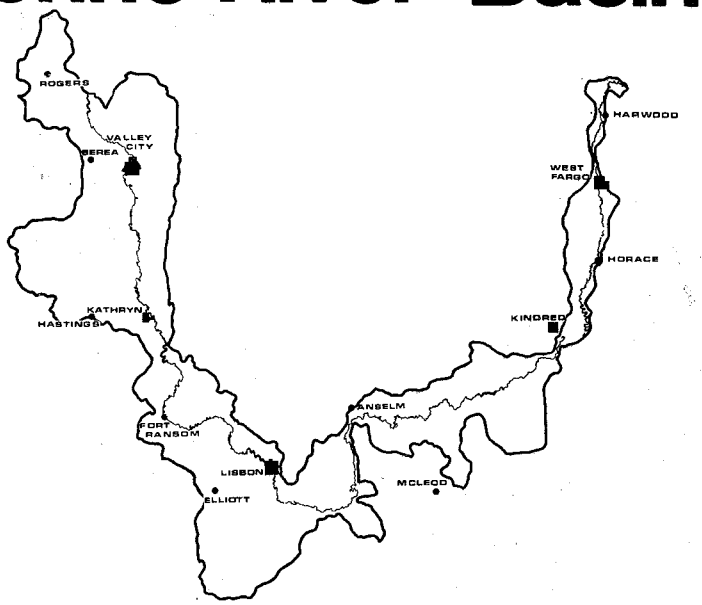
Agricultural Economics
Report No. 114

July 1976

Economic Value Of Wildlife In The Lower Sheyenne River Basin

Comparison of Four Measurement Techniques



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FOREWORD

Wildlife is continually being reduced in numbers due to man's activities which are competitive with wildlife for the use of land. The authors hope that this report will assist individuals and groups in making decisions affecting the future population of wildlife.

We extend our appreciation to the following persons for their comments and information:

Donald Scott, Assistant Professor, Agricultural Economics, North Dakota State University.

George Pfeiffer, Research Associate, Agricultural Economics, North Dakota State University.

James Grier, Assistant Professor, Zoology, North Dakota State University.

William Barker, Associate Professor, Botany, North Dakota State University.

Larry Falk, Chairman, Sociology, Concordia College.

The research for this report was part of a project on land use and water quality in the Lower Sheyenne River Basin. The research is being conducted by a multidisciplinary team composed of William C. Nelson, Agricultural Economics; William T. Barker, Botany; Mary C. Bromel, Bacteriology; John A. Brophy, Geology; Delmer L. Helgeson, Agricultural Economics; and William D. MacKeller, Chemistry. The research was supported with funds from:

North Dakota Agricultural Experiment Station

North Dakota Water Resources Research Institute

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HIGHTLIGHTS

Wildlife numbers have decreased rapidly due to the elimination of habitat necessary for their survival. Objective measures of the value of wildlife are required to compare wildlife habitat to competing land uses. The most common measure of value is dollars and cents; therefore, the value of wildlife can be compared to other land uses if it is also valued in monetary terms.

The goals of this research were to estimate the economic value of the wildlife community in the Lower Sheyenne River Basin (LSRB) and to compare four techniques frequently used to estimate the economic value of wildlife. An estimate of the species composition of wildlife was determined from the literature and personal communications with State Game and Fish Department personnel. To determine the value of this wildlife, four techniques were applied to the LSRB: (1) utility value, (2) expenditures, (3) the value of comparative private recreation, and (4) wildlife land value. Resulting values (in 1974 dollars) were (1) annual utility value of $95,000 ($.11 to $1.16 per acre), (2) an annual expenditures value of $304,777 ($.36 to $4.18 per acre), (3) the annual value of alternative private recreation of $832,000 ($.98 to $14.93 per acre), and (4) the land value technique revealed an annual per acre return for wildlife of up to $33.

ECONOMIC VALUE OF WILDLIFE IN THE LOWER SHEYENNE RIVER BASIN--COMPARISON OF FOUR MEASUREMENT TECHNIQUES

by
Jay A. Leitch and William C. Nelson*

I. INTRODUCTION

Increasing attention has been focused on wildlife and the environment in recent years. This concern has been brought about by increased population, more leisure time, a better educated populus, and higher levels of pollution. Wildlife has been caught in a squeeze from two directions: diminishing habitat and increasing demand as an element of outdoor recreation (Jensen, 1973). Expanding human populations with higher incomes demand more recreation, a part of which is wildlife oriented. At the same time, the expanding population has demanded increased material goods from industry and agriculture.

> (The) increased intensity of farming effort (for example) has resulted in larger farms, consolidation of fields, more machinery, fewer fence rows, less edge effect, subsidized drainage, elimination of bushy draws, and aerial spraying of insects and weeds. In summary, ... all factors mentioned have had a tendency to decrease the amount of food and cover ... available for wildlife. (National Academy of Sciences, 1970: 123)

The net effect is the farms and croplands (that have long been recognized as major habitat for wildlife) no longer provide that habitat. The market system does not provide a mechanism effective in maintaining a sufficient quantity or quality of habitat to support wildlife. From an economic standpoint, farmers benefit most by using intensive agricultural practices. It would be irrational for them to maintain habitat for wildlife.

It may be argued from the viewpoint of society, however, a unit of wildlife is valued higher than additional units of whatever displaces that wildlife at some point on a continuum from all wildlife habitat to all other uses of land. A study in Oregon revealed that people valued flood protection

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*Leitch is a Research Assistant and Nelson is an Associate Professor, Department of Agricultural Economics, North Dakota State University, Fargo. This report is based on a M.S. thesis by Leitch titled, "Application of Five Methods for Measurement of Wildlife Value; Lower Sheyenne River Basin, North Dakota," 1975.

above wilderness maintenance, but were not willing to give up all wilderness options (Pendse and Wyckoff, 1974). The same relationship may hold true in a comparison of agriculture and wildlife. People need to eat, but there may be a point where they are no longer willing to give up wildlife habitat in order to increase food production.

Wildlife fits at a midway point on a public goods-private goods continuum. Private goods are divisible into discrete units and are bought and sold under market conditions.

> Pure public goods are produced collectively and collectively consumed. In the most restrictive case presented by Samuelson, a public good is thought to be available to everyone if it is available to anyone, and one person's usage does not detract from or reduce usage by other persons. These conditions imply a pure public good to be: (1) not divisible into discrete, identifiable units and (2) without cost to the consumer in the sense that no price is paid as a condition for use or consumption of the good. Conventional examples of pure public goods are: (1) the light from a lighthouse which is available without user cost to all ships sailing in its vicinity and is used equally and fully by all those ships and (2) national defense which is equally available to residents if it is available at all. Pure public goods are not distributed through the market and no one can be excluded from their enjoyment or use. In current terminology, a pure public good consists entirely of externalities and is available to all consumers regardless of the degree to which any one consumer or group of consumers uses it. (Gessaman, 1975)

Wildlife is divisible and some consumers can be excluded from enjoyment of wildlife. Wildlife, however, is not normally bought or sold and, by definition, is not restricted in their movement.

A problem underlying the maintenance of wildlife habitat which is common to public goods is that no individual or group assumes the responsibility for providing the good.

The provision of wildlife is most often the responsibility of government agencies. Determining the probable values of wildlife and wildlife habitat is the problem addressed in this study.

Need for the Study

Wildlife contributes to society's welfare in many ways. "The composition and condition of fish and wildlife populations serve as a barometer of the quality of the environment for man, ..." (Pecora, 1972: 13). Once a part of the wildlife community becomes extinct, it is not possible to retrieve that species. There is a need, therefore, for a mechanism by which objective values can be assigned to wildlife. Expressed in economic terms, wildlife values should be comparable to alternatives.

How does one measure the value of wildlife? During the time of settlement in North America, wildlife was an essential and abundant commodity. It was the main food source of trappers and settlers. The importance of wildlife for man's direct livelihood diminished as the country developed. Only a handful of people in North America today depend on wildlife for their well-being.

What is wildlife worth to society today? Each person may be able to express in subjective terms what it is worth to him as an individual and probably what he thinks it is worth to society. Subjective arguments, however, do not preserve wildlife habitat areas. What is needed is an acceptable method of assigning objective values.

The need for this study rests on the assumption wildlife is a public good and wildlife habitat, essential for the preservation of wildlife, is not equitably represented when weighted against private development or other land-use alternatives.

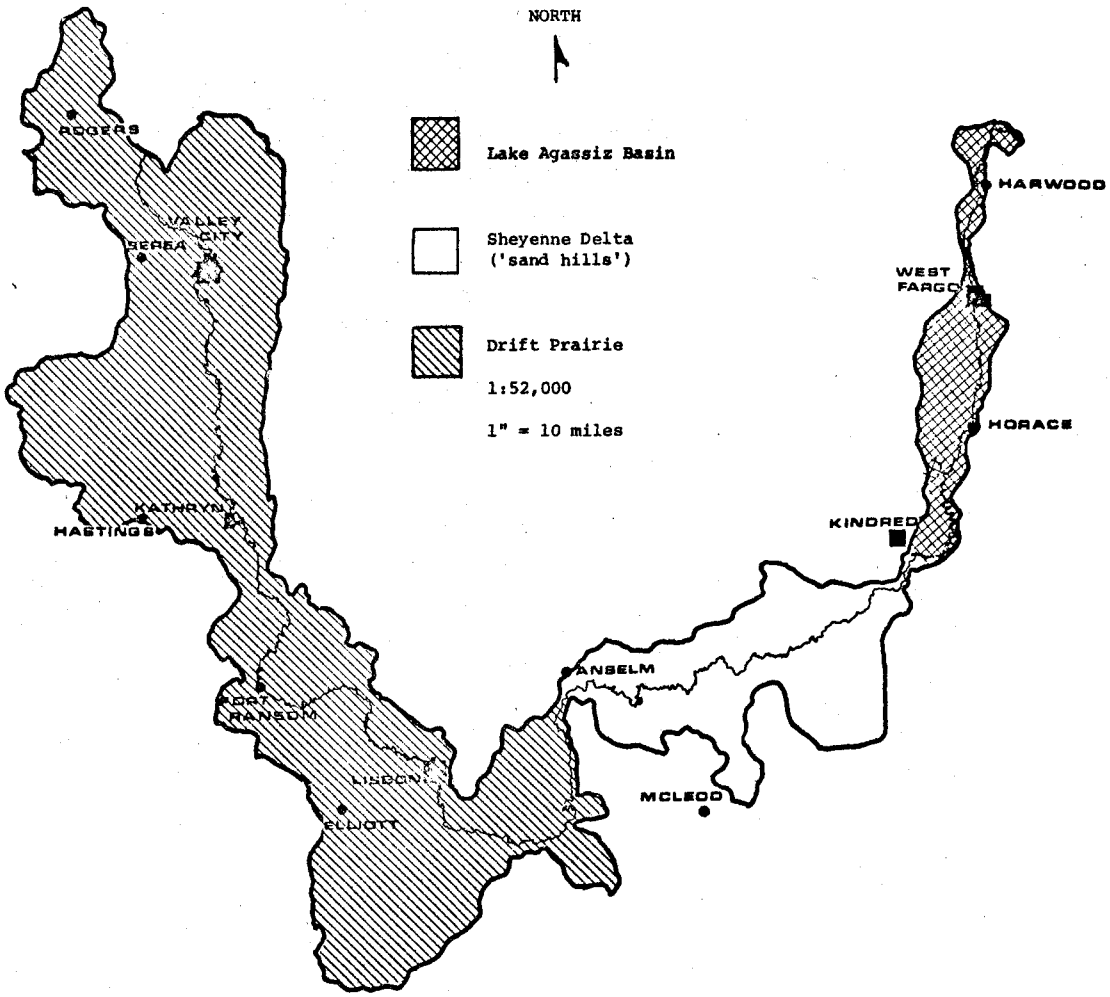
Objectives

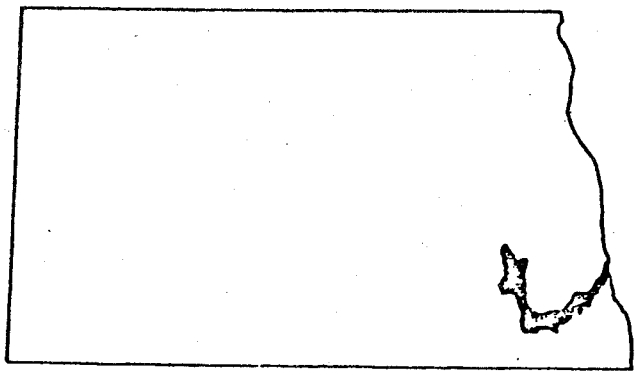
The primary objective of this study was to estimate the economic value of wildlife of the Lower Sheyenne River Basin (LSRB). The components of this objective were (1) to describe the wildlife community of the LSRB and (2) to apply and compare alternative methods of estimating values of wildlife in this area.

Study Area

The Lower Sheyenne River is the section from the Bald Hill Dam, north of Valley City, North Dakota, to its mouth on the Red River--about one-third of the total length of the river (Figure 1). This section of the river lies in a relatively deep, narrow valley for the first one-third of the distance, then drops from the Manitoba Escarpment through a delta region and meanders across the bottomlands of glacial Lake Agassiz, now the Red River Valley.

> Probably the outstanding, or most prominent, features on the drift prairies are the relatively small rivers which do flow through enormous, broad, deep valleys eroded and washed out by the mass of glacial melt water, as the ice front melted back. The Sheyenne River is the most glaring example of this, ...
>
> ... These valleys can be used for flood control, irrigation, recreation, wildlife, and other important uses. Where the Sheyenne emptied into Lake Agassiz, east of present-day Lisbon, it built the delta which is the present-day Sheyenne Sand Hills. From the Sand Hills to the Red River, the Sheyenne flows through a small V-shape post glacial valley. (Wills, 1972: 62-63)





North Dakota

Figure 1. Lower Sheyenne River Basin: Physiographic Regions.

A basic concept of classical conservation philosophy is identity of uniqueness in the natural environment (Pecora, 1972: 4). The LSRB is a unique area of eastern North Dakota. "... The Sheyenne Grasslands, near Lisbon, lend interesting variety to the North Dakota landscape and provide some of the most valued wildlife habitat" (Souris, Red, Rainy River Basin Commission, 1972: J-46). The area is a veritable oasis for wildlife surrounded by land primarily under cultivation or pastured. In a state with a low percentage of land in woodland, about 1 percent (Wills, 1972), relatively large woodland areas are unique.

Lake Agassiz Basin

The Sheyenne Basin from Kindred, north to the Red River, is predominantly under cultivation. Approximately 94 percent of the land is cultivated (Table 1). This section of the river basin has a high human density, especially on the river banks, with as many as 264 people per square mile and an average of 30 people per square mile (Nelson, et al., 1974). The main wildlife habitat in this section is the gallery forest, the area immediately adjacent to the river, ranging from nearly treeless to a hundred yards wide on either side of the river.

Under present land-use conditions in the Lake Agassiz Basin, the majority of hunting is for tree squirrels, Hungarian partridge, fox, rabbits, and some deer hunting. The mourning dove, although not presently on the game bird[1] list in North Dakota, is the one species whose habitat is increasing each year and has the greatest population potential (Vollink, 1975).

Songbirds are well represented in this area, a part of the central flyway, and provide enjoyment for birdwatchers. Audubon bird counts indicate there are at least 50 species of winter bird residents (Audubon, 1972). Over 150 species of birds are common to the area in the warmer months (Wills, 1972). Some of the more common are the meadow lark (the state bird), robin, mourning dove, and various warblers. Common winter residents are the chickadee, house sparrow, starling, and the crow.

This section of the Sheyenne Basin has limited hunting potential but provides wildlife viewing enjoyment. Sport hunting is severely curtailed

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[1]Game animals are those pursued by either sport hunters or trappers. Their use is consumptive in nature and requires the user to be licensed. Game species can be divided into four categories: (1) big game, (2) upland game, (3) waterfowl, and (4) furbearers.

TABLE 1. LAND USE IN THE LOWER SHEYENNE RIVER BASIN

Physiographic Subdivision	Urban and Built-up	Woodland	Grassland Prairie (Grazed)	Wetland/ Marsh	Cultivated	Total	Rural Residences[a]
Lake Agassiz Basin							
Acres	541	2,252	38	1,228	63,621	67,680	218
Percent	0.7	3.3	0.05	1.8	94.0	8.0	
Sheyenne Delta							
Acres	0.0	13,601	56,093	4,153	61,678	135,525	198
Percent	0.0	10.0	41.4	3.1	45.5	16.0	
Drift Prairie							
Acres	1,761	15,673	131,228	35,982	459,282	643,926	1,328
Percent	0.3	2.4	20.0	6.0	71.0	76.0	
TOTAL	2,302	31,526	187,359	41,363	584,581	847,131	1,724
Percent	0.3	3.7	22.0	4.9	69.0	100.0	

[a]Does not include platted subdivisions.

SOURCE: Interpreted from aerial photographs by technical members of LSRB Research Team.

both by the lack of game and the density of human inhabitants. There is a potential for more wildlife viewing activity which could be increased by developing attractants, such as bird feeders, or by maintaining habitat area for breeding birds and rest stops for migrating birds.

Among the more common nongame[2] species of wildlife observed are rabbit, raccoon, skunk, and woodchuck.

Sheyenne Delta

Land use in the Sheyenne Basin from Kindred to Anselm (Figure 1) is much different than in the Lake Agassiz region. Only 46 percent of the land is under cultivation, the remainder being either in woodland (10 percent), wetland (3 percent), or grazed (41 percent). It is the least densely populated reach of the LSRB, with many sections (one square mile) having no human inhabitants. The savanna vegetation of the grasslands and the associated gallery forest of the river banks combine to make this one of the richest areas of wildlife habitat in eastern North Dakota.

The Sheyenne National Grasslands constitute approximately 20 percent of this area. They are administered by the U.S. Forest Service and leased for livestock grazing. Mirror Pool Game Management Area (546 acres) owned and operated by the North Dakota State Game and Fish Department, provides habitat for several wildlife species. There are 28,844 acres of publicly owned hunting area in this region (Table 2).

TABLE 2. PUBLIC WILDLIFE AREAS IN THE LSRB, INCLUDING REFUGES

Subdivision	Acres of Public Hunting	Wildlife Refuges	Total
Lake Agassiz	0	0	0
Sheyenne Delta	28,844	0	28,844
Drift Prairie	3,392	2,480	5,872
	31,236	2,480	34,716

SOURCE: Robert Morgan, North Dakota Game and Fish Department; James C. Gritman, Fish and Wildlife Service, United States Department of the Interior; and County Atlases.

[2]Nongame wildlife species are defined as those which there is currently no official hunting season. Nongame wildlife provide nonconsumptive uses. Their use, viewing, for example, does not require a license. Examples of nongame wildlife are: songbirds, birds of prey, reptiles, invertebrates, and amphibians.

Because of the land use in this area, it harbors a relative abundance of wildlife and possesses the potential for more. "Development of this potential rests primarily in the hands of private landowners to initiate land-use practices which will enhance wildlife habitat" (Vollink, 1975: 36). Government agencies could provide the encouragement and set examples on their own land for enhancement of habitat.

The Sheyenne delta at present provides many hours of sport hunting. Whitetail deer are probably the single most sought after game species in the delta. The delta has a herd of approximately 1,500 deer and is the wintering area for deer from the surrounding agricultural land.

In addition to deer hunting, the delta supports large numbers of squirrels and upland game birds. There is also waterfowl hunting provided by migrating waterfowl and augmented by local birds. Fox hunting is also pursued in this section of the Sheyenne Basin. Walcott, North Dakota, (located just outside the basin) claims to be the "Fox Capitol of North Dakota."

As in the rest of the LSRB, there is a variety of nongame wildlife in the delta area that provides enjoyment to recreationists. However, as a result of the unique grassland ecosystem, an isolated habitat for fauna has developed here. At least three species of birds--barred owl, pileated woodpecker, and cerulean warbler--are not known to occur elsewhere in North Dakota. Six others classified as very rare in North Dakota--scarlet tanager, yellow-billed cuckoo, yellow-bellied sapsucker, yellow-throated vireo, green heron, and the American woodcock--also exist in the delta region. Four nongame animal species rare in North Dakota also are found here. They are gray fox, Eastern chipmunk, Northern flying squirrel, and woodland deer mouse. The wood frog and the redsided garter snake are found only in this particular part of the state (Cann, 1971).

Drift Prairie

The largest of the three subdivisions is the drift prairie. This section stretches fron Anselm to the Bald Hill Dam, 12 miles north of Valley City, an area of over 800 square miles. The area is characterized by an undulating plain with low-rounded knolls, numerous interspersed wetlands, and a few widely spaced and poorly developed stream systems (Karpen, 1975). Land use is directed towards the production of small grain with milk and meat production secondary. The area is sparsely populated with concentrations around municipalities and along the Sheyenne River.

The major wildlife habitat areas are the gallery forest and wetland areas. The forest is extensive in the area around Fort Ransom (Figure 1). Because of topographic restrictions to cultivation, such as coulees and wetlands, there are more "odd"[3] areas for wildlife cover than found in the Lake Agassiz subdivision. There are 5,872 acres of state or federal owned wildlife or public hunting land in the drift prairie (Table 2).

The drift prairie is much like the delta in hunting and wildlife-oriented recreation. The topography differs somewhat, however. In the drift prairie the Sheyenne flows through a rather narrow valley, which differs from the surrounding highlands. The drift prairie is in the prairie pothole region of the Midwest, a region of high waterfowl production. For this reason the region is more oriented toward waterfowl than the other three game categories, but provides some deer and upland game hunting.

Nongame species of wildlife are abundant in this area, being enhanced by several state and federal wildlife areas in and adjacent to the basin.

II. AN APPLICATION OF FOUR TECHNIQUES OF VALUATION TO THE LSRB WILDLIFE COMMUNITY

Several methods have been used previously to evaluate wildlife and outdoor recreation.[4] Each method provides a means of valuing the wildlife resource, but each approaches the problem from a different perspective. Four of these techniques were used to estimate the economic value of wildlife resources in the LSRB.

Direct Returns/Utility Value Technique

The utility or meat value approach is a measure of the wildlife product as food, or other marketable feature of the carcass, such as hides and horns. Moyle (1962: 4) argues this approach is "... especially applicable to fish and wildlife having a known market value, such as furbearing animals ..." Using annual harvest figures, dollar values were computed for the LSRB wildlife harvest.

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[3]An odd area, for reasons of topography or other restrictions, is not cultivated or put into direct use by man.

[4]Discussion of evaluation methods can be found in Leitch, Jay Andrew, "Application of Five Methods for Measurement of Wildlife Value; Lower Sheyenne River Basin, North Dakota," unpublished M.S. thesis, Department of Agricultural Economics, North Dakota State University, Fargo, December, 1975.

The following values were assigned:

1. Big game: $1 per packaged pound; estimated 60 pounds per animal.

2. Upland game and waterfowl: Equal to the price for dressed, frozen game birds (data obtained from game farm survey).

3. Furbearers: Average price paid for raw furs in North Dakota in 1974.

The individual dollar value for each species was multiplied by the current estimated harvest numbers. The resulting utility value for wildlife in the LSRB was estimated to be $95,024 (Table 3). Allowing for an error of 30 percent[5] in estimating animal numbers and harvest, the value could range from a low of $66,517 to a high of $123,531.

To receive an annual payment of $95,024 from an investment for infinity, at a 6 percent rate of return, a total of $1,583,733 would have to be invested. Therefore, the wildlife community that produces an annual utility value of $95,000 is worth $1.6 million.

Use of this valuation technique assumes the hunting experience was for the pleasure of sport hunting and any value of meat is an added amenity. If the hunter took game for its meat value only, it would have a negative value since the average cost of all hunters of procuring that game is more than its utility value. The assumption is the hunter would continue to hunt, even if he could not bring any game home.

The utility figures include furbearers and mourning doves. The later methods will exclude furbearers because trapping expenses cannot be figured the same as sport hunting. Mourning doves will be included in all calculations since they represent an untapped resource to the sport hunter. Dove hunting is gaining popularity and is compatible with farming. The average income per acre to farmers who charged for dove hunting in Tennessee is $12 per acre (Minser, 1974). A demand also exists in North Dakota as a dove hunting bill was introduced in the 1973 and 1975 sessions of the state legislature.

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[5]Thirty percent is an arbitrarily chosen error level.

TABLE 3. THE UTILITY VALUE OF THE ANNUAL WILDLIFE HARVEST OF THE LSRB,[a] 1974

Species (Value of Each)	Lake Agassiz Harvest	Sheyenne Delta Harvest	Drift Prairie Harvest	Total Dollar
Whitetail Deer ($60)	26	400	250	$40,560
Mule Deer ($60)	--	2	2	240
Pheasant ($5)	42	410	412	4,320
Hungarian Partridge ($2.50)	100	250	250	1,500
Sharptail Grouse ($5)	4	40	20	320
Mourning Dove ($1)	3,000	5,000	5,000	13,000
Tree Squirrel ($1)	250	750	600	1,600
Ducks, Diving ($5)	10	300	400	3,550
Ducks, Dabblers ($5)	25	750	500	6,375
Geese ($10)	10	250	1,000	12,600
Coot ($1)	25	25	50	100
Merganser ($5)	25	25	50	500
Snipe ($1)	10	25	25	60
		SUBTOTAL (excl. furbearers)		$84,725
Beaver ($11.50)	--	20	40	$ 690
Muskrat ($1.75)	50	400	400	1,750
Mink ($20)	5	20	35	1,200
Red/Gray Fox ($29)	7	60	90	4,553
Coyote ($26)	--	5	5	260
Weasel ($.50)	7	25	50	41
Raccoon ($9.50)	15	75	100	1,805
		TOTAL (inc. furbearers)		$95,024

[a]Prices given are adjusted to 1974 dollars.

SOURCE: Furbearer price data from D. Jensen, North Dakota Game and Fish Department, 1975, other prices as noted in text. Annual harvest numbers for 1974 from D. Tibke, District Warden, Valley City, 1975; J. Violett, District Warden, Wyndmere, 1975; and North Dakota Game and Fish Department, Pittman-Robertson supported studies.

Expenditures Technique

Hunter expenditures were also used as a measure of the economic value of wildlife in the LSRB. Expenditures were computed on a hunter-day basis and an aggregate expenditure was computed using estimated harvest figures.

Hunter days per unit bagged were taken from previous studies in North Dakota (Table 4). The average annual expenditures of each type of hunter--big game, small game, and waterfowl--were divided by the average number of days hunted, as given by Sorenson (1975: 91). A big game hunter, for example, spends an average of $28.46 per day of hunting. It takes an average of 9.5 days to bag a deer; therefore, each deer harvested represented estimated hunter expenditures of $270.37 (Table 4).

TABLE 4. HUNTER EXPENDITURES IN THE LSRB, ESTIMATED, 1974

Species	Hunter Days/[a] Unit Bagged	Annual Hunter[b] Days Provided	Average Daily[c] Expenditures	Total Hunter Expenditures
Whitetail Deer	9.5	6,422	$28.46	$182,770
Mule Deer	9.5	38	28.46	1,081
Ringneck Pheasant	0.64	553	7.55	4,173
Hungarian Partridge	1.3	780	7.55	5,889
Sharptail Grouse	1.5	96	7.55	724
Mourning Dove	0.5[d]	6,500	7.55	49,075
Tree Squirrel	0.5[d]	800	7.55	6,040
Ducks, Diving	0.86	611	$16.60	$ 10,142
Ducks, Dabblers	0.86	1,096	16.60	18,194
Geese	0.86	1,084	21.19	29,970
Coot	0.86	86	16.60	1,428
Merganser	0.86	86	16.60	1,428
Snipe	0.86	52	16.60	863
TOTAL				$304,777

[a]Souris, Red, Rainy River Basin Commission (SRRRB), p. J-49.
[b]Harvest multiplied times hunter days/unit bagged.
[c]Sorenson, p. 91.
[d]Authors.

SOURCE: Leitch, Jay Andrew, "Application of Five Methods for Measurement of Wildlife Value; Lower Sheyenne River Basin, North Dakota," unpublished M.S. thesis, Department of Agricultural Economics, North Dakota State University, Fargo, December, 1975.

The total hunter expenditures for LSRB amount to $304,777 annually. Hunter expenditures were more than three times as large as the utility value

of wildlife in the LSRB. With a 30 percent error possibility, the range would be from $213,344 to $396,210. If utility and expenditure values are additive as some authors claim (Helliwell and Steinhoff), then the aggregate value of wildlife from sport hunting would be $389,502 annually. It would represent the return at 6 percent of an investment of $6.49 million. The expenditures figure alone would require an investment of $5.08 million.

Comparative Costs Technique

Moyle (1962) and Davis (1964) suggest using what recreationists would pay for similar private recreation as a measure of the value of recreation in the public sector. An assumption of this technique is the recreation experience on a private shooting preserve is not unlike the experience in the public sector. Rahn (1974) argued they are similar in most respects, the only variation that might exist is in the daily bag.

The value of the annual wildlife harvest of the LSRB, if taken on a private shooting preserve, was calculated. This method assumes hunters on shooting preserves are paying closer to the maximum that they would be willing to pay for the experience, while those hunters not on preserves could be realizing a consumer surplus.[6]

Questionnaires were mailed to 20 preserve operators in North and South Dakota, Minnesota, and Iowa to obtain data on preserve operations (40 percent of the population). Ringneck pheasants and Chukar partridge were the most often offered species. Charges, in addition to membership fees, to shoot a pheasant averaged $6.73, and to shoot a mallard, $6.29 (Table 5).

A pheasant hunter not hunting on a shooting preserve spends an average of $7.55 a day to bag 1.56 birds in North Dakota (Sorenson; SRRRB). These expenditures could include licenses, clothing, ammunition, lodging, weapons, dogs, taxidermy, etc. Fees paid to landowners for the privilege of hunting amounted to less than 1 percent for nonpreserve hunting and were ignored in the calculations.

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[6]Consumer surplus is defined as the difference between what one would be willing to pay for something and what one actually pays for the good or service.

TABLE 5. SHOOTING PRESERVE FEES FOR FIVE BIRD SPECIES, 1974 PRICES

Location	Membership Fee	Pheasant	Mallard	Quail	Chukar	Turkey
		North Dakota				
Grand Forks	$150	$6.50	---	$3.50	$5.25	$22.50
		Minnesota				
Cohasset	none	$7.50	---	---	---	---
Elk River	$150	$8.00	$8.00	---	$4.50	---
Granite Falls	$ 75	$7.00	---	---	---	---
Hector	none	$6.50	---	$4.50	$4.50	---
Hugo	$250	$8.00	$8.00	$4.00	$6.00	---
Marine on St. Croix	$250	$7.25	$7.25	$4.50	$4.50	$ 5.25
		Iowa				
Delhi	none	$5.00	$5.00	---	---	---
Goose Lake	$ 65	$6.50	$6.00	$2.50	$5.50	$22.00
Webb	$100	$5.00	$3.50	$2.00	$4.50	$15.00
Mean Price	$149	$6.73	$6.29	$3.50	$5.00	$19.83
Median Price	$150	$6.75	$6.63	$3.75	$5.25	$22.00

SOURCE: Mail survey of shooting preserve operators, June, 1975.

Assuming the fee hunter's costs are the same as the nonfee hunter, he would spend $7.55 for ordinary hunting expenditures, plus $6.73 for each bird bagged, plus his membership fee. Sorenson found the small game hunter in North Dakota spends an average of 8.5 days afield each year. Dividing the average membership fee of $149 by 8.5 days results in a daily membership fee of $17.53. For example:

	Nonfee Hunter	Preserve Hunter
Daily Expenditures	$7.55	$ 7.55
Bird Fee	0	10.50 (1.56 birds)
Membership Fee	0	17.53
Daily Total	$7.55	$35.58

The shooting perserve hunter pays $35.58 for 1.56 birds or $22.81 for each bird bagged.

Making the same assumptions for mallard shooting, the nonfee hunter pays $16.60 daily and bags 1.16 birds (Table 5). The preserve duck hunter spends $40.51 for a day of mallard shooting (1.16 birds).

Acknowledging the fact that preserve hunting may yield more bagged birds than nonfee shooting, multipliers were calculated both including and excluding preserve membership fees. The following multipliers were calculated:

	Including Membership Fee	Excluding Membership Fee
Pheasant	$4.71	$2.39
Mallard	2.44	1.44
Mean	3.57	1.89

Applying the above "mean" multipliers to the entire wildlife harvest of the LSRB would give a value of $576,000 (1.89 x 304,777), excluding membership fees; and $1,088,000 (3.57 x 304,777), including membership fees.[7] The amount required to invest at 6 percent to obtain an annual return for infinity equal to the above figures would be $9.6 million and $18.33 million, respectively.

Compared to the utility value, the hunter expenditures are more than three times as large. The value of alternative private recreation that will produce the same annual game harvest is worth at least six times as much and possibly as much as 12 times more than the utility value (Table 6).

TABLE 6. COMPARISON OF ANNUAL AND INVESTMENT VALUES FOR WILDLIFE DERIVED FROM THREE TECHNIQUES

Technique	Annual Value	Required Investment at 6% for an Infinite Annuity
Utility	$ 84,725	$ 1,583,733
Expenditures	304,777	5,080,000
Comparative Costs	1,088,000	18,330,000

[7]Preserve fees for game other than pheasants and mallards may be different, but information was not available for other game. These multipliers may be conservative since deer make up a large portion of the LSRB wildlife harvest and the relative price to shoot deer on a preserve may be considerably higher than birds.

Although the utility and expenditures values may be additive,[8] the alternative recreation value expresses the consumptive use of wildlife by itself since a per bird fee is included. The comparative costs value is larger than the sum of utility and expenditures by an amount that could be considered a consumer surplus.

Annual and investment values estimated by each of the three techniques were divided by the total land area in the LSRB; by only woodland, grassland, and wetlands acres in the LSRB; by only the woodland and wetland acres in the LSRB. This procedure results in annual returns ranging from $0.11 per acre to $14.93 per acre (Table 7). The per acre value of wildlife calculated from these annual returns is from $1.87 to $251.48 which is competitive with some other land uses in the LSRB.

TABLE 7. ANNUAL AND INVESTMENT VALUES OF UTILITY, EXPENDITURES, AND COMPARATIVE PRIVATE RECREATION DIVIDED BY THREE ALTERNATIVE LAND ACREAGES

	Utility	Expenditures	Comparative Private
Total LSRB			
847,134 Acres			
Annual/Acre	$ .11	$ .36	$ .98
Value/Acre	1.87	6.00	21.64
Woodland, Grassland, and Wetland			
260,251 Acres			
Annual/Acre	.32	1.17	4.18
Value/Acre	6.08	19.52	70.43
Woodland and Wetland			
72,892 Acres			
Annual/Acre	1.16	4.18	14.93
Value/Acre	21.73	69.28	251.48

Land Value Technique

The aforementioned techniques measure only the value of wildlife in a consumptive use, sport hunting. The land value technique, as used by Gupta and Foster (1975) in Massachusetts, measures what the public is willing to pay to preserve wildlife habitat. The land value figure is useful in comparison with alternative land-use values.

[8]Utility and expenditures values are additive only if hunting is done purely for sport. The other extreme would be to subtract expenditures from utility for a purely meat hunter. This study assumes all hunting is for sport only, while recognizing the mix of hunting for sport and for meat may vary with the individual.

Gupta and Foster adjusted purchase prices of wildlife areas by multiplying the price by a coefficient based on differences in areas' ability to provide wildlife habitat. For example, if an area had been purchased for $50 an acre and the relative wildlife habitat coefficient for the area was determined to be .5, or marginal for wildlife, then the price paid would have to be doubled to reflect the proper relationship between prices paid for different parcels of wildlife habitat.

These coefficients ranged from 0.0 to 1.0 and land with a 0.0 coefficient would be incapable of supporting wildlife, and land with a 1.0 rating would be capable of supporting a maximum number of wildlife. Two acres of land with a 0.5 coefficient would be required to yield the same wildlife production as one acre with a 1.0 coefficient. For this study the land values were adjusted to March 1, 1974. No coefficient for differences in wildlife supporting potential was used. The values found are, therefore, more conservative than if adjusted for habitat differences.

The market prices of all publicly owned wildlife areas purchased since 1965 in the four counties of the LSRB were placed on a continuum ranging from lowest to highest.[9] The highest price on this continuum which the constituency will accept without strong political objection can be assumed to be the value of wildlife habitat. The price paid for any specific parcel, of course, is its market price and reflects the current opportunity cost of preservation. The highest prices actually paid in the study should approach the true value although consumer's surplus is possible.

The five highest per acre prices paid ranged from $527 to $211 per acre (Table 8). The least costly parcel was purchased for $13 an acre. The top five prices were averaged and the resulting value was assumed to be the price people are willing to accept for purchasing wildlife habitat.

The per acre price of $284 (average of the top five) was capitalized at 6 percent. The resulting value was $17.04 per acre. This means the public expects it is getting at least $17 worth of wildlife benefits annually from each acre of public wildlife land. The previously estimated values based on woodland and wetland acres were $1.16, $4.18, and $14.93. The difference between these "consumption" values and $17.04 could be due

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[9]Game management areas, wildlife refuges, waterfowl production areas, etc.

TABLE 8. HIGHEST AND LOWEST VALUED LAND PURCHASED FOR WILDLIFE PROPAGATION AND PUBLIC USE, 1974 DOLLARS

Name of Area	Annual Value @ 6%	Cost Per Acre	Acres Purchased
Highest Values			
Clausen Springs GMA	$31.62	$527	77
Waterfowl Production Areas (3)	14.28	238	1,510
Waterfowl Production Area	13.38	223	32
Waterfowl Production Area	13.26	221	44
Erie Dam GMA	12.66	211	1,031
Average	17.04	284	538.8
Lowest Values			
Englevale Slough GMA	.78	13	160
Wild Rice GMA	.96	16	320
Koldok GMA	1.92	32	214
Waterfowl Production Area	1.92	32	25
Waterfowl Production Area	2.46	41	120
Average	1.61	26.8	167.8

SOURCE: Robert Morgan, North Dakota Game and Fish Department; James C. Gritman, Fish and Wildlife Service, United States Department of the Interior; and County Atlas.

to "nonconsumption" (hiking, picnicing, viewing, etc.) values, to erroneous information on society's value of wildlife habitat by government agencies responsible for the purchases or a combination of these two reasons.

A farmer could realize approximately $82 to $87 per acre annually if he cultivated wheat on good cropland in eastern North Dakota (Table 9).[10] Good cropland is frequently poor wildlife habitat and vice versa; consequently wildlife can be competitive with agriculture on marginal agricultural land.

III. DISCUSSION AND CONCLUSIONS

The four techniques of evaluation of wildlife resources discussed in this report have each given different results. The first three--utility,

[10]The base year, 1974, used was atypical in the returns to farming. Proceeding years saw much lower per bushel prices. The following year showed increased costs/acre and a drop in prices/bushel. The net could be cut to half of what it is in Table 9 and would be more representative in the long run.

TABLE 9. RETURNS FROM AGRICULTURAL LAND USE, 1974, EASTERN NORTH DAKOTA

Crop	Cost/Acre	Projected Yield	March, 1974 Price/bu.	Net/Acre
Wheat (f)[a]	$75.30	32.7 bu.	$ 4.95	$87
Wheat	51.70	27.1	4.95	82
Barley (f)[a]	71.04	45.8	2.68	52
Barley	49.30	41.1	2.68	61
Oats	46.27	50.9	1.26	18
Flax	45.23	11.2	10.80	76
Rye	42.69	28.6	2.90	40

[a]On fallow land.

SOURCE: Billy Rice, Farm Management Planning Guide, North Dakota State University, and North Dakota Crop and Livestock Statistics, Annual Summary for 1974.

expenditure, and alternative private recreation--each expressed the value in a lump sum, an annual or total value, and on a per acre basis. The last--land value--expressed the value on per acre basis. The land value figure is quite useful since it can be compared on a one-to-one basis with alternative land uses. It could underestimate the value of the land for wildlife since it is a measure of opportunity cost, and wildlife areas frequently are not suited for other uses. Gupta and Foster's study was done in a more densely populated part of the country where it was profitable to convert wetland areas to commercial development and the opportunity costs were high. The other three techniques are more suitable as measures of the aggregate value of wildlife to an area.

Problems of Application to LSRB

A viable technique of valuation should be one that is readily applicable to the study area and leaves little room for guesswork. Some of the data required in calculating the three aggregate values were not readily available. Therefore, arbitrary decisions had to be made with the assistance of learned professionals.

The utility value approach, although very straightforward, requires information on the potential annual harvest of all game species. These data are not only hard to obtain, but vary from year to year. Another variable element of this approach is the dollar values of the flesh and hides of the harvest. Fur prices vary considerably from year to year, as do meat and poultry prices.

In addition to the uncertainty of some of the data used in calculations, the usefulness of the result is somewhat limited. The utility value, alone, measures only a fraction of the complete value of the wildlife resource. It measures only a part of one type of use, consumptive recreation. As evidenced in the comparison with expenditures and alternative private recreation, the utility value is much lower than either of the others. The major component omitted is the value of nonconsumptive recreation, such as birding, nature photography, or simply, wildlife enjoyment. Horvath (1974) showed that wildlife enjoyment, a nonconsumptive use, was valued at over one and one-half times as much as consumptive sport hunting. The best use of the utility value is as a component in estimating total wildlife value.

Problems with the expenditures approach are much the same as with the utility approach. The same base, annual harvest, was used to compute the value. The other data needed for this method, daily expenditures and daily bag, were rather easy to obtain from surveys done by government agencies, such as state game and fish departments. The expenditures approach more closely expresses the complete value of wildlife in an area. It also falls short since it fails to account for nonconsumptive uses and consumer surplus.

A more realistic measure is obtained by adding expenditures and utility value of wildlife. The rationale for combining these is that the meat or hide provides value in addition to the value of the hunting experience.

The alternative private recreation method rests on the most controversial assumptions: (1) that preserve and nonpreserve shooting are similar experiences, (2) that the daily bags are the same on or off a preserve, (3) annual days of hunting are equal, and (4) nonfee expenses are similar for both situations.

The preserve value includes some of the consumer surplus and more closely approaches the complete value of wildlife in a consumptive use than the other two consumptive use value techniques in the author's opinion. This method may not be the best to use in supportive arguments for maintaining wildlife populations due to its weak assumptions, but it does go a

step beyond the expenditures value in trying to evaluate the consumer's surplus found in public shooting.

None of these techniques consider negative values of wildlife. These include crop depredation by waterfowl, big game, or rodents; nuisance caused by nesting birds around farm buildings; or insect pest damage. On the other hand, many other values of wildlife are omitted, such as insect pest control by birds, aesthetic value of wildlife, or wildlife option values.[11]

The land value technique probably represents the most concrete argument available for equitably comparing wildlife habitat and alternative land uses on an economic basis. The data are a matter of public record and the results can be expressed on a per acre basis, comparable with the returns from other land uses. The subjective portion of this technique is in assigning wildlife habitat ratings to different areas and adjusting their prices accordingly.

The assumption that the maximum paid is what the political constituency is willing to pay may not be valid. It depends on effective communication channels between voters and purchasing agencies, such as the Bureau of Sport Fisheries and Wildlife. These channels are so complex that there may not be an opportunity for people to voice satisfaction or dissatisfaction with the actions of government agencies. This problem may lead to overestimation of the value of wildlife.

The land value technique may underestimate wildlife values in areas where there is little use for the land other than for wetlands or wildlife habitats because it is based on the opportunity cost of land.

Conclusion

The value of an area's wildlife resources can be calculated in many ways. The four techniques tested in this study are just an example of those that have been applied elsewhere. Their purpose is to place an objective value on the resource, which has in the past been supported by subjective arguments. This study shows the LSRB wildlife community does have positive economic value to North Dakota and the value of wildlife habitat can be comparable to the value of agricultural uses of marginal land.

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[11]Wildlife option value is normally defined as the value or satisfaction derived from the knowledge that a certain wildlife species exists and an individual has the option, whether exercised or not, of viewing, hunting, or in some manner gaining direct benefit.

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