

nary officer works with the rancher until the infection is eliminated.

Recently, the federal government proposed withdrawing much of the funding for the brucellosis program in 1990. This forces the remaining states with the disease to intensify eradication programs or face possible restrictions from their disease-free neighbors.

Prevention and Control

Because of the economic losses to the livestock industry and the public hazard, it is necessary to actively control the occurrence of brucellosis in animals. There are two basic methods for controlling the disease: isolation and slaughter of animals with the disease and immunization by vaccination with live strains of *Brucella*.

It is recommended that female calves from 4 to 12 months old be vaccinated with strain 19 vaccine in areas of high infection rate. This vaccine is a lyophilized agglutinogenic strain of *Brucella abortus*. The U.S. Department of Agriculture is in charge of maintaining the strain 19

vaccine and providing culture stocks. In 1987 a total of 9.1 million calves were vaccinated.

The individual state governments maintain various forms of control over the importing of breeding cattle. Usually a brucellosis test within 30 days of the date of movement across state lines is required. Some states may not allow the importing of animals from herds that have been quarantined in other states even if they pass the brucellosis test. The best form of enforcement of laws and regulations concerning brucellosis is for informed ranchers to be aware that they are protecting their own investment when they adhere to the regulations.

In human populations, the pasteurization of milk is one of the best means of preventing human brucellosis. Veterinarians, farmers, and meat packers should observe strict rules of sanitation. There is a real need for public awareness for all aspects of the brucellosis problem, because there is always the possibility for modification of the organism, resulting in an explosive outbreak of the disease and thus becoming a problem to livestock producers as well as a continuing threat to public health.

Changes from Free to Fee Hunting

Delwin E. Benson

The issue of managing for wildlife and natural resource values on private and public lands is a growing concern. Sport hunting is a common denominator for interaction among landowners, users, and resource managers. Hunting can provide an income from the land, serve as a population regulation tool for large animals, and provide for recreation and food supply.

Private lands produce and maintain game animals. Landowners are asked to share their property rights with hunters as recreational demands increase. The idea of hunting on private land with no access costs is changing to paying for access privileges.

There is also a growing interest about charging for hunting (and other recreation) on public lands. Big game hunting, especially, represents a value of public lands where large sources of biomass (animals) are produced and removed without commensurate generation of revenue for management. This paper reviews the causes of change from free to fee hunting, the context in which it occurs, consequences of change, and implications for the future.

Cause of Change

Hunting has definite problems of supply and demand. Demand for hunting is high even though hunter numbers were down slightly from 17.4 million in 1980 to 16.7 million in 1985a. According to the United States Fish and

Wildlife Service 1985 National Survey of Fishing, Hunting and Associated Recreation. Hunting generated \$10.1 billion in the U.S. during 1985. Supply of hunting opportunities may be decreasing however. A 1986 survey of hunters by National Family Opinion Research Inc., provided insight about why hunters have become discouraged. The top five factors were:

1. Poor access to hunting land;
2. Crowded hunting areas;
3. Finding time to go hunting;
4. Less cooperation from landowners; and
5. Less game in general.

In the East, Brown et al. (1984) reported a steady increase of lands being posted against hunting access in New York between 1963 and 1980. By 1980, approximately 50% of the private land in upstate New York was posted. If posting continued to increase at rates experienced between 1963 and 1972, all private land in New York would be posted in 1993. In the West, Guynn and Schmidt (1984) reported that 79% of private land was closed to hunting in Colorado during 1977, up from 68% in 1969 (Rounds 1975).

Access was considered a major problem by wildlife administrators in 26 of the 50 states (Wright and Kaiser 1986). In western states with 16-75% of the area in public land, 91% of administrators indicated that access was a major problem. In contrast, states where public lands occupied $\leq 15\%$ of the area, 57% of administrators felt that hunter access was a minor problem.

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Insufficient access by hunters has important economic and political implications for wildlife management. Primary sources of funds for wildlife management programs include: licenses; excise taxes on sporting goods; and other sportsmen-generated revenues. As opportunity for hunting declines, so do hunter numbers, revenues for wildlife programs, and political support for wildlife.

Fee hunting can promote the opening of closed private lands for access and promote better management of public lands for wildlife. Conversely, fees can discourage hunters.

Context of Change

Definitions for ownership and access to wildlife on private lands must be addressed to fully understand the "fee or free" hunting problem. Wildlife belongs to the people of the U.S., but access to wildlife on private land is controlled by the landowners. Bean (1977) reviewed the evolution, application, and improvement of federal wildlife law and concluded that wildlife in the United States was not the private property of any individual or group but was the collective property of all the people. Government (state and federal) has a paramount role as public trustee in the task of wildlife conservation.

Property rights, however, include access controls to land held by private owners, groups of owners, and their operators. "Ownership of land has not carried any obligation or responsibility on behalf of the owner to use it for the public interest" (Binger 1975). State and federal agencies can execute their role as trustee for wildlife on national interest, public lands; yet roles and relationships for managing wildlife on private lands are much less clear. Russell Train (1978) posed the rhetorical question of "Who owns wildlife?" His answer relates best to the confusion over private lands where "wildlife ... is owned by both everybody and by nobody. And, in this country as well as abroad, our approach to wildlife has, in fact, generally been governed by the familiar principle that everybody's business is nobody's business, that what belongs to everybody belongs to nobody and is, therefore, fair game for anybody."

Managing the public's wildlife on public land is one problem, but the dilemma of how to deal with the public's wildlife on private land becomes a more critical issue. Landowners are not generally able to use wildlife on their property for personal or economic gain except as provided by state and federal wildlife agencies for the public at large. This occasionally means that no opportunity exists for landowners to personally obtain licenses to hunt or to seek specific hunters on their land even though costs of producing animals were borne by private landowners. The public, through random drawing, may have a permit to hunt in the area of a landowner's property. It is easy to understand how landowners become confused and angry over wildlife on their land and express concerns about hunters who seek permission for access.

The first American Game Policy (Leopold 1930) recom-

mended three ways to include landowners to manage for wildlife:

1. Buy them out and become the landowner;
2. Compensate them directly or indirectly for producing a game crop and for the privilege of harvesting it;
3. Cede them the title to game so that they will own it and can buy and sell it just as they own, buy and sell their poultry.

The first option was considered viable for cheap lands, but prohibitive elsewhere. The second option was feasible anywhere. The third option was the "English System" and was rejected as incompatible with American tradition and thought.

Benson (1988a) reviewed examples of how the three options were used and viewed currently in the U.S. Land ownership was central to the issue.

The idea of ceding public wildlife values directly to private persons was not very popular. For example, the federal government was not successful to turn public lands over to private persons via the "Sagebrush Rebellion." Similarly, political attitudes were not favorable for converting private lands to public ownership and management.

Sentiment for converting public wildlife to private ownership is a matter of discussion among landowners, sportsmen and wildlife agency personnel. The term "privatization" has been used to describe the process of ceding wildlife ownership rights from the government to the private sector. It is also used when certain incentives are provided to landowners that formerly were under total control of state wildlife agencies. On the negative side, Kruckenberg (1987) said that "if one takes a public resource, that is managed by a public agency, for the public good—and transfers some or all of that management responsibility to the private sector, it is privatization—pure and simple. With that as a basis for definition, it should come as no surprise that the Wyoming Game and Fish Commission, and consequently the Game and Fish Department, is opposed to privatization in any way, shape or form." On the positive side, providing landowners with opportunities to be included in goal setting, making harvest objectives and decisions about hunters on their property is considered a logical way to form a partnership between producers, consumers, and the public trustees. Teer et al. (1983) Burger and Teer (1981) and Steinbach and Ramsay (1988) compared hunting systems in Texas and the U.S. with the sometimes maligned "European System" and concluded that similarities exist in some areas where private landowners are actively concerned with managing wildlife and recreation and where some hunting decisions have been conveyed to landowners. Yet, there is no private ownership of game. Rather, some of the responsibilities, authority, and advantage of wildlife are vested in the landowner by the state wildlife agency, which leads to better management. Wildlife are not privatized in this manner; they are revitalized!

Somewhere between the extremes of taking and giving rights, compensation methods for enhancing wildlife and



hunting on private land were tried with limited success (Teer et al. 1983, Burger and Teer 1981, Holecek and Westfall 1977, Benson 1976). In 1985 Wigley and Melchior (1987) conducted a survey of all state wildlife management agencies to determine the extent of state management programs for wildlife and hunting on private land. These represent forms of compensation. In 43 states, agencies had management programs for wildlife and 38 states sponsored programs to increase public access. Programs were considered successful in 48 states. Wildlife agencies perceived success, yet attitudes of hunters and landowners seemed to indicate otherwise.

Consequences of Change—Private Land

Changes in the hunting system from free access to paying fees for access is evolving on both private and public lands. Hunters may be more willing than managers and landowners to accept fee hunting and to lease private lands for access. Berryman, (1981) the lead speaker at the conference about "Wildlife Management on Private Lands," said that "the plain average sportsman has been ahead of the professionals and the administrators, and has been willing for many years to accept the kind of system that will assure the future of habitat and the opportunity to harvest game surpluses."

Wiggers and Rootes (1987:526) surveyed the views of the nation's wildlife agencies about private land operators who lease land for hunting. Fifteen states, primarily in the southeast (mostly private land states) considered the amount of private land leased to be of major importance. Leasing increased in 14 states and remained stable in 12 states. Twelve states reported that lease hunting increased the amount of private land available to hunting; but 23 states said it had little effect. Four states reported a decline. Eight states reported that hunting opportunities were improved while 18 states believed that fee hunting somewhat limited the average sportsman's opportunity to hunt. Game abundance was reported to have increased on leased lands in 19 states. No state reported that abundance had declined. Most wildlife agencies reported that economic gains from lease hunting had not influenced landowners to make habitat improvements. Habitat improvements on leased land were reported by 8 states. No improvements were reported by 31 states. This summary may reflect the lack of knowledge and responsibility by wildlife agency professionals for private land work. Wildlife agencies have traditionally had less direct interest, contact, and impact with the private sector.

Actual attitudes of sportsmen about fee hunting are not well reported. Langner (1987) reported that 8% of American hunters paid to use private land. Benson (1988b) reported from a random sample of 355 hunters in five states that 10% paid fees for big game, 1% for small game, 6% for upland game and 6% for waterfowl. A willingness to pay was expressed by 51% of the sample. In the same report 55% of National Wildlife Federation affiliate leaders representing 34 states expressed a willingness to pay for hunting.

Consequences of Change—Public Land

The idea of charging fees for hunting on public land is also growing. Fee hunting is a way to add values in the form of economic income from wildlife and recreation to existing non-market values. Thomas (1984) reviewed sentiment about charging user fees for managing public land. It was reported that wildlife habitats would be protected better when hunters pay for using wildlife similar to how other users pay for extracting natural resource commodities. Activities such as outdoor recreation that do not produce income will have a harder time competing with uses that produce revenue. Thomas justified fee-hunting for big game because it has a more equitable relationship with other products of forests and rangelands such as wood production and livestock use. He cited Jackson (1980) who said:

...The essential difference between game and non-game ... is the degree to which ... property rights are ... obtained When you have it in your creel or bag, it's yours ... non-game wildlife never becomes the property of an individual The "lucky" hunters convert a capital item to non-durable goods ... title ... is transferred from the state to the ... individual (Hunters) privatize the commons.

These economic sentiments do not suggest that aesthetic and other non-market values should be overlooked. Aesthetic values of wildlife and public lands should always remain high. By adding a market component through fee hunting, the commodity values of wildlife and hunting would be added to the bundle of non-market values.

Judgments about Consequences and Results of Change

The most significant change taking place due to fee hunting is that wildlife and recreational values are being positively expanded and included in decision-making by the private and public sectors. Benefits are derived by landowners, land agencies, land users, and managers of wildlife and recreation.

Public and private sectors must weigh aesthetic and economic justifications when searching for alternatives. Public lands were intended for public and national interest values, thus one could argue that aesthetic reasons are justification alone for providing wildlife and recreational opportunities. Economic realities cannot be overlooked, however. Economics is part of the language for decision making. Cost and benefit ratios are considered by private and public land operators when making decisions. Aesthetics do not provide food, shelter, security, and competitive advantage; thus economics plays a significant role in land use decisions.

Hunters will benefit from fee hunting. Charges on public lands will not likely be high enough to exclude users, so fears of not being able to afford hunting are unlikely. Hunters already make payments toward hunting, but little goes directly to the resource. The 1985 United States Fish and Wildlife Service "National Survey of Fishing and Hunting and Associated Recreation" determined that 55% of wildlife-associated recreation expenditures were

for equipment, 39% were trip-related, 5% were other, and 1% was for licenses, stamps, tags, permits, etc. It seems desirable and necessary that a higher percentage of hunting expenditures should be spent directly toward the base of resource production, namely the private and public lands.

Hunters often seek access to private lands because there is: less crowding; known companions; lack of competition for camping and hunting areas; freedom of choice; and better success. Hunters are able to plan recreational experiences with less uncertainty and greater ability to attain the goals.

Hunters who become more dedicated and committed participants will likely become more intense and valued supporters of wildlife and land stewardship. I hypothesize that fees paid to private landowners along with lease agreements create a contract (formal and informal) that enhances the bonding of hunters to the landowner, land, wildlife, and recreational activity. This should lead to higher quality hunters and a more positive image of hunters. Unfortunately, I predict that user fees paid to federal agencies will not have the same bonding benefits.

Wildlife agencies will benefit from improved hunter behavior, increased opportunities for hunting on private land, and increased bargaining power for hunting and wildlife values on all lands. More hunters will lead to increased revenues for license sales. Agencies will be able to work more closely with landowners to develop management plans for private properties. The site-specific management knowledge from private lands will be added to more broadbased statewide plans to increase sophistication of information for overall wildlife, habitat, and recreation enhancement.

Society and the environment will be the greatest benefactors. Increased interest in wildlife will lead to improved habitats and animal populations on private and public land. The public will also receive direct benefits from improved wildlife-based recreational and aesthetic experiences.

Projected Future Direction—Conclusion

Obtaining direct economic values from wildlife on private and public land has led to maintenance of wildlife populations in other parts of the world. Western Europe, Great Britain, southern Africa, Australia, and New Zealand have evolved an economic component to wildlife and hunting management on private and public land. Eastern Europe has economic value on state and private land. Both the East and West have hunting fraternities that are dedicated and committed to their sport whether on state or privately owned lands.

Western Europe and Great Britain provide the historical roots of law for U.S. wildlife management and hunting. This part of the world may also provide hints to the future of programs in the U.S. Aristocratic, feudal approaches to wildlife values and hunting were rejected by Americans, but the new "European" systems do not resemble the old ways either. Europe has maintained high wildlife popula-

tions and hunting opportunities in spite of dense human populations. Hunters and landowners work together to encourage wildlife, to provide hunting, and to reduce forest damage. The U.S. may be able to learn from these countries who maintain wildlife and hunting recreation in spite of 10 fold population differences.

Alternatives to fee hunting are too few. Leopold's (1930) alternatives of buying hunting rights, ceding rights and compensating for rights seemed rather complete. One alternative that is missing would remove access controls from private ownership and allow public access to private land. This alternative has merit in densely populated areas, but is not currently advocated for hunting in the U.S.

Compensating mechanisms outside the direct market place have not worked well enough mostly because landowners gave up more than they received. The incentives were only real for the consumers and managers, not for the producers of wildlife and recreation. Economic incentives provide a direct linkage between landowners, users, and land managers.

New challenges await managers of range and forest lands. Those landscapes will have greater value for wildlife and recreation, thus management strategies must reflect the needs of wildlife and users. Grazing and timber harvest can still be compatible with recreation and wildlife values, but a more holistic approach to management will be necessary. Holism cannot be defined as how everything integrates into cattle or tree production, however. Rather, holism must integrate components of the environment with values of humans into the best system for environmental integrity and use. Hunting should fit well into that process. Fees will help to maintain and communicate hunting values. Fees will link producers, consumers, and land managers into a system of cooperative stewardship.

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Cryptogamic Soil Crusts in Arid Ecosystems

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Observant travelers of desert and arid lands frequently notice the dark, lumpy surface crusts of the soil. These soil crusts are formed by cryptogamic plants which reproduce by means of spores; they do not produce flowers or seeds. Cryptogamic communities grow on or directly under the soil surface. A well-developed community forms a distinguishable, dark crust. These crusts are important because they stabilize and protect otherwise sparsely vegetated desert soils from the natural forces of water and wind erosion (Kleiner and Harper 1972). These biologically active crusts influence soil properties, such as moisture holding capacity, infiltration rate, organic matter content, texture (Fletcher and Martin 1948, Bond and Harris 1964), and fix atmospheric nitrogen (Sheilds et al. 1957).

Unfortunately, these crusts are fragile, and easily damaged or destroyed. Range management practices have generally ignored the importance of cryptogamic crusts, although livestock grazing and recreational use have impacted the soil crust over much of its range, degrading the health of desert ecosystems (Brotherson et al. 1983).

Cryptogamic crusts harbor many different species, and composition varies with region and substrate (Rogers

and Lange 1971, Anderson and Rushforth 1976). Algae are usually the dominant genera. Lichens and mosses are also important components of crusts on rangelands (Brotherson et al. 1983).

Cryptogamic soil crusts are found world-wide in arid environments. In the United States, the most well-developed crusts are found on soils derived from gypsum in southern Utah and Nevada, and northern Arizona. Crusts can also be found in California, Colorado, New Mexico, Oregon, Washington, Wyoming, and throughout many of the plains states north into Canada (Anderson et al. 1982, Looman 1964). Cryptogams are common on rangelands of Australia, especially in the south (Rogers and Lange, 1971).

Development of cryptogamic crusts depends on the influences of soil characteristics, climate, competition from vascular plants, and the effects of animal and human disturbance. Managers of western rangelands should understand the ecology of cryptogams because they may have a greater effect on productivity than the plants which are currently emphasized in traditional range condition evaluation techniques.

Cryptogamic Crust Development

Soil characteristics that are influential in crust development are surface rock, texture, and chemistry. Large areas of exposed rock do not favor extensive cryptogamic

Acknowledgements

J.W. Bartolome provided criticism and comments on this paper, and I extend my thanks to him. Also, Cindi Jones, Amy Beaton Dunne, Lenny Brennan, Bill Block, Marc Liverman, and *Rangelands* reviewers gave necessary critiques.