7

Estimating the Economic Value of Subsistence Harvest of Wildlife in Alaska[1]

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INTRODUCTION

Knowledge of the economic value of wildlife (including fish, as used in this chapter) is useful in setting public policy about wildlife resources. Neoclassical economic methodology includes powerful tools for estimating the value of resources, including wildlife. But can these economic methods be applied to subsistence use of wildlife? Within the framework of economic efficiency and a competitive market economy, can we measure the value of subsistence harvests, and the value of wildlife kept for personal use? If this is possible in general, can we measure total as well as marginal value, and for which species and in which locations? Further, if reasonable estimates of economic value are possible within this framework, what then are the limitations of those estimates? This paper attempts to answer these questions.

These issues recall a complex controversy, heard mainly during the 1950s and 60s, about the applicability of the neoclassical economic paradigm in understanding the workings of primitive and peasant nonmarket-oriented economies. Some authors in economic anthropology, such as Karl Polanyi (1944), argued that the economic tools developed to understand highly developed market economies were of limited use in studying and understanding economies lacking markets and a generalized medium of exchange. As described by Dalton (1971), who relied heavily on Polanyi, the contention was that subsistence economies are generally characterized by "pervasive social control of production and distribution, and the assurance of subsistence livelihood to persons through social determination of labor and land allocation and the social right to receive emergency material aid in

time of need" (p. 91). Land and labor are typically allocated in accordance with kinship, political or tribal rights, and obligations, and most exchange is reciprocal gift giving and redistribution, not market exchange (p. 19). Furthermore, Dalton points to a possible lack of an economizing predisposition in production, and to conditions where "extensive material acquisition is not culturally regarded as important as other goals" (p. 50).

That cultural and social conditions in some economies may so constrain or direct behavior as to seriously limit the usefulness of neoclassical economic theory in describing the workings of these economies seems indisputable. However, is this the case for subsistence sectors of late 20th century Alaska? We do not concern ourselves here with the question of whether Alaska Native economies before contact with western market-oriented traders and settlers can be adequately described in terms of the neoclassical economic paradigm. The current need is to determine whether the economies are *today* sufficiently market-oriented as to allow formation or estimation of prices and values that are comparable to those determined in a competitive market.

It is our premise that the growing participation of subsistence sectors in Alaska's market economy, with the concomitant attenuation in the importance of reciprocity and redistribution, preclude the *a priori* rejection of neoclassical economic methods for estimating the value of subsistence harvests. To the contrary, market transactions have become so common throughout Alaska that it seems reasonable to anticipate that, for at least some wildlife species in some locations, comparable economic values can be determined. However, application of neoclassical economic methods is complicated by the complex mixture of market and traditional transactions used to exchange wildlife products, by the laws that currently govern Alaskan wildlife harvest and exchange, and by the cultural importance of wildlife harvest and exchange to many subsistence hunters.

A portion of the subsistence harvest is directly consumed by the hunters (including fishers) and their families, and portions are also traded, bartered, and shared or otherwise given away. Over the years, as commercial enterprises have developed in Alaska and as subsistence hunters have

increased their use of cash, store-bought foods, and manufactured goods, traditional forms of transfer and exchange have come to involve a smaller portion of the total harvest. However, the noncommercial transfer and exchange of wildlife are still important institutions in rural Alaska (Langdon and Worl 1981, Wolfe 1981, Magdanz 1988a). Further, many of the noncommercial transfers and exchanges of wildlife products occur without the use of money. And even where money is used, it is in dispersed locations without mechanisms or procedures for recording prices. The prevalence of direct consumption, of nonmonetary transfer and exchange, and of dispersed monetary exchange of wildlife resources make it difficult to determine their economic value.

As Alaskan ethnographic literature reveals (Langdon and Worl 1981, Langdon 1984, Schroeder et al. 1987, Wolfe and Walker 1987), wildlife and wildlife products play an important role not only in alimentation and habilitation, but also in the ceremonies and long-standing social and religious traditions of Alaska Natives. Human survival, the economy, and the means of establishing prestige and of maintaining peace have all involved the consumption, transfer, and exchange of fish, game, and of products made thereof, since time immemorial.

Hunting and fishing are important activities in Alaska for non-Natives as well as Natives. Indeed, surveys suggest that the continued existence of wildlife, and the opportunity to hunt and fish, are indispensable to the maintenance of what might be called the "pioneer" Alaskan lifestyle, particularly in rural communities (Schroeder and Nelson 1983:156, Stratton and Georgette 1984, Gmelch and Gmelch 1985:156, Reed 1985:187, 195, Fall and Foster 1987, Stanek 1987, Stanek et al. 1988:156). The continued existence of this way of life should be reflected in the value that harvesters of wildlife place on the wildlife resource.

This paper contains two main sections. The first describes the harvest and exchange of Alaskan wildlife. We review what is known about the importance of wildlife resources to people in Alaska and the prevalence of the different forms of transfer and exchange of wildlife resources. Subsistence harvest is compared with sport and commercial harvest so as to

put each in proper perspective. The second section discusses economic valuation theory and methods. We outline the neoclassical economic approach to valuation in the current context, discuss the special problems for economic valuation presented by the existence of a significant subsistence sector, suggest ways to solve these problems, and highlight the limitations of these methods as a basis for setting public policy.

HARVEST AND EXCHANGE OF WILDLIFE

Harvest

Alaskan communities form a continuum with regard to the harvest of wildlife. At one extreme are communities where almost no one harvests wildlife, while at the other are those where practically every able-bodied person spends at least some time hunting, fishing, or trapping each year.

A general idea of the magnitude of the wildlife harvest in Alaska is provided by Table 1, which shows the mean annual per capita harvest of wild foods in a sample of rural Alaskan communities. The research projects on which this table is based were all conducted or sponsored by the Division of Subsistence of the Alaska Department of Fish and Game, and they were all conducted during the early and middle 1980s.[2] The communities are ordered in the table according to the extent to which their populations were made up of Alaska Natives at the time the research was conducted, with the variation ranging from 0% to 100%. The total population figures are also those obtaining at the time the research was conducted. The harvest figures are presented in pounds of usable food products. No commercial harvest is included. The "subsistence regions" are those distinguished by the Alaska Department of Fish and Game (1989: fig.1).

Table 1 demonstrates that the harvest of wildlife for food is important across a broad spectrum of Alaskan communities. The smallest mean annual per capita harvest listed in the table is 37 pounds in the relatively urbanized community of Kenai. Only three others fall below the 100-pound level. The overall average annual per capita harvest in the 45 communities listed in the table is 363 pounds, of which overwhelmingly the greatest proportion consisted of fish, meat and fowl; the quantity of berries and other vegetable products included in the figures is negligible. This compares with average annual per capita purchases of meat, fish and poultry in the western United States of 222 pounds (Wolfe and Walker 1987:59).

Table 1. Annual per Capita Harvest of Wild Foods in Selected Alaska Communities.

Community	Percent Alaska Natives	Population	Mean per Capita Harvest in lbs.[a]	Subsistence Region	Reference[b]
Ivanof Bay	100	38	445	SW	h
Perryville	100	111	390	SW	h
Chignik Lake	99	138	283	SW	h
Kivaline	99	270	824	Arct	a
New Stuyahok	99	337	896	SW	o
Allakaket	98	152	909	Int	g
Hughes	98	94	1498	Int	g
Quinhagak	98	427	756	West	o
Beaver	97	78	459	Int	r
Kotlik	96	293	510	West	m
Stebbins	96	331	1012	West	m
Tyonek	95	273	272	SC	c
Alakanuk	94	522	733	West	m
Emmonak	91	567	612	West	m
Mentasta	90	67	109	SC	l
Pilot Pt.	89	64	384	SW	d
Chignik	88	178	194	SW	h
Tetlin	88	107	532	Int	f
Port Graham	85	161	145	SC	s
Angoon	78	630	216	SE	e
Egegik	78	75	385	SW	h
English Bay	78	124	147	SC	s
Chignik Lgn.	75	48	229	SW	h
Port Heiden	73	103	814	SW	d
Yakutat	62	550	369	SE	q
Dillingham	57	2004	242	SW	n
Klawock	57	600	223	SW	b
Chistochina	55	65	115	SC	l
Gulkana	49	115	114	SC	l
Seldovia	35	506	52	SC	i
Gold Creek	30	11	174	SC	k

Table 1, continued

Community	Percent Alaska Natives	Population	Mean per Capita Harvest in lbs.[a]	Subsistence Region	Reference[b]
Bettles	29	66	260	Int	g
Broad Pass	26	41	178	Int	k
Chitina	24	43	190	SC	l
Upr. Tonsina	20	228	120	SC	l
Ninilchik	17	623	76	SC	i
Petersburg	11	3282	203	SE	j
Chickaloon	11	136	213	SC	l
Glenallen	10	861	71	SC	l
Kenai	10	5231	37	SC	i
Tenakee Spr.	8	100	250	SE	p
McCarthy Rd.	8	78	209	SC	l
Slana	6	43	252	SC	l
Homer	2	2897	104	SC	i
Chase	0	78	209	SC	k

[a] Amount of usable food products, not gross harvest, per capita.

[b] Sources: a. Burch 1985, adjusted for usable weight; b. Ellanna and Sherrod 1987; c. Fall et al. 1984; d. Fall and Morris 1987; e. George and Bosworth 1988; f. Halpin 1987; g. Marcotte and Haynes 1985; h. Morris 1987; i. Reed 1985; j. Smythe 1988; k. Stanek et al. 1988; l. Stratton and Georgette 1984; m. Wolfe 1983b; n. Fall et al. 1986, Wolfe et al. 1986; o. Wolfe et al. 1984; p. Leghorn and Kookesh 1987; q. Mills and Firman 1986; r. Sumida 1989; s. Stanek 1985.

The variety among Alaskan communities and their hunters and fishers relates to three sets of distinctions that are fundamental to an understanding of the harvest of wildlife in Alaska: (1) subsistence vs. sport vs. commercial harvests; (2) urban vs. rural communities; and (3) Alaska Natives vs. non-Natives.

Subsistence vs. Sport vs. Commercial Harvests

Commercial harvest of wildlife consists of hunting or fishing for the purpose of selling some or all of the goods so acquired. In Alaska it is restricted to certain species of fish (e.g., salmon, halibut, herring), some small game (e.g., hares, rabbits), fur bearers (e.g., mink, muskrats), and in certain restricted contexts, marine mammal parts or products (e.g., blubber,

seal oil). Noncommercial harvest of wildlife consists of all other forms of hunting and fishing.

One category of noncommercial wildlife harvest falls under the rubric of "subsistence." "Subsistence" typically refers to a minimum level or standard of living for physical and mental survival. Some authors extend the concept to include not only survival, but also "productive efficiency," which brings in the minimum requirements for "productive living" in the society (Sharif 1986). In either case, the emphasis is on determining a minimum level of economic well being. In Alaskan natural resource policy writings, however, "subsistence" usually refers to customary reliance on harvest and personal use of renewable natural resources to provide for a significant portion of a family's private needs. This perspective has influenced both state and federal laws dealing with noncommercial fish and game harvests in Alaska, and has led to the legal distinction between subsistence hunting and fishing, on the one hand, and sport hunting and fishing, on the other.

According to the (state) Joint Boards of Fisheries and Game Subsistence Procedures, "customary and traditional subsistence use by rural Alaska residents will be identified by ... a use pattern in which the hunting or fishing effort or the products of that effort are distributed or shared among others within a definable community of persons, including customary trade, barter, sharing and gift-giving [whereby] customary trade may include limited exchanges for cash, but does not include significant commercial enterprises ..." Similarly, the (federal) Alaska National Interest Lands Conservation Act (ANILCA) of 1980, which governs land use (including hunting and fishing) over extensive portions of the state, defines subsistence as "the customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation, for the making and selling of handicraft articles out of nonedible by-products of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade."

Sport hunting and fishing consists of all noncommercial wildlife harvest that does not meet the criteria for subsistence hunting and fishing. The distinction between subsistence and other types of wildlife harvest is codified in both state (1978) and federal law (ANILCA, The Marine Mammal Protection Act, The Endangered Species Act). It has become an important and very controversial issue in Alaska because subsistence harvesters may be granted more lenient restrictions than sport harvesters with regard to several significant matters: bag limits, size limits, length of open season, and uses. More important, subsistence harvesters are given priority over both sport

and commercial harvesters if the size of a given wildlife species population falls too low to provide for all of them on a sustained yield basis.

Priority does not necessarily award subsistence users a legal *right* to harvest wildlife, however. Allowable harvests are controlled by state authorities, with the goal of maintaining sustainable wildlife stocks in good condition. As long as that objective is being met, everyone may hunt and fish (subject, of course, to restrictions that vary from one game management unit [GMU] to another). In less satisfactory circumstances, wildlife harvest may be subjected to increased restrictions, with those affecting sport and commercial harvesters being more stringent than those affecting subsistence harvesters. In the event of a real crisis, *everyone* may be prohibited from harvesting the species involved.

Urban vs. Rural Communities

The distinction between urban and rural communities is particularly important because, under current state law,[3] the residents of communities (technically, GMUs) legally defined as "rural" may hunt and fish under subsistence regulations,[4] whereas residents of those defined as "urban" may not.[5]

The major urban communities in Alaska are Anchorage, Fairbanks, and Juneau, including the areas immediately surrounding them and having direct road access to them. Preliminary evidence suggests that, while a relatively small percentage of their populations regularly hunts or fishes in order to provide household food, the absolute number may be considerable. Even under sport harvest regulations, a single moose or caribou hunt, and a few days or weeks of salmon fishing, can place several hundred pounds of food on the family table; many urban residents take advantage of this opportunity on an annual basis. Wolfe and Walker (1987: 63) report that the annual wildlife harvest in Anchorage during the early 1980s yielded an average of 10 lbs. of usable food per person.[6] That, of course, is well below the per capita production of any of the rural communities listed in Table 1. However, given the fact that the city's population was almost 244,000 at the time, the total harvest of Anchorage residents was enormous, far greater than that of any rural community. To ignore urban communities in estimating the economic value of the wildlife harvest in Alaska would thus be a serious mistake.

"Rural" communities comprise all those communities in Alaska that are not specifically defined as urban under state hunting and fishing regulations. Since there are only a few urban areas, the overwhelming majority of the state's approximately 300 inhabited places fall into the rural category. In 1980, rural communities were home to more than 140,000 people, about 36% of the state's population (U.S. Dept. of Commerce, Bureau of Census 1981:9).

The geographic, demographic and ethnic differences among "rural" communities are considerable. Geographically, they range from those located relatively close to urban areas and linked to them by all-weather roads, at one extreme, to those that can be reached only by air, on foot, by all-terrain vehicle, or by small boat, at the other. This aspect of variability is important in the present context because the harvest of wildlife generally increases as one moves away from urban centers (Wolfe and Walker 1987:61). Demographically, rural communities range from populations of less than a dozen individuals to nearly 8,000 people, although the great majority contained fewer than 1,000 residents in 1980. Ethnically, Alaskan communities range from virtually 100% Alaska Native to 100% non-Native. This is important because, as is brought out in the following section, Natives generally harvest more wildlife than non-Natives.

None of the rural communities in Alaska is so isolated, so small, or so traditionally Native as to be totally uninvolved in the modern market economy. Virtually all rural communities are characterized by what has been referred to (Wolfe 1983a:252-253, Wolfe and Walker 1987:68) as "mixed subsistence-market economies." This label recognizes "that there exists a 'subsistence sector' to the community's economy and social life, and a 'market sector,' and that the socioeconomic system [as a whole] is viable because the sectors are complementary and mutually supportive" (Wolfe 1983a).[7] Even the most old-fashioned subsistence hunter uses the most modern rifles, snowmachines, boats, boat motors, nets and traps that he can afford, and these goods cannot be acquired without cash.

A special type of Alaskan community, the "regional center" (Wolfe et al. 1986), is definitely rural, but has many of the characteristics of a large city.[8] A regional center is a mid-sized (1,000 to 6,000 people), nonurban community that acts as a center of services, government, commerce, communication, and transportation for a geographic region containing a group of smaller communities. Because of their special role in the economies of the regions surrounding them, they are often distinguished by a number of urban features, such as hospitals, state police detachments, radio and television stations, jet airstrips, major docking facilities, hotels,

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restaurants, private commercial enterprises, and government offices of various types. It is not uncommon in such communities for the family of a salaried government or business worker to live next door to a family headed by a full-time subsistence hunter; indeed, the salaried worker may also spend weekends and holidays engaged in the subsistence harvest of wildlife.

Alaska Natives vs. Non-Natives

The final distinction that is useful in understanding the harvest of wildlife in Alaska is that between Alaska Native and non-Native. The category of Alaska Native includes anyone who is of Alaskan Eskimo, Indian or Aleut descent and who considers herself or himself to be an Alaska Native. Non-Native is a residual category.

Alaskan communities range from entirely Native to entirely non-Native, but most are somewhere in between (Table 1).[9] Predominantly non-Native communities are concentrated in the southeastern, south central, and eastern interior sectors of the state.[10] Predominantly Native villages are scattered around the entire state, and are located within the traditional territories of the several cultural groups indigenous to Alaska.[11]

Physically, contemporary Native and non-Native rural communities resemble one another in many respects. Among the similarities are their small size, relative isolation, and the importance of wildlife in their economies. The evidence indicates that subsistence harvest of fish (usually salmon), land mammals (usually moose), and a variety of other wild resources makes substantial contributions to the economies of many, if not most, of these communities.

There are also some important differences between Alaska Natives and non-Natives. One of the most important of these for present purposes is that Natives tend to harvest more wildlife per capita than non-Natives living in the same areas. This was supported in a multiple regression model developed by Wolfe and Walker (1987:66), who found a significant linear relationship between the percentage of Natives in a community and the extent to which food is produced in that community. The data presented in Table 1 are consistent with that finding. (Exceptions in the table could be readily accounted for by the addition of more variables, such as the relative isolation of the communities concerned, differences in local fish and game populations, and certain unique circumstances.) The conclusion that Natives on average harvest more wildlife than non-Natives is shown even more clearly by data from the few communities where the harvests of the two segments of the population were distinguished from one another. For

example, in Glennallen, Natives harvested 338% more wild food than did their non-Native counterparts (Stratton and Georgette 1984:78), while in Dillingham, Natives harvested 67% more (Fall et al. 1986:135-136).

A second major difference between Alaska Natives and non-Natives inheres in the fact that among the former, individual, and especially group, identities are based to a much greater extent on a hunting-fishing way of life. Furthermore, Natives tend to harvest a greater variety of wildlife than their non-Native counterparts, and they prepare and distribute wild foods differently. In all of these respects, and in general contrast to non-Natives, they are following customs derived from ancient local cultural tradition. Of course there are many differences among Native groups, as well, because of the varying cultural backgrounds of their members and regional differences in available resources. For purposes of the present analysis, however, the features they have in common with one another are more important than the differences among them.

Exchange

The wildlife harvest of Alaskan residents may be sold commercially, bartered, traded, given away, or used for personal consumption, but only under specific circumstances. Among the most important of these circumstances is whether or not the harvester is acting on a commercial, subsistence, or sport basis.

Commercial transactions involve the exchange of money for a good or service. In Alaska, the legal commercial sale of wildlife or wildlife products may occur only between licensed commercial harvesters and authorized commercial buyers. Commercial markets exist for only a few species (e.g., salmon, halibut) and in only a few locations (many of which are located in rural Alaska). However, limited (and generally illegal) commercial sales -- involving a broader spectrum of wildlife species -- also occur where harvesters sell to individual strangers, such as tourists or other visitors to an area, to village stores, and particularly to other members of the community in arms-length transactions. Some wildlife products (e.g., seal meat and oil, fish) are, if not always legally, sold in stores in rural Alaskan communities with some frequency, while other products (e.g., eulachon oil, moose meat) are sold much less frequently.

Barter is similar to commercial exchange except that it involves an exchange in kind rather than an exchange of cash for a good or service. As

used here, the term refers to an exchange where "the goods exchanged and terms of trade are of central importance, rather than the relationship between the parties exchanging," where the persons involved may, or may not, be total strangers, with "both parties to the transaction seeking to economize or maximize, to receive the most for what they pay" (Dalton 1982:181). For present purposes, all moneyless exchange accompanied by active bargaining classifies as barter. Under current law, the barter of wildlife products is legal in Alaska, but only between subsistence harvesters. Just how much bartering actually occurs, however, is unknown. It probably is not very common, having been eclipsed by limited commercial sales, on the one hand, and by trading and sharing, on the other.

Trading is an exchange of either goods or of cash and goods where the profit motive is ameliorated by the nature of the relationship between the individuals involved. Here, the motive of maximizing short-term personal gain is tempered by social custom or by the desire to enhance or perpetuate a long-term relationship in which elements other than, or in addition to, the exchange are considered important. Thus conceived, trading typically occurs among relatives, friends, or others involved in some kind of long-term relationship with one another. Trading is legal in Alaska for subsistence harvesters, and it seems to be widespread, particularly among Alaska Natives.

The final form of exchange, giving or sharing, consists of transactions in which there is no calculation of a return (Price 1975, cited by Langdon and Worl 1981). Sharing generally occurs within a small social group among people who interact over an extended period of time; is woven within cultural, ethical, and religious traditions; and tends to be unequal, some people giving more than they receive (Langdon and Worl 1981). The sharing of wildlife products is legal for both subsistence and sport harvesters, and is extremely widespread in Alaska. It has been documented in both Native[12] and non-Native[13] communities.

Thus, for some products, there may be three prices in a given community: (1) the wholesale price, at which a person sells meat or fish to a store or commercial enterprise, (2) the retail price, at which another person purchases the product at the store, and (3) the local "friendly" price, which is the price used in trading among relatives and friends. Indeed, there may be a whole series of "friendly" prices depending on who is involved. Both the retail and the "friendly" prices may fluctuate considerably on a seasonal basis according to seasonal changes in the supply of the wild foods involved.

That the products of Alaskan wildlife harvest are disposed of in a variety of ways has been clearly documented. However, in our review of the

literature, we found almost no quantitative data on the relative importance of household consumption, commercial sale, barter, trading or sharing in the disposition of wildlife products. Reports are typically very general. For example, Magdanz (1988b) reported that eulachon oil in southeast Alaska was "commonly" shared, traded or sold to friends and acquaintances, but "rarely" sold to strangers. Similarly, Magdanz and Wolfe (1988) reported that the "greatest volume" of seal oil exchanges are among relatives, but that "substantial quantities" are also bartered or sold for cash.[14]

At the present level of knowledge, we do not have quantitative data concerning the disposition of wildlife products even within a single community. Without doubt, the percentage that is kept, given away, traded, bartered, or sold varies according to the species harvested, the location of the community, and the cultural heritage of the people involved. Because of the dispersed nature of these practices, especially in rural Alaska, and because of the illegal nature of some of them, they are very difficult to investigate.

ECONOMIC VALUE OF SUBSISTENCE USES OF WILDLIFE RESOURCES

Economic measures of value are *assigned* values. That is, they are values established by human choice which indicate the relative importance or worth of objects (Brown 1984). Assigned values are, of course, not the only category of human values. Two other broad categories of human values which are not addressed here are *held* values, those enduring conceptions of the preferable that guide opinion and choice (Rokeach 1973, Brown 1984), and *conceived* values, the values that people think *ought* to be assigned to objects (Morris 1956).[15] A group's assigned values do not always equal their conceived values, or clearly reflect what the group states are its held values.

Economic valuation within the neoclassical economic paradigm incorporates a fundamental distinction between efficiency and equity. Efficiency deals with the allocation of goods and services *given* the distribution of income. Equilibrium price, an economic measure of value, is determined in a market by the interaction of demand based on willingness to pay, and supply based on marginal cost. Willingness to pay is of course constrained by ability to pay, such that the number of "votes" a market participant has in the determination of economic value depends on his or

her income -- the more one's income, the more one's potential influence on economic values.

Equity deals with the fairness of the income distribution. The unfettered effects of a competitive market system are often altered by governments who desire a more equitable distribution than would otherwise occur. Mechanisms for affecting income distribution include income transfers via progressive taxes, as well as the preferential use of wildlife by subsistence users.[16]

Because demand and supply, and therefore economic value, are based on the existing distributions of income and property rights, alternative distributions may yield different estimates of economic value. This fact is perhaps of particular importance when considering the effect of subsistence users' willingness to pay on measures of economic value, since rural residents, especially those with only seasonal wage-earning jobs, are likely to have relatively little cash. And the low willingness to pay that a lack of cash causes may not reflect a lack of assigned value in the broader sense. Indeed, by remaining in the rural setting, and foregoing the steady income that a city job could provide, the resident may be indicating he assigns considerable value to the rural way of life. Yet, it is that high value placed on the rural way of life that precludes the ability to pay much in cash for the resources on which that way of life depends. Thus, the equity implications of efficiency-based resource allocations must be carefully examined. Economic value information should be considered by policymakers in light of equity considerations.

Economic Value in Theory

Any good, whether seal meat or soap, salmon or soft drinks, may have a series of economic values depending on the kind of change being evaluated. At one extreme is the marginal value, the value of a small change in availability of the good. In the current context, this small change might be either the individual animal harvested or the individual trip to harvest the animal. If a competitive market exists for a good, the market price is often a good estimate of its marginal value.

At the other extreme is the value of the entire supply of the good, which is tantamount in the current context to the right or the ability to harvest a given wildlife species. This total value can be expressed as an average per unit. Assuming a downward sloping demand curve, this average value will

be greater than the marginal value. In between these two extremes are the values of all nonmarginal changes short of complete elimination of the good. We focus below on both marginal and large nonmarginal changes.

To examine further the issue of economic value, consider Figure 1, which depicts demand and supply curves for units (e.g., pounds) of wildlife of a given species from a given area for hypothetical hunters. The curves have

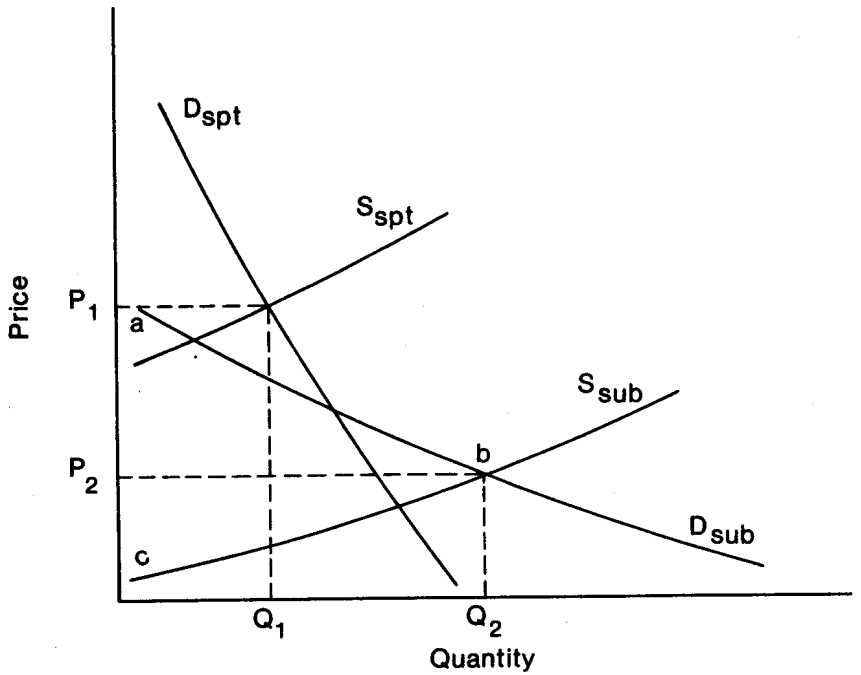

Figure 1. Hypothetical Individual Demand (D) and Supply (S) Curves for Hunting Sport (spt) and Subsistence (sub) Hunters.

the generally expected slopes. The demand curves are downward sloping, reflecting a diminishing marginal willingness to pay for the good.[17] The supply curves are upward sloping, reflecting increasing marginal costs. Areas beneath the demand curve represent total willingness to pay, and beneath the supply curve represent cost, for the given quantity of harvest.[18]

To provide perspective, demand and supply curves are depicted in Figure 1 for "sport" as well as "subsistence" hunting. These curves are not based on a random sample of any specific populations, but should reflect the relative

position of at least some sport and subsistence hunters. Assume for simplicity that the sport hunter lives in an urban area and has a full-time wage-earning job, while the subsistence hunter lives in a rural area and has only a seasonal and uncertain wage-earning job. The sport hunter has limited time for hunting and easy access to food markets, but attaches considerable importance to his occasional hunting trips. The subsistence hunter spends considerable time each year hunting because he has the time, is short of cash and uncertain about future wage-earning work, and prefers consuming wildlife to the imported substitutes available in the store.

The greater distance the sport hunter must travel results in a relatively high marginal cost of harvest, as compared with the subsistence hunter, who lives close to the hunting area. Thus, the supply curve of the sport hunter is depicted above the subsistence hunter's supply curve in Figure 1. The sport hunter's demand curve indicates a relatively high willingness to pay for initial units of wildlife, but relatively low total consumption because of his limited free time and perhaps because he considers the wildlife species a supplement to his diet, not a major contributor. The subsistence hunter's demand curve shows a high level of use, but a relatively low willingness to pay for most of that use (willingness to pay being conditioned by ability to pay).

Note that the demand *and* supply curves of Figure 1 are from the perspective of *individual* hunters or households. Thus, the hunters are the consumers *and* producers of Figure 1, and reap both the consumer and producer surpluses. The demand curves reflect the values that the hunters themselves, and their families, place on hunting.[19] The supply curves express the costs to the hunters, and ignore the societal cost of providing the wildlife, which might include agency land management costs and opportunity costs of excluding the land from manipulations (e.g., timber harvest, mineral extraction) that would remove the habitat from wildlife production.[20]

The price, indicated by the point of intersection of the demand and supply curves, is the marginal value of the good in question. This price would indicate (again, ignoring society's cost of supplying wildlife) the gross loss to society of a one unit decrease in harvest caused by a decrease in quantity supplied, all else being equal, or conversely the gross benefit to society of a one unit increase in the quantity of the good supplied. Such a decrease might occur, for instance, if the harvest were marginally limited by wildlife management policy. If a policy decision caused a marginal decrease in harvest, all else being equal, by the subsistence hunter from Q_2 to $Q_2 - 1$ in Figure 1, the gross loss would be approximated by P_2, the willingness to

pay at the margin, and the net loss would be approximated as P_2 in willingness to pay minus P_2 in harvest cost, or essentially no loss at all. Or, if the marginal decrease in quantity supplied affected the sport hunter, the gross loss would be approximated by P_1, and the net loss would be estimated by P_1 in willingness to pay minus P_1 in harvest cost, or essentially zero. Of course, the net value of nonmarginal reductions in the quantity harvested by either hunter would be estimated by the areas between the respective demand and supply curves from the new to the current quantity. And the net total value to the hunter is estimated by the area between the demand and supply curves over the entire quantity harvested (such as area abc in Figure 1 for the subsistence hunter).

Wildlife management policy may not allow harvest at the optimal level from the hunter's viewpoint. Indeed, it is common for harvest to be constrained, especially for big game species. For example, consider the situation in Figure 2 where supply is constrained at Q_2, as indicated by the vertical supply curve (SS") at the Q_2 harvest level. In the absence of the policy constraint, the welfare of the hunter would be maximized if at least Q_1 were available for harvest, because the hunter's demand curve and supply curve in the absence of the policy constraint (SS') intersect at the quantity Q_1. The loss to the hunter caused by the constraint is indicated by the shaded area, the difference between demand and supply between Q_1 and Q_2. Now, if supply were further limited, to Q_2 - 1, the additional net loss to the hunter would be estimated by P_1 - P_2.

It is interesting to note that, if both the sport and subsistence hunters are harvesting at the point where their respective marginal willingness to pay equals their marginal cost, the *net* change in welfare is essentially identical, and negligible, whether the sport or subsistence hunter is affected by a marginal change. That is, although the gross willingness to pay of the sport hunter for the marginal reduction is greater than that of the subsistence hunter in Figure 1, the net willingness to pay for a marginal change is negligible in either case. However, if the supply to one of these hunters is constrained by policy significantly below its optimal level (as in Figure 2), but not constrained for the other hunter, then there is likely to be a real difference in net value at the margin.

Over time, the entire supply curve for an individual hunter may shift, as might occur when a decrease in wildlife populations makes hunting more difficult. Assume that S1 in Figure 3 depicts the current supply curve for an individual, and S2 depicts the expected supply curve that would result from a decrease in wildlife population. The estimate of the welfare loss to the

individual of this change in supply is the area abc in Figure 3, the change in surplus from the current to the new condition.

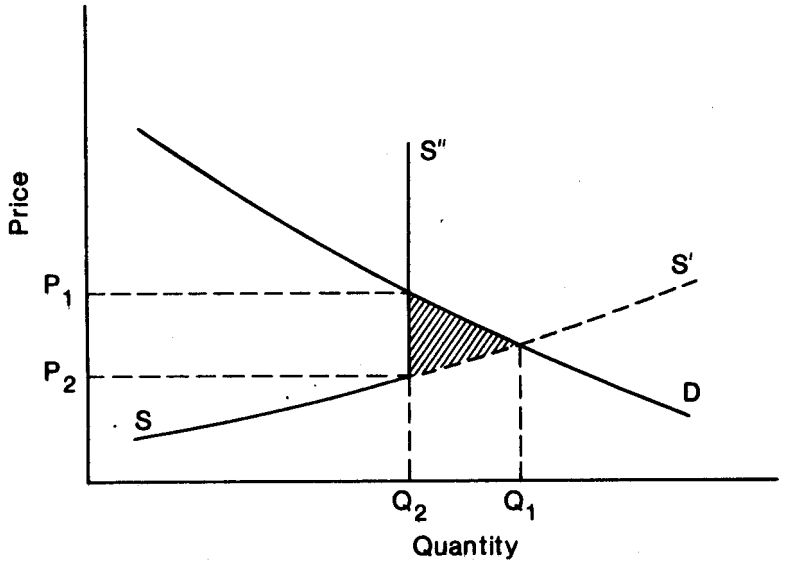

Figure 2. Effect of Supply Constraint.

The demand for hunting may result from a combination of demand for the hunting activity and demand for the end product (e.g., food, skins). The demand for hunting (D_h) may be conceived as:

$$D_h = D_a + D_p$$

where D_a indicates demand for the activity and D_p indicates demand for the product(s) provided by the activity.[21] D_h is appropriately compared to a supply curve (S) representing the cost of the hunter's material inputs (equipment, supplies, travel, etc.), not his time inputs, as in Figure 4.[22] D_a reflects the value of time spent in the activity. D_p may reflect various motives for obtaining the product, including personal consumption, sharing, and selling. Of course, "subsistence" as well as "sport" hunters may assign

value to both the activity and the end product, although the motives behind those assigned values may differ somewhat for different classes of hunters. In any case, it should be clear that these constructs (D_a and D_p) are not necessarily separable in practice; people may know what they want without having clearly determined the relative importance of the various motives behind those wants.

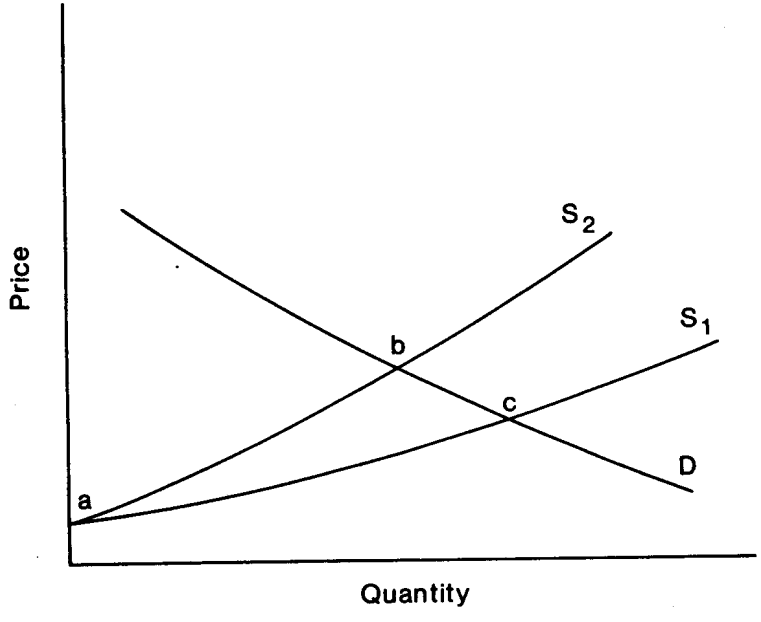

Figure 3. Effect of Change in Supply.

Including D_a as a category of demand is based on the assumption that the hunter positively values, and is willing to pay for, some quantity of the activity. This assumption is undoubtedly viable for some subsistence hunters

but not others. The assumption is less likely to be viable for those individuals who maintain a subsistence-based way of life only out of necessity (who would prefer, for example, to substitute full-time employment for their subsistence way of life, but have no such option) than for those who pursue that way of life by choice.

In Figure 4, D_p is greater than D_a, but this would not necessarily be the case. Similarly, D_a drops to zero at a lower quantity than does D_p in Figure 4, but the opposite is also feasible. As depicted in Figure 4, D_a drops to 0

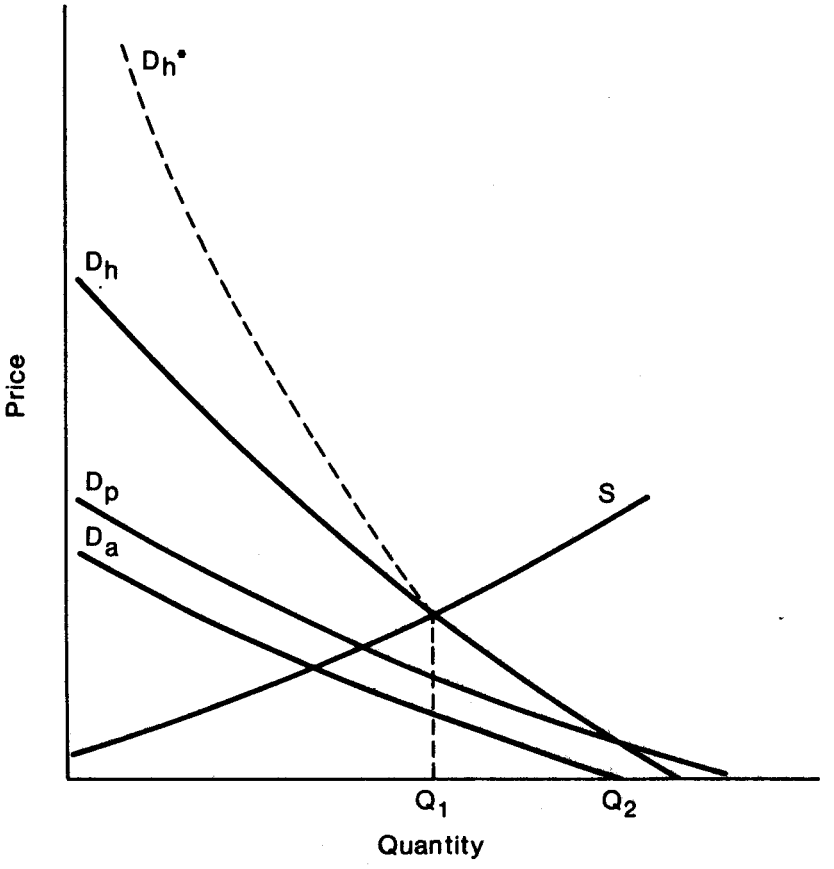

Figure 4. Individual Demand for Harvest (D_h) Composed of Demand for the Product (D_p) and Demand for the Activity (D_a).

at a quantity of Q_2, and is negative at greater quantities, indicating that time spent hunting quantities greater than Q_2 is considered a cost, not a benefit.

Cultural Values

It is sometimes claimed that "cultural values" are overlooked in estimation of the economic value of hunting (or fishing), especially where hunting practices are part of long-standing traditions, as they are among Alaska Natives and some non-Natives. "Cultural values" typically refer to the set of *held* values associated with hunting (such as self reliance, closeness to nature, and kinship). The claim is that these held values are not adequately expressed in or incorporated into the monetary value *assigned* to hunting. We suggest, however, that there is no *a priori* reason to expect that the properly measured economic value of a good or service such as hunting will ignore the cultural importance of the good to the people whose assigned values are being measured. Economic value results from the choices of individuals, who are free to express their held values in their choices. Their choices should reflect the importance that people place on the good, and that importance is a function of the full set of relevant held values. However, this stance must be qualified in three ways.

First, where value is measured in terms of willingness to pay, and that willingness is so constrained by ability to pay that cultural values are overwhelmed by more basic needs, monetary estimation of value may place some groups (and thus some cultural values) at an unfair disadvantage. As stated earlier, value estimated within the economic efficiency framework accepts the income distribution as given, and as such is blind to the issue of fairness of the distribution.

Second, economic values may not reflect the importance of impacts of the resource change that results from decisions based on those economic values, even if the impacts have significant cultural implications. Economic values, as determined in actual markets, reflect *existing* held values, cultural mores, social practices, and other conditions, not the conditions that may exist following some resource change.[23] Cultural impacts must be considered by decisionmakers who understand that the importance of those impacts to the resource users is not necessarily reflected in the value the users currently assign to the resource. Unfortunately, such cultural impacts are very difficult to predict and evaluate.

Significant cultural impacts probably do not follow most resource changes, especially in relatively stable cultures. Such cultural impacts are more likely to occur to minority cultures, which are already subject to the pervasive influence of the majority culture. Cultural impacts are also more likely where the resource change involves goods such as wildlife which, to Native subsistence hunters, are not only inputs to physical well-being, but also symbols around which cultural identity and cohesion revolve.

Also, significant cultural impacts are less likely for small (e.g., marginal) resource changes. However, discrete marginal resource changes may have cumulative impacts. The impacts of any one small change may be trivial, yet a series of small changes may combine to cause significant cultural changes.

The third qualification is that some large nonmarginal changes in resource availability may simply be beyond the purview of economic valuation. To take an extreme example, a change that eliminated the opportunity to practice one's religion could not, for most people, be valued in economic terms. There is no clear rule for distinguishing what changes are within, versus outside, the purview of economic valuation, but a strong case could be made that changes which significantly threaten a people's cultural heritage are outside that purview.[24]

WTP vs. WTA

To this point, we have assumed that the hunter's demand schedule represents both willingness to pay (WTP) and willingness to accept compensation (i.e., sell) (WTA); that at each quantity level the hunter's WTP to obtain an additional unit is equal to his WTA, the compensation he would require to give up that unit. Controversy surrounds discussion in the economics community about the comparability of WTP and WTA for relatively inconsequential goods, where income effects are trivial (Knetsch and Sinden 1984, Fisher et al. 1988). However, where the good makes a significant contribution to personal welfare (i.e., where the income effect is likely to be substantial), as wildlife access probably does to some subsistence users, all would agree that WTA may exceed WTP. If this were the case, there may be two "demand" curves, one curve representing only WTP, such as curve D_h in Figure 4, and another above the first, moving upward to the left from the quantity considered to be the individual's endowment, representing losses in terms of WTA, such as D_h^*.

Even for a good that contributes significantly to personal welfare, WTP is likely to be close to WTA at the equilibrium harvest level (such as Q_1 in

Figure 4) if the hunter harvests many units of the good and it is commonly traded. But as we move progressively back from the equilibrium quantity, WTA may be expected to exceed WTP. Thus, for marginal reductions in harvest from the equilibrium harvest level we may expect WTA to be close to WTP, but for large nonmarginal changes that would severely limit or preclude harvest, WTA may be much greater than WTP, as depicted in Figure 4. That is, if harvest of the wildlife species is considered a significant portion of the hunter's endowment, he is likely to require much more in compensation for its loss than he could pay to purchase the same quantity.

It is not always clear whether WTP or WTA is the appropriate valuation perspective for estimating the value of a specific loss. One approach (Randall 1983) bases the appropriateness of WTP versus WTA on the allocation of legal right to the resource. The traditional demand schedule assumes that the consumer has access but not legal right to the resource, such that he must pay to obtain it. This is typically the stance taken with public resources as well -- that while the entire resource (e.g., a national forest) "belongs" to the public at large, individual citizens do not have a "right" to access or to hunt except under the management guidelines approved by the public at large. Thus, the appropriate estimate of monetary value is willingness to pay. However, if individuals have a right to the resource, then the value to them of loss of the resource is appropriately estimated as willingness to accept compensation for the loss.

The second approach to the appropriateness of WTP verses WTA (Knetsch 1984) simply assumes that WTA is the appropriate measure of a negative change in welfare -- that WTA is that amount necessary to leave the person as well off as he or she would be without the change. This case is strengthened where the persons suffering the welfare loss *perceive* that they have a right to the good being lost. If they do perceive they have a right to the good, then their personal loss is measured in terms of WTA.

Estimation of Economic Value

Methods for estimating the economic value of resource changes include observation of market behavior, the alternative cost method, the travel cost technique, and contingent valuation. A description of each method is followed by a discussion of the applicability of the method to value subsistence harvests in Alaska.

Observation of Market Behavior

In the absence of a commercial market in which to sell his production, and in the absence of policy constraints on harvest, we would expect a subsistence hunter to produce at the level where his marginal willingness to pay/sell (we are assuming WTP = WTA) equals his marginal cost. This would correspond to production of Q_1 in Figure 5, where demand (D_h) equals supply (S) at price P_1. He would consume some of Q_1, but may also give some away or trade some with relatives, friends, or acquaintances. Now, if there were a commercial market for this good, with an established price, the hunter might participate in this market depending on the price, his costs, his personal demand schedule, and his transaction costs.[25] Assuming zero transaction costs, the hunter would be expected to sell some of his take if the wholesale price were greater than the marginal value of the product to the hunter in the absence of the market (if the wholesale price were greater than P_2 in Figure 5). Similarly, the hunter would be expected to purchase some of the product if the retail price were less than the marginal value of the product to the hunter, and less than his marginal harvest cost, in the absence of the market (if the retail price were less than P_2 in Figure 5). Examples of wholesale and retail prices that engender market participation and the associated impacts on harvest decisions are presented in the Appendix.

If an established wholesale market existed, and we observed no sale by the hunter in the market, we would assume, ignoring transaction costs, that the gross marginal *product* value to the hunter were probably greater than, but possibly equal to, the wholesale price. But, if the hunter sold part of his take, his action would indicate that, to him, the gross product value of the sold portion were equal to the wholesale price. But the wholesale price would underestimate the gross value of the portion retained (it is retained precisely because its value is greater than the available price from sale).

Similarly, if an established retail market existed, and we observed no purchase, we would assume, ignoring transaction costs, that the gross marginal value of the *product* were less than, but possibly equal to, the retail price. But if the hunter purchased some of the product, his action would indicate that the gross value to him of the product were equal to the retail price. And if both wholesale and retail markets existed and the hunter neither sold nor purchased the product, we would assume that the marginal value of the product to the hunter were within the range from the wholesale to the retail price.[26]

The key features in allowing us to draw inferences about a seller's or buyer's marginal product value from his market behavior are that he is a price taker (he cannot affect the price) with good information about the price, and the product is homogeneous and divisible. A fully competitive market is not necessary to indicate value; for sale, only the seller's side must be competitive; and for purchase, only the buyer's side must be competitive, such that the market participants of interest are unable to affect the price.

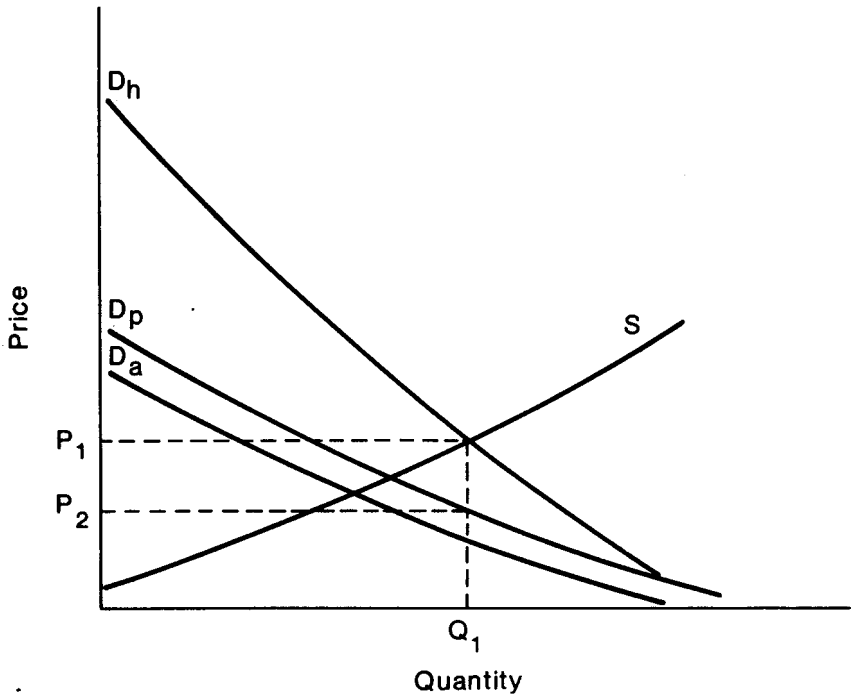

Figure 5. Individual Demand for and Supply of Subsistence Harvest.

We have observed that market behavior may indicate the value the hunter assigns to the product. However, the price at which a hunter purchases or sells the product does not necessarily indicate the value of hunting. If the value of the *activity* is positive, market price of the end product will underestimate the value of hunting. If sale is observed, the gross marginal

value of hunting is assumed to be equal to the sum of the wholesale price and the marginal value of the activity. If purchase in addition to harvest is observed, the gross value of the harvested portion is assumed to be equal to the retail price plus the value of the activity. If the value of the activity is substantial, basing estimates of a loss of hunting solely on observation of market sale or purchase of the end product underestimates the loss to the hunter.

Table 2 summarizes the inferences about economic value that can be drawn from observation of market behavior where transaction costs are minimal. For each possible observation (sale, purchase, or no market participation), the table lists the gross economic values applicable for valuing marginal and nonmarginal reductions in hunting and associated harvest. Subtraction of harvest costs from the gross values in the table would yield the net values. More detail on inferring resource value from market observation is included in the Appendix.

To this point, we have focused on commercial market prices. However, a local price, or set of prices, may exist that is used among relatives, friends, and acquaintances which has little or no relationship to commercial markets. Is the local restricted price an indication of marginal value? Assume that

Table 2. Indications of Value of Harvest given Observation of Behavior in Wholesale and Retail Markets[a].

Observation	Economic Value [b]
Sale at P_w [c]	$D_h \geq P_w + D_a$ [d]
Purchase at P_r [e]	$D_h = P_r + D_a$
Neither sale nor purchase	$P_w + D_a \leq D_h \leq P_r + D_a$

[a] Assumes the good may be sold competitively at price P_w and purchased competitively at price P_r, where $P_w < P_r$ and transaction costs are nil.

[b] D_h indicates gross value to the hunter per unit of harvest. D_a indicates gross value of activity per unit of harvest. These indications of economic value apply whether or not the pre-reduction harvest level was already constrained below the hunter's optimum level.

[c] The hunter sells some or all of his take at price P_w.

[d] Equality necessarily applies for marginal changes and for those nonmarginal changes affecting only the portion of harvest sold by the hunter (not the portion retained, if any).

[e] The hunter supplements harvest with purchase at price P_r.

the hunter of interest (hunter A in Figure 6) produces good X. In the absence of any exchange possibility, and given his demand (D_x) and supply (S_x) curves for X, he harvests Q_1 of X. The gross marginal value of his harvest is P_1. Now, assume that another hunter produces good Y but hunter A does not, and that hunter A's demand for Y is depicted by D_y. With the opportunity to trade X for Y, pound for pound, hunter X would produce Q_2 of X and exchange the quantity Q_2 - Q_3 of X for Y, keeping Q_3 of X for personal use. The gross marginal value of hunter A's harvest is P_2 and the marginal value of what he keeps is P_3.

Of particular interest here is that if, instead of trading, the hunters sold their produce to each other at an agreed upon price, the specific price would not affect their harvest and sale decisions. Such a price among friends may be below the marginal price, such as P_4 in Figure 6. Although P_4 is lower than P_1, hunter A would still sell Q_2 - Q_3 of X as long as he knew that he could buy Q_2 - Q_3 of good Y at the same price at which he sold that quantity of good X. In fact, he would produce and sell the same quantities at any restricted "friendly" price as long as trading were advantageous and he were confident that his trading partners would all honor the local

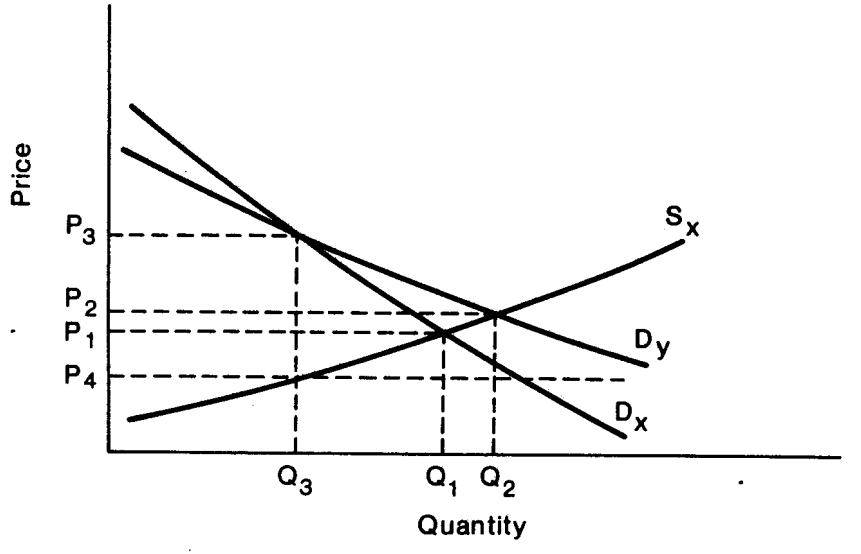

Figure 6. Hunter A's Demand for Goods X and Y, and Supply of Good X.

exchange rate. The local price may not serve as an estimate of the marginal value of good X, if that price reflects a "gentleman's agreement" rather than an impersonal market.

Application to Alaska. Observation of market participation is of limited utility for valuing harvest by Alaskan subsistence hunters because of the lack of commercial markets for many species and legal constraints on participation by hunters in markets even where they exist. Commercial enterprises, participating in large-scale markets, exist for some species, including salmon, halibut, herring, and king crab, but harvest taken under noncommercial provisions cannot legally be sold to such enterprises. Edible portions of marine mammals harvested by Native subsistence users can be sold legally in Native villages and towns, or for Native consumption, but well-developed markets are generally lacking. Only fur bearers (e.g., beaver, land otter, lynx, and wolf) and rabbits may be sold in more general markets.

Although commercial sale of most species harvested under subsistence provisions is not permitted, some sale probably occurs. This may happen where a hunter has a commercial permit and subsistence rights for the same species (e.g., salmon) and can rather easily add subsistence catch to the commercial catch, or vice versa, or where a local unauthorized market exists. However, observation of behavior in these markets is problematic. First, commercial sale may be difficult to distinguish from "customary trade" and barter, which typically are permitted under subsistence laws and which may occur at "friendly" prices that reflect the relationship between the parties to the exchange. Usher (1976) suggests that local exchanges among rural Arctic residents are often performed at prices which depend on kinship or friendship between buyer and seller.[27] Second, participants may not consider divulging such information to be in their best interests. Finally, an agency charged with enforcing game laws would be in an awkward position if it also attempted to study unauthorized market behavior for the purpose of resource valuation.

An alternative to observing actual markets is, following a carefully controlled sampling design, to actually attempt to purchase goods at the lowest possible price and sell at the highest price. That is, actual market transactions would be attempted in selected locations for selected species. In Alaska, however, this approach would not be viable where commercial exchange of subsistence harvest is not legally permissible.

Barter among subsistence hunters, or between subsistence hunters and others, has largely been replaced by cash sale in Alaska, but still occurs occasionally. If the barter involves two or more nonmarketed goods, we still

have no indication of the monetary value of any of them. Only where one of the goods is a commonly available market good do barter transactions offer a convenient estimate of price.

Market observation can potentially provide good estimates of marginal product value, but rarely of the value of the entire amount of the good consumed. Yet, many important changes to be evaluated in Alaska will be nonmarginal. The value of the entire good is reflected by the demand curve over the full quantity used. The demand curve is not observable directly. Anthropological studies offer some clues about the shape of individual demand schedules for typical residents of some rural Alaskan communities, but we are not aware of any detailed studies that attempted to estimate such schedules. Such work would contribute significantly to our understanding of the value of wildlife to subsistence users.

Computation of net value requires estimation of the hunter's cost of production, to be subtracted from the gross value. We know of no estimates of the marginal cost of hunting by rural Alaskans. Nowak (1977) estimated average harvest costs per pound to rural southwestern Alaska hunters, and found them to be about one half of the retail price of imported substitutes. And Wolfe (1986) estimated average costs of subsistence food production for a western Eskimo population. Cost estimation is complicated by the existence of joint costs (costs such as those for equipment and travel that are incurred in the harvest of several products), and is a problem for all four valuation methods described herein.

A final problem with market observation, mentioned above, is that it ignores the value of the hunting activity. We know of no studies examining the value of the harvest activity to Alaska subsistence hunters. The activity value may be minimal *at the margin* for a species harvested in abundance, such as salmon sometimes is, but is not necessarily so. It is less likely to be low for species not harvested in large numbers. This is an empirical issue that would need to be resolved before observation of market behavior could be relied upon to yield reliable estimates of the value of subsistence hunting.[28]

Alternative Cost Method

This method estimates the gross value of a loss as the minimum cost of replacing it with a substitute, and estimates the net value as this replacement cost minus the now avoided cost of providing the original good (i.e., new

cost minus old cost). Application of the method first requires determination of an appropriate substitute. If the hunter could and would react to the loss of a hunting opportunity by substituting the hunting of another species, the loss is simply estimated as the difference in cost between the two hunting options (plus some accounting for the drop, if any, in quality of the product and/or the activity). But if a viable hunting substitute is unavailable, and a commercial product is a reasonable substitute for the lost hunting product, success of the method depends on finding such a commercial product.

If hunting another species is not a viable substitute, both the wildlife product and the hunting activity are lost when hunting is restricted. Thus, the total replacement cost consists of the cost of the substitute product (call it P_p) plus compensation for the lost activity (call it P_a). The avoided cost consists of the cost of hunting that is no longer incurred (S over the quantity change). The gross value (replacement cost) using this method would therefore be $P_p + P_a$, and the net value would be $P_p + P_a - S$.

Note that subsistence users may or may not be consuming wildlife such that their marginal willingness to pay for hunting is as great as the cost of the least expensive commercially-available substitute. The similarity of marginal WTP and substitute cost is an empirical question, the answer to which may differ by location and time depending on the availability and cost of the full range of substitutes. However, in many situations, the substitute cost is likely to be considerably greater than the subsistence user's WTP at the margin.[29] Use of the alternative cost method in situations where the alternative cost exceeds the hunter's marginal WTP in essence amounts to adoption of the WTA perspective, if we assume that the hunter would not accept less than the alternative cost in compensation for a loss of hunting.

The appropriateness of the alternative cost approach in cases where the substitute price is greater than marginal WTP of the user can be considered to rest on whether society has a *responsibility* to provide the good or an acceptable substitute. This responsibility might be reasonable, for example, if the subsistence user is considered to have a *right* to the good, or if, for equity reasons, the government decided to assure access to the good. If provision of the good is taken as given, then the value to society of the wildlife unit is as great as the cost of replacing it, since society would incur that cost in the event of lack of availability of the good in question. In this case, previous assertions in the market observation section about the inaccuracy of using retail price to estimate gross product value may be incorrect. However, if society has not accepted this obligation and if there

is no other justification for taking the WTA perspective, then the welfare change is more appropriately estimated as the WTP for the good at issue.[30]

Application to Alaska. Usher (1976) discusses three potential problems with application of the alternative cost method. First, pound for pound, the nutrition provided by wildlife is typically greater than that provided by common substitutes such as beef (see also Nowak 1977). Second, commercially produced substitutes such as beef may lack the taste characteristics of the wildlife product. Third, the value of the lost hunting activity has typically been ignored or assumed to be 0.

Assuming that use of the alternative cost method is appropriate, a viable substitute must be found for valuation to proceed. The most appropriate substitute product (for example, a food with equal nutritional value) may not be what people facing a budget constraint in fact would substitute for a loss of the product. An inappropriately chosen substitute could lead to either under or overvaluation of the good in question. And assuming society does not have the responsibility of replacement, use of the method with the obvious substitutes for wildlife in Alaska (imported canned or frozen meat) may tend to overvalue wildlife at the margin, but may still undervalue total wildlife harvest.

Travel Cost Method

The travel cost method (Dwyer et al. 1977, Mendelsohn and Markstrom 1988) values a site, such as a hunting area, by observing how much people are willing to pay to visit the site. The method is based on the reasonable assumption that people will make repeated trips to a site in a given season until the value of the last trip is just worth what they have to pay to get there. By measuring how often people visit the site from different distances, the value of all trips, not just the marginal ones, can be inferred and the value of the site can be estimated.

Application to Alaska. Travel cost analysis has been used to estimate the value of hunting, but it is best applied to estimate the value of a hunting site, rather than a wildlife species. Where the species habitat covers a wide range, such as salmon or some big game species, and hunting or fishing occurs in many different areas, isolating specific sites as the focus of the valuation may be difficult. Also, if hunting trips tend to jointly produce harvest of more than one species, isolating the value assigned to one species is arbitrary. Furthermore, application of the travel cost technique requires that users of the site to be valued originate from locations at numerous

different distances from the site. Before snowmobiles and fast boats were commonly available, this condition did not apply in many Alaskan hunting areas. Typically rural residents of only one or two areas hunted at given site. The degree to which use of modern backcountry transportation has altered the geographical distribution of users is unclear. Application of the travel cost technique to estimate the value of harvest of specific species by subsistence hunters appears to face significant difficulties.

Contingent Valuation Method

Contingent valuation, the method of carefully constructing questionnaires to induce unbiased individual estimates of monetary value (Cummings et al. 1986, Mitchell and Carson 1989), has gradually received the support of many economists, as well as government agencies (U. S. Water Resources Council 1979, U. S. Department of Interior 1986). Contingent valuation can potentially measure the value of marginal or nonmarginal changes. The method can be used to elicit indications of WTP to obtain a positive change or to avoid a negative change, or WTA to endure a negative change. The method can use various formats, described briefly here in terms of WTP for a positive change. In the open-ended format, respondents are asked the maximum they would be willing to pay for some specified change. In the bidding game, respondents are asked if they would be willing to pay a specified amount. If they answer positively, the question is repeated with a larger amount, and so on until a negative answer is obtained; if the original response is negative, the amount can be decreased until a positive answer is obtained. With the dichotomous choice format, each respondent is asked whether or not he or she would pay a specified amount; the amounts are varied among respondents. The distribution of positive, versus negative, responses at each specified amount is used to infer the population's WTP. The final format, the referendum format, is similar to the dichotomous choice format, but the question is in the form of a vote. Respondents are asked whether they would vote for or against a policy that would bring about some improvement to the group at a specified cost. The cost is varied among respondents, and the distributions of yes, versus no, votes at the different costs indicates the population's WTP.

Each format has its advantages and disadvantages, and one may be better than another in a given situation. In any case, the survey must be carefully designed and pretested, and the sample must be wisely chosen. "Focus groups" made up of members of the population of interest are sometimes

used to help researchers understand the population's familiarity with such survey mechanisms and knowledge of the relevant issues. Difficult choices must be made about just what "background" information should be provided to respondents about the good being valued, the form of payment, and the expected distribution of the total costs and benefits. This information should be detailed enough for the respondents to be well informed, but not so detailed that they lose interest or become confused.

Unlike the three methods reviewed above, contingent valuation offers the possibility, at least in theory, of valuing not only the specific good at issue, but also the impacts of its loss. Values derived using the other three methods reflect only the value people assign to the good in the context of current conditions. With contingent valuation, because the good to be valued is verbally described to respondents, it can be described as not only the resource per se, but also the expected consequences of its loss; or the consequences can possibly be separately valued using other contingent valuation questions. (Indeed, respondents' estimates of value of a resource may be influenced by their perception of the impacts of its loss even if the contingent valuation question makes no mention of such impacts.) These consequences can include cultural impacts.

Application to Alaska. Contingent valuation could be used to estimate the value of wildlife products in Alaska, but the accuracy of the results would potentially suffer from four problems, especially when applied to estimate values of subsistence hunters. First, as Glass and Muth (1987) have indicated, mistrust of resource management agencies and a reluctance to divulge information about wildlife may affect survey responses. Second, hypothetical bias (Cummings et al. 1986) may be particularly acute with respondents who are unaccustomed to thinking about the monetary value of the good in question.[31] We know of no published research on the validity of using contingent valuation with populations who are less accustomed than the average American citizen with markets and monetary valuation. Furthermore, hypothetical bias may be a serious problem for species that cannot be legally sold.

The third concern about the use of contingent valuation with Alaskan subsistence users is that there may not always be a sufficiently large sample of respondents. If a prospective change will affect only one village, such as some of the smaller villages listed in Table 1, the entire population of respondents may be insufficient to enable reliable estimation of monetary value. The sampling problem is further confounded in small towns, because potential respondents are likely to discuss the survey among themselves

before all have been contacted by the interviewers, possibly biasing the later responses. Indeed, collective decisionmaking is traditional among Native groups, and respondents may insist that discussion among themselves is necessary before they can or will comply.

The fourth concern is over the potential for applying contingent valuation to situations beyond the ability of the method to yield valid estimates. While contingent valuation may be quite successfully used to estimate the marginal value of some harvested species, the tendency would be to apply the method to value significant nonmarginal changes, changes which contingent valuation, unlike the other methods, is potentially suited to handle. Yet if we are valuing a large nonmarginal change and ask more traditional rural Alaskans in a contingent valuation survey what they are willing to pay to maintain hunting access to a wildlife species, we are asking to a certain extent what their way of life is worth to them. Indeed, wildlife access might be considered a weak complement to the rural Alaskan way of life such that, if the change at issue is removal of wildlife access, the value of the wildlife access includes the value of the way of life. Valuation in such a situation may be asking too much of the contingent valuation method.

Of course, the value of any one species depends to some extent on the availability of substitutes. Although each species has a place in the different cultural traditions of Alaskan communities, some big game species may be reasonable substitutes for others, and some fish species may be reasonable substitutes for others. The extent and nature of substitutability presumably could be empirically determined in different parts of the state. But, to the extent that substitutes are not available, and to the extent that wildlife access is integral to maintenance of the way of life, can the typical respondent deal with such monumental issues in the context of a WTP question about a specific resource change, and will the WTP of cash-poor rural residents introduce such a serious equity question that the monetary estimates become of only academic interest?

However, WTP may not be the appropriate perspective for valuing rural Alaskans' right to hunt. It is not clear to what extent rural Alaskan residents who qualify as subsistence users have a right to the wildlife resources. But the fact that legislation gives designated rural residents priority over others in access to wildlife, and that land management will be constrained by the harvest practices of these residents, suggests that the law leans towards protecting rural Alaskans' rights to access. In any case, it seems reasonable to assume that Alaskans, in particular Alaska Natives, at

least *perceive* they have a right to harvest wildlife in traditional areas. Thus, their loss may be most appropriately measured in terms of WTA.

The problem then becomes one of designing an appropriate WTA valuation instrument. Two nearly contrary concerns arise. On the one hand, given the special place of wildlife in the rural Alaskan way of life, and the ancient traditions surrounding Native uses of wildlife, it may not be possible to design a contingent valuation survey without incentives to overstate WTA for wildlife access. A significant proportion of infinite bids would be likely, and it would be difficult to distinguish between those representing protests at the idea of valuing such a good monetarily and those representing legitimate expressions of exceedingly high value.

On the other hand, some Native respondents may state a finite WTA, when in fact they would not consider selling the good at any price if they believed they could avoid the sale. Their bid may reflect what they believe is the best deal they are likely to get, because past experience had shown that they had little power to forestall change proposed by the political power structure.

Nonuser Values

Nonparticipants, especially those removed from the local controversy about subsistence hunters' priority uses of wildlife, may also assign value to maintenance of the traditional Alaskan way of life, and therefore to the right of subsistence users to harvest any wildlife that is integral to their traditional way of life. That is, there may be economic value to the existence of Alaska Native cultures, or to the non-Native "pioneer" way of life which, being dependent to some extent on the availability of wildlife, implies a value to their continued access to wildlife. In essence, nonparticipants may consider Alaskan residents' way of life to have "existence value" (Krutilla 1967, Brookshire et al. 1983). This is, of course, in addition to any existence value that the wildlife resources have irrespective of human use.

The value to nonparticipants of the hunting and fishing rights of subsistence users is complicated when the rural Alaskan way of life places pressure on the survival of wildlife species, or involves what nonparticipants may consider to be brutal treatment of wildlife. Furthermore, it could be argued that such value is paternalistic and should therefore be ignored. Nevertheless, excepting certain circumstances, the value of Alaskan wildlife

is probably enhanced by the value nonparticipants place on the existence of the rural Alaskan way of life.

Contingent valuation could be used to estimate nonusers' WTP for maintenance of wildlife access. We would have the problem of reasonableness of valuing a way of life in economic terms, but the problem is not likely to be as serious as when asking participants for their WTA.

Regional Differences

The values of both marginal and nonmarginal changes may be quite different from one location to another in Alaska. For example, the marginal value of seal meat may differ among locations because local animal populations differ (supply) or because of differences in preference for seal meat and availability of substitutes (demand). The great distances between locations and difficulties of transportation may preclude development of one large market with homogeneous prices. Thus, it may not be correct to generalize the results of a study in one location to other locations.

CONCLUSIONS

It is much more feasible to estimate marginal values and values of small nonmarginal changes than to estimate the value of large changes, such as the right to harvest a wildlife species. Indeed, it may not be feasible to estimate the value of large nonmarginal changes, and especially the right to harvest, given the likelihood that WTA is the appropriate perspective and the difficulty in obtaining meaningful responses to contingent valuation questions about WTA.

Where a commercial market exists and subsistence harvesters who are price takers sell some of their take in those markets or buy wildlife products in those markets the market price provides a good estimate of the marginal value of the harvested product although it may fail to reflect the marginal value of the activity, if any. Where users do not participate in the commercial market or where no market exists, which is typical for subsistence users in Alaska, we are left with four approaches: (1) examining the prices of substitutes, (2) observing the complex set of local sales and trades among actors of varying relationships, (3) using a nonmarket technique such as contingent valuation, or (4) attempting to actually

purchase or sell the goods to subsistence users in a carefully designed experiment.

Where appropriate substitutes exist and society has assumed the responsibility to replace lost harvest, the alternative cost approach is preferable because of the relatively low level of effort required. But suitable substitutes are not always available, and the approach as typically applied ignores the value of the activity. The increasing importance of cash transfer has enhanced opportunities to learn of marginal value via observation on the local level. However, this would take a major field research effort requiring the long term involvement of individual observers in specific villages, and it is complicated for most species by legal restrictions on commercial sale. The ubiquitousness of cash transfer has probably also enhanced the possibilities of a successful contingent valuation survey or cash experiment, but careful design and significant pretesting would be required to gauge potential success among the rural, largely Native population.

Little is currently known about the economic value of many wildlife products harvested by subsistence hunters, and even less is known about the value of the hunting activity. While the value of the activity is very likely to be positive overall, it may not be substantial or even positive at the margin. Research is needed on the value of the hunting activity.

Decisionmakers must realize that most economic valuation methods only indicate the value of a wildlife resource, not the value (i.e., cost) of the cultural or other impacts of loss of the resource. Only contingent valuation offers the possibility of incorporating (intentionally or otherwise) the value of expected impacts of the loss into the value of the resource. If the value of the impacts are not somehow incorporated into the resource value, they should be separately valued, or at least described and then considered in the decision.

Decisionmakers must also realize that WTP is conditioned on ability to pay, which may be generally lower among people participating in a subsistence way of life than among nonparticipants. Estimating the value of wildlife in terms of WTP may therefore put participants at a disadvantage relative to nonparticipants, allowing nonparticipants, such as persons with full-time wage-earning jobs, to bid away wildlife from subsistence users. And this may occur although the subsistence users rely more heavily on wildlife for their well-being.

The clear distinction between efficiency and equity in neoclassical economics places a considerable burden on decisionmakers when values of different social or cultural groups are relevant to a decision, for in such cases equity considerations are particularly important. The equity

implications of an efficiency-based WTP analysis of economic value can be specified by the analyst, but it is up to decisionmakers at the political and public policy level to consider the fairness of those implications. Reliance on the efficiency framework, without considering the equity implications of that reliance, can lead to unsatisfactory decisions. Reliance on efficiency-based analyses, to the exclusion of equity concerns, in valuing Alaskan wildlife could tend to move Alaskan society towards a more homogeneous, market-oriented sociopolitical order, to the detriment of the current more pluralistic society.

Estimates of economic value clearly have their limitations. But, as Randall (1988) reminds us, we should not expect more of economics than the theory and methods allow. Economic valuation can provide useful insights and, as long as its limitations are recognized, contribute to informed decisionmaking (see also Boulding 1970). To ignore economic valuation in major policy decisions affecting hunting and fishing might be just as serious an error as focusing solely on economic valuation in such decisions.

Notes

1. This paper has benefitted from comments and suggestions by Gregory Alward, Dennis Cory, James Fall, Ronald Glass, Robin Gregory, Terry Haynes, Jack Kruse, John Loomis, Daniel McCollum, George Peterson, Randy Rogers, Donald Rosenthal, Robert Schroeder, Peter Usher, Robert Wolfe, and William Workman.

2. For a critique of Arctic Native harvest surveys and statistics, see Usher and Wenzel (1987).

3. The Alaska Supreme Court, in McDowell v. State in December 1989, declared the state subsistence law to be unconstitutional, stating it discriminated unfairly against urban dwellers. The court's decision does not directly affect federal law, which still distinguishes between subsistence and other harvest on the basis of rural versus urban residence. This dichotomy is leading to complicated distinctions between federal and state lands in how subsistence harvests are regulated. The implications of these changes are still unclear.

4. Even activities of residents of GMUs defined as "rural" fall under sport regulations under certain circumstances, such as when fishing with rod and reel.

5. Subsistence use fishing by urban residents is also permitted in some rural areas, in which cases the urban/rural dichotomy breaks down.

6. There are almost certainly subpopulations in Anchorage with a much higher degree of dependence on wild foods, and others with no dependence on wild foods at all.

7. In this context, government and other public sector agencies are considered part of the "market sector."

8. Examples of regional centers include Barrow and Kotzebue, in the northern part of the state; Nome, in the west (Ellanna 1983b, Wolfe et al. 1986); Bethel and Dillingham (Fall et al. 1986), in the southwest; and McGrath (Stokes 1985), in the interior.

9. Here, as in other areas, it is important to keep in mind the difference between relative and absolute figures. Thus, Anchorage, which is overwhelmingly non-Native in composition, also held nearly 9,000 Alaska Natives at the time of the 1980 census (U.S. Bureau of the Census 1981:9). This number was larger than the population of any predominantly Native community in the state.

10. Subsistence studies of predominantly non-Native communities include the following: the Matanuska-Susitna Borough (Stanek et al. 1988), the Copper River basin (Stratton and Georgette 1984), the Kenai Peninsula (Reed 1985), and southeastern Alaska (Schroeder and Nelson 1983, Gmelch and Gmelch 1985, Smythe 1988).

11. Representative subsistence studies of predominately Native communities include: (1) the Iñupiaq Eskimos in the northern and northwestern sector (Ellanna 1983a, Burch 1985, Pedersen et al. 1985, Sobelman 1985); (2) the central Alaskan Yup'ik Eskimos, in the western and southwestern sectors (Andrews and Peterson 1983, Charnley 1984, Wolfe et al. 1984, Brelsford et al. 1987); (3) the Chaplinski Yup'ik Eskimos, on Saint Lawrence Island (Ellanna 1983a); (4) the Sugpiaq Yup'ik Eskimos, on the mainland and islands of the northern and western Gulf of Alaska (Stanek 1985, Fall and Morris 1987, Morris 1987); (5) the Aleuts, of the Pribilof and eastern Aleutian Islands and part of the Alaska Peninsula (Veltre and Veltre 1981a, 1981b, 1983); (6) the Tlingit and Haida Indians, along the southeast coast (Ellanna and Sherrod 1987, George and Bosworth 1988); and (7) the Koyukon (Marcotte and Haynes 1985), Kutchin (Caulfield and Pedersen 1981, Caulfield 1983), Ingalik, Upper Kuskokwim (Stokes 1985), Tanana (Haynes et al. 1984, Halpin 1987), Denai'na (Behnke 1983, Fall et al. 1984, Kari 1985), and Ahtna (Stratton and Georgette 1984) Indians of the interior, the Copper River basin, and the southern slopes of the Alaska Range.

12. Ellanna (1983b:112-114), Fall et al. (1984:71-77, 197-199), Fall and Morris (1987:77-19), George and Bosworth (1988:63-67), Kari (1985:46-56), Marcotte and Haynes (1985:97-100), Sobelman (1985:153), Stokes (1985:105-109), Sumida (1989:40-42), Thomas (1982:264-269), Wolfe et al. (1984:363-371, 399-402; 413-414, 423-424, 428-427).

13. Fall and Foster (1987:47-50), Gmelch and Gmelch (1985:145-155), Reed (1985:176-178), Schroeder and Nelson (1983:237), Smythe (1988:47-50), Stanek et al. (1988:49-50, 112).

14. Some interesting data are available for salmon. Wolfe (1983a:43) reported on salmon use in six small communities of the Yukon Delta, a region with a considerable commercial salmon harvest. He showed that, among these six

communities, from 4% to 52% of the salmon harvest was kept for subsistence use rather than sold commercially. Glass et al. (1990: Table 6) report that 2% of the total (5 species) salmon harvest (but 13% of the king salmon) was kept for personal use, with the rest sold commercially, in a community located along the Gulf of Alaska. But neither study documents what happened to the salmon kept for personal use (the amount that was consumed directly by the family whose members caught the fish, the quantities that were traded, bartered or given away, and the amounts that were sold in limited commercial transactions within the community).

15. See several papers in Decker and Goff (1987) for more on the distinction between assigned and held values as they apply to wildlife.

16. Governments interfere with market allocation of resources for other reasons as well, principally to correct market imperfection by limiting negative externalities and providing for the supply of public goods.

17. We shall throughout be making the standard assumptions about demand: a constant marginal utility of money; diminishing marginal rate of substitution among goods (i.e., convex indifference curves); the products of interest (hunting and wildlife products) are normal (not inferior) goods; the resulting downward sloping demand curves reflect existing prices of all other goods.

18. Technically speaking, it is the Hicksian (income compensated) demand curve that accurately depicts a consumer's willingness to pay. The ordinary demand curve may approximate the Hicksian curve (Freeman 1979).

19. Thus, the individual demand curves ignore the values of others who may have an interest in the success or failure of the hunters (i.e., we assume away interdependent utility functions).

20. A market demand curve would represent the horizontal summation of all relevant individual demand curves or, more accurately, the horizontal summation across individuals of the positive differences between their demand and supply curves. This market demand curve would thus be net of individual harvest costs, and would be appropriate for comparison with the supply curve representing the societal cost of providing hunting opportunities. Note also that societal decisions, and therefore costs, such as those involving location of hunting opportunities, may affect costs of individual hunters; the two kinds of costs can interact.

21. More accurately, D_a is the *net* value of the harvest activity; i.e., the gross value of the activity minus the value of the next best alternative use of the individual's time. Thus, D_a indicates the individual's WTP to hunt rather than engage in some other activity.

22. Alternatively, we could consider the value of participating in the activity (D_a) to reduce the cost of hunting. In this formulation, the hunter's supply function is $S' = S - D_a$, and the comparable demand function is D_p. Either specification (D_h vs. S or D_p vs. S') will yield the same quantities demanded, the same estimates of welfare change, and the same market demand curves.

23. The potential for cultural change raises the possibility of a incongruity similar to the "Scitovsky paradox" for changes in income distribution (Scitovsky 1941).

Suppose a resource change, resulting from a decision based on economic values estimated before the resource change, affects held values that in turn affect demand for the very resource that was changed, and that an ex post analysis based on the new economic values would support *reversing* the resource change. The possibility of reversals suggests that extreme caution be exercised in evaluating resource changes that are likely to affect held values.

24. While some goods may not be amenable to economic valuation, decisions may nevertheless need to be made that require consideration of tradeoffs involving such goods. Incommensurability of value makes tradeoffs difficult, but does not preclude their consideration. See Krutilla and Fisher (1975) for examples of how tradeoffs among incommensurables can be evaluated.

25. Transaction costs are the costs of participating in the market (minus the actual cost of the product), including both out-of-pocket costs (e.g., transportation to the market place) and any costs imposed by cultural or social pressures or legal constraints.

26. Some authors in the anthropological literature (e.g., Chibnik 1978, who cites Mellor 1966) argue that the value of product consumed by the hunter is best estimated by its retail (i.e., replacement) price. We suggest that, if transaction costs are minimal and value is measured as willingness to pay, this is true if he buys some, but incorrect if he sells some (assuming of course that the retail price exceeds the wholesale price), and indeterminate if he does neither.

27. As a related example of this, consider the water "rental" market in northern Colorado, where water is sold on a piecemeal basis without transfer of water rights. As Anderson (1961) reports, the price charged by cities, that typically hold excess water, to farmers who typically need extra water, is usually no more than the assessment fee that the cities pay for the water (the cities' variable cost of owning the water). This occurs even when the cities could sell the water for considerably more than the assessment fee to farmers whose willingness to pay is high because they might lose their crop without the water. Local practices tend to keep the cities from selling the water for what the market will bear, perhaps because of notions of fairness (see Kahneman et al. 1986, on fairness).

28. A lower limit on the value of subsistence activities in general (not the value of hunting a particular species) might be approximated by estimating the income forgone by remaining in the rural area (by not moving and obtaining employment available in an urban area). However, this approach is fraught with problematic assumptions.

29. For example, assume that the cost of the substitute product is P_3 in Figure 5, that compensation for the lost activity is simply equal to the marginal value of the current activity (P_4), and that the hunter is consuming at Q_1 where his demand (D_h) equals his harvest cost (S). The alternative cost method would estimate the gross value of the marginal wildlife unit as $P_3 + P_4$, although the hunter's gross marginal WTP for hunting is only P_1, and would estimate the net marginal value as $P_3 + P_4 - P_1$, or $P_3 - P_2$, although the hunter's net marginal WTP is 0.

30. In a 14 July 1989 U. S. Court of Appeals opinion about proposed Department of Interior regulations for computing resource damage, the court found fault with the U. S. Department of Interior's proposal to select the lesser of willingness to pay and replacement cost, and suggested that the intention of Congress was that replacement cost be used in determining damage value where damage value may be greater than willingness to pay. The court appears to assume that damaged parties have a right to the state of the world before the damage occurred. The relevance of this decision to the case at hand would depend on the extent to which a wildlife change were considered a damage.

31. An alternative to using money directly would be to solicit responses about nonmarket goods in terms of other goods, such as furs, that have relatively well established prices.

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Appendix

A graphical analysis of sale and purchase conditions can help demonstrate the reasoning behind the inferences drawn from market behavior about the economic value of the product and of hunting. We will investigate sale and then purchase of the product, assuming throughout that transaction costs are nil.

Figure 7 is a reproduction of Figure 5, with additions. Recall that if the wholesale price were below P_2 in the figure, the hunter would continue to produce at Q_1 and
not sell any in the market; but if the wholesale price were above P_2, he would be expected to sell some quantity of his take because the marginal value to him of the product in consumption would be below the price obtainable in the market.

Existence of a wholesale price essentially alters the hunter's demand curve. Because the hunter can sell any quantity at the wholesale price, his product demand (the minimum compensation he is willing to accept for the product) is truncated at the wholesale price. For example, at a wholesale market price of P_w, the hunter's demand curve for the product in essence becomes kje in Figure 7, and his corresponding demand curve for hunting becomes abd (the sum of kje and D_a). Given P_w, he would be expected to

produce at Q_3, where the modified hunting demand curve crosses the marginal cost curve (S), and sell the quantity $Q_3 - Q_4$, keeping (and perhaps sharing) only the quantity Q_4, that quantity for which his demand for the product is greater than the price. The hunter's net change in welfare from entering the market (from increasing production from Q_1 to Q_3 and selling $Q_3 - Q_4$) is indicated by the total surplus with market participation (area abdi, Figure 7) minus surplus without market participation (area afi), or area bdf.

If the hunter were observed selling at price P_w (Figure 7) in the commercial market, P_w would indicate the gross *product* value of the sold portion. P_w would also indicate the gross marginal product value of that portion of the harvest retained for personal use (i.e., if Q_4 is retained for personal use, P_w is its gross marginal value). But, P_w would underestimate the gross average value of the portion retained, given the downward sloping demand curve from 0 to Q_4 units.

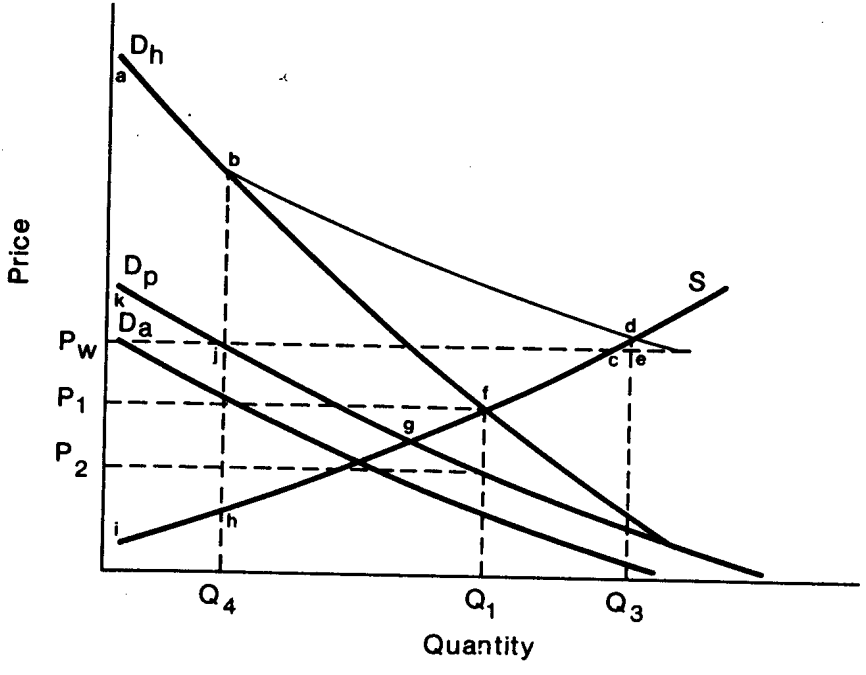

Figure 7. Effect of Wholesale Price (P_w) on Harvest and Consumption.

Still focusing only on the value of the product, and assuming a wholesale price of P_w in Figure 7, the net loss of a prospective policy that would limit the hunter's harvest would be indicated by the difference between the product demand curve (kje) and the supply curve. For example, if the policy would limit harvest to Q_4, the net loss to the hunter would be equal to the profit foregone (area jch minus area cde).
cde. (Note that if no market had existed, constraining harvest to Q_4 would have caused a loss to the hunter equal to area bfh.) Ignoring demand for the hunting activity in computation of the loss to the hunter of the harvest

Because the value of the activity (D_a) is positive, however, market price underestimates the value of hunting. For example, if harvest were limited to Q_4 in Figure 7, the net loss would be indicated by area bdh, not area jch - constraint would underestimate the loss by an amount indicated by area bdej, which corresponds to the area below D_a from Q_4 to Q_3.

Turning now to purchase, consider Figure 8, which is also an elaboration of Figure 5. Recall that if the retail price were above P_2, the hunter would continue to produce at Q_1, and not purchase any of the product in the market, but if the price were below P_2, he would be expected to purchase some amount. He would purchase some because the marginal value to him of the product would be above the price for which it could be obtained, and the price would be below his marginal hunting cost.

Existence of a sufficiently low retail price (one below P_7, or D_p at 0 quantity, in Figure 8) essentially alters the hunter's demand for the product. Because the hunter can purchase any quantity at the retail price, his maximum willingness to pay for the product is truncated at that price. Of course, a retail price above P_2 would still not affect harvest decisions or be sufficient to cause purchase by the hunter, so we shall consider the effect of a retail price below P_2. For example, at a retail price of P_r in Figure 8, demand for the product essentially becomes jfe. Given this modified demand for the product, demand for harvest (the sum of demand for the product and demand for the activity) essentially becomes ade.

Given P_r, the hunter would harvest up to Q_3, where the modified demand curve (ade) crosses the marginal hunting cost curve (S), and purchase the additional quantity $Q_4 - Q_3$. His harvest decisions can be considered to follow this reasoning: (1) At each harvest increment from 0 to Q_5, hunting costs are below P_r, so even ignoring activity value, hunting is the obvious choice. (2) At harvest increments from Q_5 to Q_3, the hunter still gains more in activity value if he hunts than he would save in costs if he purchased (i.e., $D_a > (S - P_r)$), so he continues to hunt. (3) The hunter switches from hunting to purchase at Q_3, because at that quantity the loss in activity value

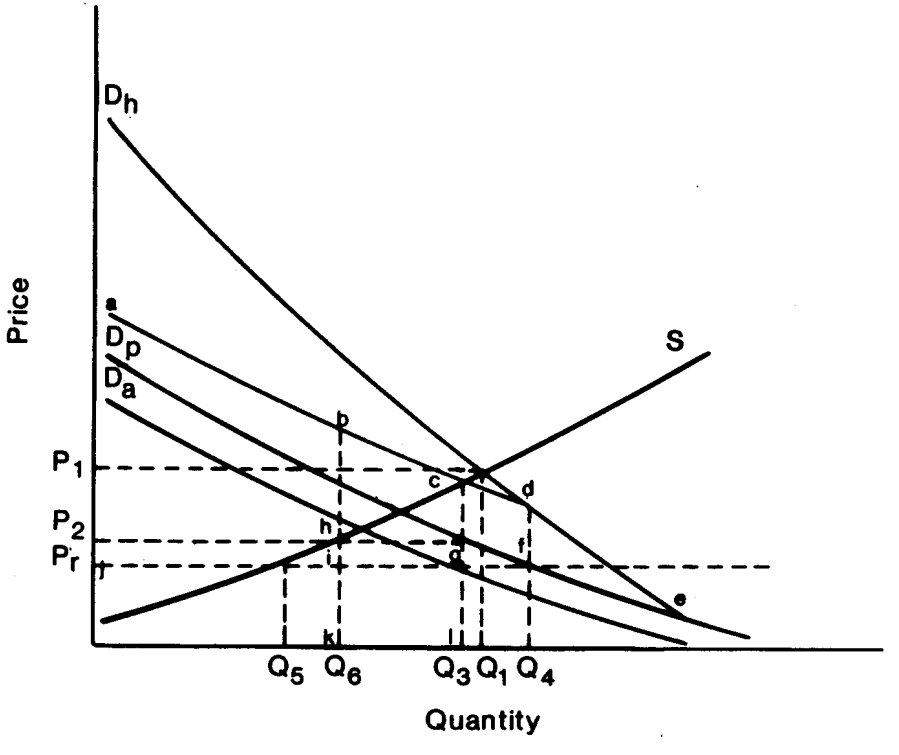

Figure 8. Effect of Retail Price (P_r) on Harvest and Consumption.

from not hunting (equal to distance cg) equals the cost savings from purchase (S - P_r, also equal to distance cg). At increments from Q_3 to Q_4, the hunter saves more from purchase than he loses from not hunting (i.e., $D_a < (S - P_r)$), so he purchases. (4) No purchase occurs at increments above Q_4, because the cost of purchase exceeds the value of the product (i.e., $P_r > D_p$), and the harvest cost exceeds the demand for hunting ($S > D_h$).

If the hunter were observed purchasing at the retail price, that price would indicate the gross *product* value of all units consumed (since his

willingness to pay is no greater than the retail price). If the value of the activity were 0, the gross loss per unit caused by a prospective policy that would limit the hunter's harvest would be equal to the retail price, since every unit not hunted could be replaced by purchase at that price. The net loss per unit would be equal to the retail price minus the per unit cost of hunting avoided.

But, if the value of the activity were positive, market price would underestimate the gross loss from a harvest constraint. For example, if harvest were constrained from Q_3 to Q_6 in Figure 8, the gross loss would be equal to area kbcl, not area kigl. Ignoring the value of the activity would underestimate the gross value of the loss by area ibcg (i.e., the activity value, also depicted by the area below D_a from Q_6 to Q_3). The net loss of a limitation of harvest from Q_3 to Q_6 would be equal to the gross loss (area kbcl) minus the harvest cost (area khcl), or area bch. Note that this net loss is also equal to the loss in activity value (D_a from Q_6 to Q_3) minus the cost savings ($S - P_r$, from Q_6 to Q_3). Given the conditions of Figure 8, ignoring the value of hunting would indicate a gain, from constraining harvest at Q_6, of the cost savings rather than the actual loss indicated by area bch.

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