substantial surpluses of processed food for winter consumption was an essential component of this subsistence strategy.

RESOURCE MANAGEMENT: PLATEAU AND NORTHWEST COAST COMPARED

The Columbia Plateau contrasts sharply with the adjacent Northwest Coast culture area in terms of actual resource-use restrictions and conservation practices by Native Americans. On the coast, the rights of families and local village groups to control and harvest specific resources at specific sites were highly developed and often heritable.[24] A wide variety of resources was so controlled, including salmon fishing sites, halibut shoals, shellfish beds, camas, bracken, clover and berry patches, crabapple orchards, and mountain goat hunting ranges. If permission were formally requested, and if the owner had harvested a sufficient quantity, non-owners might share the resource.[25] However, warfare motivated by and/or resulting in territorial aggrandizement apparently was common.[26] Environmental manipulations designed to improve yields, such as burning and various types of cultivation, were also widely reported.[27]

In contrast, resources in the plateau were harvested in common. Individuals apparently were free to travel over great distances and to harvest resources freely in the course of their travels.[28] Typical are accounts of several thousand men, women, and children peaceably sharing the abundance of a camas field, a bitterroot-lomatium zone,[29] a favored berrying and hunting

ground,[30] or a concentration point for migrating fish.[31] At these sites, families might camp in traditional locations[32] and harvest within traditionally limited sections of the camas meadow,[33] but there is no evidence of conflict over use rights or of efforts by owners to restrict access by others to the resources at these collocations. Nor are there reliable reports of violent confrontations between plateau groups over access to indigenous resources.[34] Accounts of controlled burning,[35] cultivation, or explicit conservation practices are few and scattered, though the general proscriptions against waste associated with animistic belief systems are acknowledged in myth.[36]

There is one notable exception to this contrast between coast and plateau approaches to resource management. At Celilo Falls and at The Dalles in Chinookan territory immediately downstream, a family controlled each fishing platform and well-situated point of rock;[37] these rights were heritable. A "salmon chief" was empowered to open and close the fishing daily to allow escapement and to regulate the onset of the spring Chinook salmon harvest.

This intensity of resource management is anomalous in the larger plateau context, and it is tempting to attribute it to the fact that the salmon resource at The Dalles and Celilo Falls was uniquely concentrated and predictable—and thus particularly defensible.[38] The typical plateau pattern of use-in-common held force, however, at the region's second largest fishery, at Kettle Falls in the Okanogan Salish life-range. At Kettle Falls, salmon were distributed equally to all comers, apparently without regard for group of origin or kinship connection. The salmon chief's role there seems to have been essentially ritualistic rather than managerial.[39] Similarly, the explanation of restricted access to a resource in terms of the predictability and concentration of that resource cannot account for the plateau pattern of camas utilization, since camas is an eminently concentrated and predictable resource. Nor does this explanation account for the fact that camas, berries, shellfish, and game were harvested by both coastal and plateau people but were explicitly owned and managed on the coast while being exploited in common and apparently not regularly managed in the plateau.

A more convincing explanation must account not simply for the intrinsic characteristics of particular resource species, such as their concentration or predictability, but also for the interaction of the subsistence strategy with those resource characteristics. Here again plateau and coastal people contrast. The coastal people tended to be more sedentary and to exhibit a greater tendency toward subsistence specialization than did upriver groups along the Skagit,[40] the Cowlitz,[41] the Nooksack,[42] and other coastal rivers. A similar difference can be seen between groups occupying the outer coasts

and those of the sheltered inland waters.[43] This variation resulted not so much from the degree of concentration of any *particular* resource or from the abundance of all the resources within the region; rather, it resulted from the fact that the shorewise concentration of a *variety* of key resources favored exploiting closely spaced rather than widely separated habitat patches.[44] This strategy was also consistent with a seasonal round that was independent of variations in elevation.

In the plateau, a balanced and varied diet was obtained by means of extensive upslope movements in spring and fall. The major caloric resources, bitterroot and the lomatiums, apparently defined this basic seasonal rhythm by virtue of their annual growth characteristics. Their restricted temporal availability combined with their widespread but patchy spatial distribution to protect them from overexploitation by requiring their human predators to be highly mobile. Perhaps the plateau people were incapable of depleting bitterroot and lomatium populations during their brief annual availability. In such cases, direct resource management through territoriality or conservation does not pay because it is superfluous. Furthermore, to get the most from the key plateau energy sources, Sahaptin households had to adopt a strategy of movement that incidentally limited their impact on more concentrated and less temporally restricted staples such as camas and salmon. In short, *time* rather than any specific resource may have been the factor limiting the intensity of resource exploitation in the plateau—the time required to move from one widely separated resource concentration to the next.

As Lewis and Clark descended the Columbia River in 1805 they noticed a dramatic change from mat-covered to cedar plank lodges just below Celilo Falls.[45] This material culture boundary coincided with the linguistic distinction between Sahaptin and Chinookan; it also marked a transition from Columbia Plateau to Northwest Coast cultural orientations. One key aspect of this was a transition to a more specialized, river-oriented subsistence economy and a less mobile lifestyle toward the coast, symbolized by the degree of portability of material used in house construction. Perhaps the anomalous pattern of resource management at Celilo Falls is best interpreted as a reflection of this coastal cultural influence rather than as an ecological response.

CIRCUMSTANCES THAT LIMIT RESOURCE USE: AN EVOLUTIONARY PERSPECTIVE

There are at least three situations in which humans may exploit a resource species at a level below that which in theory could be sustained without

the species experiencing a population decline. Each type of restricted resource use has evolutionary implications. The three types of restricted resource use may be divided between *direct* and *epiphenomenal*, and direct limitations on resource use can be further divided into *exclusive* and *inclusive*.

Direct and exclusive limitation on resource use involves *territoriality*, which may be defined as any restriction on access to a resource based on group membership. Typically, territoriality involves "ownership" of land or resources with enforceable rights to restrict access by non-owners. Direct and inclusive limitation involves *conservation*, which may be defined as a culturally sanctioned pattern of restricted resource use imposed upon the members of the resource-controlling group. Conservation may be manifested in a variety of ways: by an ideology that mandates supernatural sanctions against waste; by harvest practices designed to spare a resource, such as leaving a portion of a tuber for regeneration; by selective hunting practices designed to spare reproductive females; and so on. Epiphenomenal restrictions on resource use differ from direct restrictions because they are by-products of some other conduct. For example, the use of an animal species may be limited by the species' migratory behavior.

In both types of direct restricted resource use, a direct cost is incurred. In a territorial system, the resource owner must pay the cost of preventing outsiders from using the resource through force or litigation. In the case of conservation, there is the "conservation cost" of some added labor per unit of resource harvested—for example, the cost in efficiency of harvest consequent to digging up a tuber and then leaving a portion for regeneration.

The theory of natural selection requires that the costs incurred be justified by a compensating selective advantage to the individuals who must pay the cost.[46] For example, in the case of territoriality, those who pay the cost of defending the territory are the same people who benefit from the rights of ownership, which may assure them a more secure food supply. Those who avoid the costs of territorial defense by defending no territory may suffer in the case of shortages, since they will not be able to limit the harvests of others. Their population will decline relative to those who defend adequate resources. Thus territoriality may make evolutionary sense in an environment characterized by the expectation of shortages. In contrast, conservation is evolutionarily problematic because "wasteful" individuals may cheat the system, thus avoiding the costs of conserving while suffering no more from shortages than conservers do. If "conservation costs" are minimal, however, and cultural sanctions against cheaters are effective, a conservation strategy could evolve by natural selection.

Epiphenomenal restrictions on resource use differ from direct restrictions because no direct costs are incurred. The only "costs" are those of opportunities not taken. An example is the "buffer zone" phenomenon described by Harold Hickerson, in which resource conservation is an epiphenomenon of warfare: a no-man's-land between two warring tribes becomes a wildlife refuge because hunters do not visit the area for fear of becoming casualties in the war.[47] In this instance it is warfare, not conservation, that requires evolutionary explanation.

The familiar recourse to technological limitation to explain the sparing of resources by preindustrial people is a good example of an epiphenomenal restriction but a poor explanation: it is sometimes argued that Eskimo whale hunters limited to harpoons constructed of locally available materials, bison hunters of the Great Plains armed with bows and arrows or stone-tipped spears, or hunters of beaver and caribou in the Canadian forests lacking firearms and steel traps were simply technologically incapable of exterminating their prey. Calvin Martin argues, in contrast, that the Canadian forest hunters of beaver lacked not the technological capacity but rather the motivation required to pursue their prey to extinction—at least, that is, prior to the ravages of epidemic disease following European contact.[48] In any case, the sparing of resources is not an epiphenomenon of technological limitation, because the existing technology may always be employed by more people, thus circumventing the so-called limitation. The human use of technology is an integral part of a culturally defined strategy for making a living, which includes a more or less explicit "population policy." The sparing of resources may, however, be an epiphenomenon of the subsistence strategy.

Columbia Plateau resources were spared primarily as an epiphenomenon of the highly mobile subsistence strategy that characterized the region. Thus, neither territoriality nor a conservation ideology (as defined here) was the effective means of plateau resource management.

DISCUSSION AND CONCLUSION

I have argued that restrictions on resource use may either result from direct efforts at resource management or be incidental to strategic decisions that are motivated by factors unrelated to conservation per se. In the latter case, they are what I call here epiphenomenal restrictions. The striking contrast between the degree to which resources were directly managed in the Columbia Plateau as opposed to the Northwest Coast is a function of the contrast-

ing subsistence strategies characteristic of the two regions. Coastal strategies focused on littoral resources within easy reach and control of a home base occupied for most of the year. Plateau strategies were characterized by extensive seasonal movements patterned after the temporal and spatial distribution of key carbohydrate resources.

As a general rule, if groups of equal size vary in mobility, the more mobile group will exploit its resources less intensively than the less mobile group. This is a simple consequence of not being able to be in more than one place at a time. The apparent lack of direct resource management practices in the aboriginal Columbia Plateau, in contrast to the Northwest Coast, may best be explained by reference to the greater mobility consequent to the plateau subsistence strategy. That strategy was tailored to the distributional facts of the plateau resources selected as staples, but it was not the only conceivable strategy for survival in this environment. Plateau people might well have adopted a more specialized riverine orientation comparable to that of their Chinookan neighbors downstream, which might have supported increases in overall population density. Alternatively, groups of plateau people might have developed increasing specialization coupled with regional commodity exchanges. They did not. The fact that direct resource management was not an obvious concern on the plateau suggests that the plateau resource base could have supported more intense exploitation and that this remained a viable evolutionary option at the time of European contact. In sum, the plateau case suggests that an evolutionarily stable subsistence strategy is possible in the absence of both territorial defense and altruistic conservation practices. The "tragedy of the commons" may prove to be a special case.[49]

NOTES

An earlier version of this essay was previously published as "Mobility as a Factor Limiting Resource Use in the Columbia Plateau of North America," in *Resource Managers: North American and Australian Hunter-Gatherers*, eds. Nancy M. Williams and Eugene S. Hunn (Boulder, Colo.: Westview Press, 1982). Reprinted with the permission of the American Association for the Advancement of Science.

1. Luther S. Cressman, *Prehistory of the Far West: Homes of Vanished Peoples* (Salt Lake City: University of Utah Press, 1977).

2. Eugene S. Hunn, *Nch'I Wana "The Big River": Mid-Columbia Indians and Their Land* (Seattle: University of Washington Press, 1990).

3. *Ibid.*

4. C. M. Nelson, "Prehistoric Culture Change in the Intermontane Plateau of Western North America," in *The Explanation of Culture Change: Models in Prehistory*, ed. Colin Renfrew (London: Duckworth, 1973), pp. 371–90.

5. Verne F. Ray, *Cultural Relations in the Plateau of Northwestern America* (Los Angeles: Southwest Museum, Publications of the Frederick Webb Hodge Anniversary Publication Fund 3:13, 1939).

6. Eugene S. Hunn, "On the Relative Contribution of Men and Women to Subsistence among Hunter-Gatherers of the Columbia Plateau: A Comparison with Ethnographic Atlas Summaries," *Journal of Ethnobiology* 1 (1981): 124–34; Eugene S. Hunn and David H. French, "*Lomatium*: A Key Resource for Columbia Plateau Native Subsistence," *Northwest Science* 55 (1981): 87–95.

7. Gordon W. Hewes, "Indian Fisheries Productivity in Pre-Contact Times in the Pacific Salmon Area," *Northwest Anthropological Research Notes* 7 (1973): 133–55; Hunn, "On the Relative Contribution of Men and Women."

8. Its fresh growth is particularly high in vitamin C. E. M. Benson, J. M. Peters, M. A. Edwards, and L. A. Hagen, "Wild Edible Plants of the Pacific Northwest," *Journal of the American Dietetic Association* 62 (1973): 143–47; P. B. Keeley, *Nutrient Composition of Selected Important Plant Foods of the Pre-Contact Diet of the Northwest Native American Peoples* (M.S. thesis, University of Washington, 1980).

9. Keeley, *Nutrient Composition of Selected Important Plant Foods*.

10. Alexander Ross, *The Fur Hunters of the Far West*, ed. Kenneth A. Spaulding (Norman: University of Oklahoma Press, 1956), pp. 22–28. Ross's estimate of 10,000 seems excessive by an order of magnitude.

11. Alan G. Marshall, "Nez Perce Social Groups: An Ecological Interpretation" (Ph.D. diss., Washington State University, 1977), pp. 55–56.

12. *Original Journals of the Lewis and Clark Expedition, 1804–1806*, ed. Reuben G. Thwaites (New York: Dodd, Mead, and Co., 1905), 4: 294, 3: 173–74.

13. Eugene S. Hunn, "Sahaptin Fish Classification," *Northwest Anthropological Research Notes* 14 (1980): 1–19; *Original Journals of the Lewis and Clark Expedition*, 4: 290, 328.

14. Hunn, "Sahaptin Fish Classification."

15. Joseph Craig and Robert L. Hacker, *The History and Development of the Fisheries of the Columbia River*, National Marine Fisheries Service Fishery Bulletin 32 (Washington, D.C.: Government Printing Office, 1940), pp. 135–37.

16. *Original Journals of the Lewis and Clark Expedition*, 3:107–40.

17. D. R. Idler and W. A. Clemens, *The Energy Expenditures of Fraser River*

Sockeye Salmon during the Spawning Migration of Chilko and Stuart Lakes (New Westminster, B.C.: International Pacific Salmon Fisheries Commission, Progress Report no. 6, 1959); Hunn, "On the Relative Contribution of Men and Women."

18. Alexander Ross, "Adventures of the First Settlers on the Oregon or Columbia River," in *Early Western Travels, 1748–1846*, ed. Reuben G. Thwaites (1849; reprint, Cleveland: Arthur H. Clark, 1904), 7: 123.

19. *Original Journals of the Lewis and Clark Expedition*, 3: 288.

20. Cf. *Original Journals of the Lewis and Clark Expedition*, 3: 290.

21. Nancy Turner, "Economic Importance of Black Tree Lichen (*Bryoria fremontii*) to the Indians of Western North America," *Economic Botany* 31 (1977): 461–70.

22. David H. French, "Aboriginal Control of Huckleberry Yield in the Northwest," paper read at the annual meeting of the American Anthropological Association, Chicago, 1957.

23. Marshall, "Aboriginal Nez Perce Subsistence."

24. Allan Richardson, "The Control of Productive Resources on the Northwest Coast of North America," in *Resource Managers: North American and Australian Hunter-Gatherers*, eds. Nancy M. Williams and Eugene S. Hunn (Boulder: Westview Press, 1982), pp. 93–112.

25. Nancy Turner, *Food Plants of British Columbia Indians, part 1: Coastal Peoples* (Victoria: British Columbia Provincial Museum, Handbook no. 34, 1975), pp. 129, 152, 187, 191, 221.

26. E.g., Wayne P. Suttles, "Economic Life of the Coast Salish of Haro and Rosario Straits" (Ph.D. diss., University of Washington, 1951).

27. June M. Collins, *Valley of the Spirits: The Upper Skagit Indians of Western Washington* (Seattle: University of Washington Press, 1974), p. 55; A. B. Reagan, "Plants Used by the Hoh and Quileute Indians," *Proceedings of the Kansas Academy of Science* 37 (1934): 55–70, 56–57; Turner, *Food Plants of British Columbia Indians*, pp. 68, 81, 150, 164, 203; Richard White, "Indian Land Use and Environmental Change," *Arizona and the West* 17 (1975): 327–38, pp. 331, 333; H. G. Zenk, "Contributions to Tualatin Ethnography: Subsistence and Ethnobiology" (M.A. thesis, Portland State University, 1976), pp. 22–25.

28. Deward E. Walker, *Mutual Cross-Utilization of Economic Resources in the Plateau: An Example from Aboriginal Nez Perce Fishing Practices* (Pullman: Washington State University, Laboratory of Anthropology Report of Investigations no. 41, 1967).

29. N. Washington, "Tsukalorsa (*Lomatium canbyi*): Key to Understanding Central Washington Nonriverine Archaeology," paper presented to the twenty-ninth annual Northwest Anthropological Conference, April 10, 1976, Ellensburg, Washington.

30. George Gibbs, "Report of Mr. George Gibbs to Captain McClellan, on the Indian tribes of the Territory of Washington, Pacific Railroad Report," in *Report of the Secretary of War* (Washington, D.C.: Government Printing Office, 1854), vol. 1, p. 404; Helen H. Schuster, "Yakima Indian Traditionalism: A Study in Continuity and Change" (Ph.D. diss., University of Washington, 1975), p. 85.

31. Verne F. Ray, "Native Villages and Groupings of the Columbia Basin," *Pacific Northwest Quarterly* 27 (1936): 99–152, p. 142.

32. Haruo Aoki, "Nez Perce Texts," *University of California Publications in Linguistics* 90 (1979): 81–85.

33. Marshall, "Nez Perce Social Groups."

34. For a rare exception, see Click Relander, *Drummers and Dreamers: The Story of Smowhala the Prophet and His Nephew Puck Hyah Toot, the Last Prophet of the Nearly Extinct River People, the Last Wanapums* (Caldwell, Idaho: Caxton Printers, 1956), p. 312.

35. French, "Aboriginal Control of Huckleberry Yield."

36. M. Jacobs, "Northwest Sahaptin Texts, 1," *University of Washington Publications in Anthropology* 2 (1929): 175–244, 196–200.

37. Leslie Spier and Edward Sapir, "Wishram Ethnography," *University of Washington Publications in Anthropology* 3 (1930): 151–300, 175. A family's ability to restrict use was tempered, however, since individuals were entitled to exercise fishing rights on the basis of extended kin links. Because the peoples of the plateau frequently intermarried across dialect and language boundaries, fishing rights were not restricted to local residents. Similarly, the elderly were entitled to fish for their immediate needs on request.

38. R. Dyson-Hudson and E. A. Smith, "Human Territoriality: An Ecological Reassessment," *American Anthropologist* 80 (1978): 21–41.

39. R. Bouchard and D.I.D. Kennedy, "Utilization of Fish by the Colville Okanagan Indian People," *British Columbia Indian Language Projects* (Victoria, B.C.: Ms., 1975); Verne F. Ray, "The Sanpoil and Nespelem: Salishan Peoples of Northeastern Washington," *University of Washington Publications in Anthropology* 5 (1933): 69–75.

40. Collins, *Valley of the Spirits*.

41. Verne F. Ray, *Handbook of Coeluz Indians* (Seattle: Northwest Copy Co., 1966).

42. Pamela Amoss, *Coast Salish Spirit Dancing: The Survival of an Ancestral Religion* (Seattle: University of Washington Press, 1978).

43. Philip Drucker, *The Northern and Central Nootkan Tribes*, Bureau of American Ethnology Bulletin no. 144 (Washington, D.C.: Government Printing Office, 1951).

44. Cf. Richard A. Gould, "To Have and Have Not: The Ecology of Sharing among Hunter-Gatherers," in Williams and Hunn, *Resource Managers*, pp. 69–91.

45. *Original Journals of the Lewis and Clark Expedition*, 3: 154.

46. Ronald Dawkins, *The Selfish Gene* (New York: Oxford University Press, 1976).

47. Harold Hickerson, "The Virginia Deer and Intertribal Buffer Zones in the Upper Mississippi Valley," in *Man, Culture, and Animals: The Role of Animals in Human Ecological Adjustments*, eds. Anthony Leeds and Andrew P. Vayda (Washington, D.C.: American Association for the Advancement of Science, 1965), pp. 43–66.

48. Calvin Martin, *Keepers of the Game: Indian-Animal Relationships and the Fur Trade* (Berkeley: University of California Press, 1978).

49. Garrett Hardin, "The Tragedy of the Commons," *Science* 162 (1968): 1243–48.