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Concepts in Environmental Valuation

The term *value* in economics has a precise definition — it is the price individuals are willing to pay in order to obtain a good or service. The basic economic concepts of supply and demand are employed to estimate willingness-to-pay (called producer surplus and consumer surplus, respectively). This idea of value and its measure remain consistent whether a market good or a state of the environment is at stake.

The term *value*, in the context of coastal issues, can have different meanings to those with different interests. To an ecologist, the value of a salt marsh might mean the significance or importance of the marsh to the reproductive capacity of certain species of fish. To a coastal engineer, the value of a salt marsh may be associated with its contribution to shoreline stabilization. In general, these values are mathematical and functional: mathematical, meaning magnitude, and functional, meaning the physical or biological relationships of one entity to another. These values exist whether or not humans prefer them or are even aware of them.

ECONOMIC VALUE

A fundamental distinction between the way economics and other disciplines such as ecology use the term value is the economic emphasis on human preferences. Thus, the functionality of economic value is between one entity and a set of human preferences. If a coastal area is degraded so it supports a lower abundance of organisms, an ecologist would characterize this degraded area as less valuable for those organisms than a non-degraded area. In economic terms, however, a polluted area only has less value than an otherwise equivalent non-polluted area if some individual members of society prefer non-polluted to polluted areas. If no one cares that there are fewer organisms in the polluted area, then there is no difference in economic value. Typically, some members of society will display a preference for an environment that is less degraded.

Economic value is a measure of what the maximum amount an individual is willing to forego in other goods and services in order to obtain some good, service, or state of the world. This measure of welfare is formally expressed in a concept called *willingness-to-pay* (WTP). Thus, the lost value from the degraded environment is the maximum amount individuals are willing to pay to have a state where that same area is free of pollution.

A common difficulty in understanding economic valuation is distinguishing between what something is valued at by individuals and what its economic value really is. Thus, one can find commercial fish landings in the United States in 1993 *valued* at $3.5 billion and assume that is the value of our commercial fishery. But what is the willingness-to-pay of commercial fishers to be able to land this catch? If all the fisheries were closed tomorrow, would we have to pay $3.5 billion a year in compensation to leave them as well off as if the fishery were open? The answer would be yes only if fishing was a com-

pletely costless activity, which we know it isn't. The harvesters have to pay for fuel, gear, and, of course, their time which would have been available for alternative income earning endeavors. The fishery, therefore, is worth somewhat less to the harvesters. Figuring how much it is worth is the subject of Chapter 5, Measuring the Value of Non-Market Goods and Services.

In assessing the value of some policy or management plan, the economist is interested in estimating how much an individual's (or society's) well-being would change: how much it will decrease if a natural resource were lost or increase if a natural resource or resource service were better managed or its quality improved. In other words, when economists try to estimate the economic value of a coastal resource or resource service, they attempt to answer one of two questions:

- How much are people willing to trade (give up) of other goods and services to have some natural resource or resource service?

- How much better off would people be if a policy or management plan action were implemented and the amount or quality of a resource or resource service were improved?

Characteristics of Economic Value

- **Products or services have value only if human beings value them, directly or indirectly.**
- **Value is measured in terms of trade-offs, and is therefore relative.**
- **Typically, money is used as a unit of account.**
- **To determine values for society as a whole, values are aggregated from individual values.**

SCARCE RESOURCES, LARGE DEMANDS

The economic definition of value is rooted in a simple idea: all resoures are scarce, but the demands for those resources are large relative to their availability. There is never enough labor or land or water to do all the things that all individuals might wish. Because resources are scarce, it is necessary to make choices about how society will use what is available. We make choices about the amount of money to devote to schools, roads, libraries, and natural resource protection programs individually and collectively. These choices are often based on complex tradeoffs; thus, value is revealed in decisions about how individuals and society collectively choose to allocate these resources. People may recoil at the notion of placing a value on the natural environment, but there are other uses or alterations of that environment that might be proposed. Society always has to compromise, giving up something to get something else.

The most direct and visible monetary symbol for a good is its

market price. The relationship between a good's market price and its value in terms of willingness-to-pay (WTP) can be confusing. We might think, for example, that because an individual buys a certain good at a market price of $8, then $8 is what the individual is willing to pay for this good, and thus $8 is the value to the individual. Such reasoning, however, is not necessarily true. If an individual spends $8 to obtain a good, we know only that the good is worth at least this much to the individual; he or she may also have been willing to spend more, for instance a maximum of $10, to obtain the good. In this case, the $8 market price is only a lower bound estimate of the total value of the good to the individual, that is, the individual's total WTP for the good.

You might conclude from this example that total market expenditures for a good (i.e., price times quantity sold) would constitute a lower bound estimate of its consumer value. The problem with this conclusion is that the appropriate economic measure of welfare or value is *net benefit*, not total value. The net benefits society derives from a good is represented by net WTP, or the amount society would be willing to pay to produce and/or use a good *beyond that which it actually does pay*.

The same principle of economic value holds for *non-market goods*, goods that do not have observable market prices. For example, consider the case of a recreational fisher who would be willing to spend up to $30 a day to use a particular fishing site, but only has to spend $20 a day in travel and associated costs. The net benefit or economic value to the fisher of a fishing day at the site is not the $20 expenditure, but the $10 difference between what that fisher would be willing to spend and what he or she actually has to spend. If a development project eliminated all fishing opportunity at the site, the fisher would lose the satisfaction of fishing there, as represented by $10 a day in net benefits. The $20 a day he or she would have spent to visit the site would not be lost but would be available to spend elsewhere.

Because market expenditures are not measures of net benefits, we cannot use expenditures on the purchase of related goods as a direct measure of the *social value* of the good. Several steps must be taken to provide the information on social value.

Because a market provides a forum for society to express relative preferences in monetary terms, market transactions can be used to infer preferences, and thus economic values. Also, non-market goods can sometimes be valued based on information on preferences provided by market transactions for related products. For example, we

Economic Value Based on Net Willingness to Pay (WTP)

Consider the case in which only one unit of a certain market good, oysters, is produced at a cost of $1 per dozen and sold at a price of $8. If the purchaser had been willing to pay $10, the net benefit of a dozen oysters to this consumer would be $2 ($10 less $8) — this amount is called consumer surplus. At $8 a dozen, the producer earns $7 from the sale (the selling price minus the production price), so the net benefit of the good to the producer is $7 (called producer surplus). The total economic value of a dozen oysters is thus $9 ($2 net benefit to the consumer plus $7 net benefit to the producer). If for some reason the producer was denied the opportunity to produce and sell oysters (say because of a moratorium on fishing) — and the consumer was denied the opportunity to buy and consume oysters — the total loss to these individuals would be $9.

can estimate the value of a recreational site by travel expenditures (i.e., gas, lodging, meals).

CONSUMER AND PRODUCER SURPLUS

In measuring the general satisfaction that society as a whole derives from a good or service, economists often use the concepts of *consumer surplus* and *producer surplus* to approximate the net willingness-to-pay (WTP). When a good is exchanged in a perfectly competitive market, its market price measures the consumer demand (marginal WTP) for the last unit of the good purchased. Market price is determined by the equilibrium of demand and supply, i.e., the price and quantity that correspond to the level at which the consumer's WTP for the next unit produced is equal to the cost of producing it. For all other units of the good purchased, however, the consumer marginal WTP for each unit exceeds market price.

Before discussing consumer and producer surplus, it will be useful to first review supply and demand curves. Supply curves describe the relationship between the quantities of a producer's good or service and the price the producer receives. This relationship is shown

in Figure 2.1. The price for fish and shellfish or whale watching trips, for example, might be represented by the ex-vessel price or fee, respectively. The greater the quantity of whale watching trips or fish produced, the higher the incremental costs (e.g., fuel, ice and crew wages). The producer will produce a higher quantity only for a higher price. Thus, supply curves are upward sloping. Industry supply curves are the aggregation of the quantities of individual firm supply curves.

Demand curves describe the price-quantity relationship for a particular good or service for a consumer (Figure 2.2). They describe what a consumer is willing to pay for various quantities of the good or service, such as whale watching trips or fresh fish. As the number of whale watching trips or fish offered to a consumer increases, satiation sets in and the consumer's WTP for the marginal unit is less. Thus, the demand curve slopes downward to the right. Consumer demand curves are summations of the quantities of individual demand curves.

The excess of what consumers are willing to pay over what they actually do pay for the total quantity of a good purchased is called *consumer surplus* (Figure 2.3); it represents the good's value to consumers in terms of net WTP, and is represented by the area under the good's demand curve, bounded by price (Figure 2.2). Moreover, a good's market-clearing price — the price that satisfies suppply and demand simultaneously, represented by the intersection of the supply and demand curves — also corresponds to the marginal cost of producing the last unit of output. For all other units of the good produced, however, the producer marginal production cost for each unit is less than market price.

The excess of what producers earn over their production costs for the total quantity of a good sold is called *producer surplus* or economic rent. This value represents the production value or net benefit of the good to producers, and it is represented by the area over the good's supply curve, bounded by price (Figure 2.3). While not an exact measure of social welfare, the sum of consumer surplus and producer surplus provides a useful approximation of the net benefit of a good or service.

The concept and measurement of economic value, generally upheld in courts of law, has been evolving. There are clearly issues that have not yet been resolved in this conceptual framework. For example, there is controversy about whether it is appropriate to use a minimal amount one is willing to accept when estimating welfare losses due to environmental damage. Yet, these concepts are useful. They bring us closer than we have ever been before to incorporating some

Figure 2.1. Supply Curve

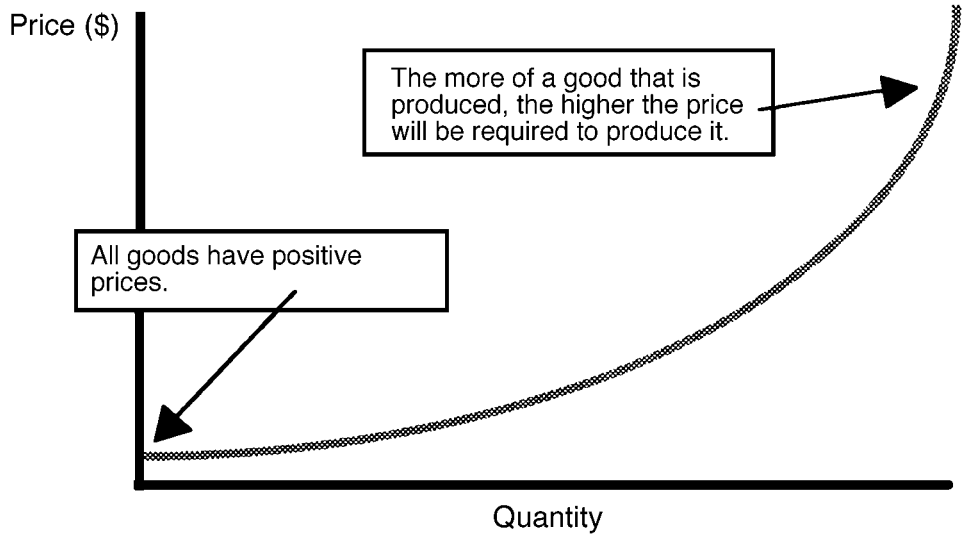


Figure 2.2. Demand Curve

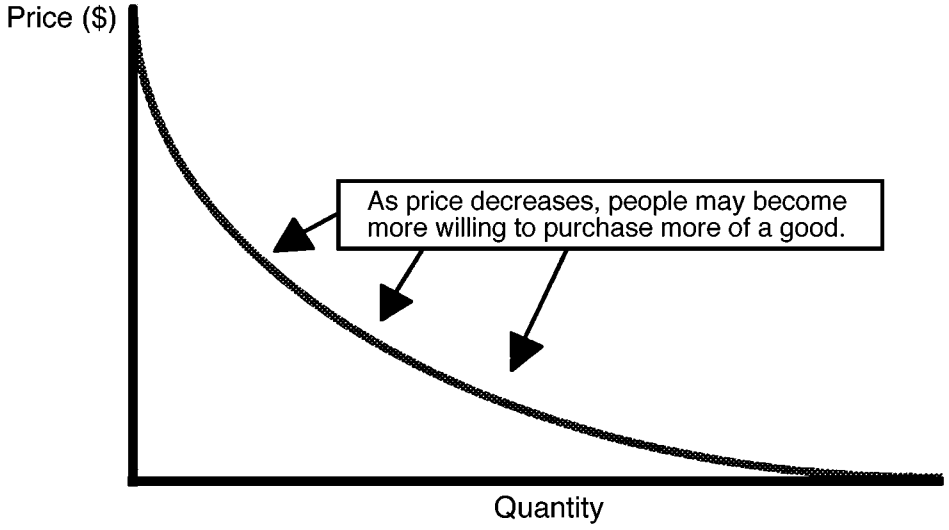
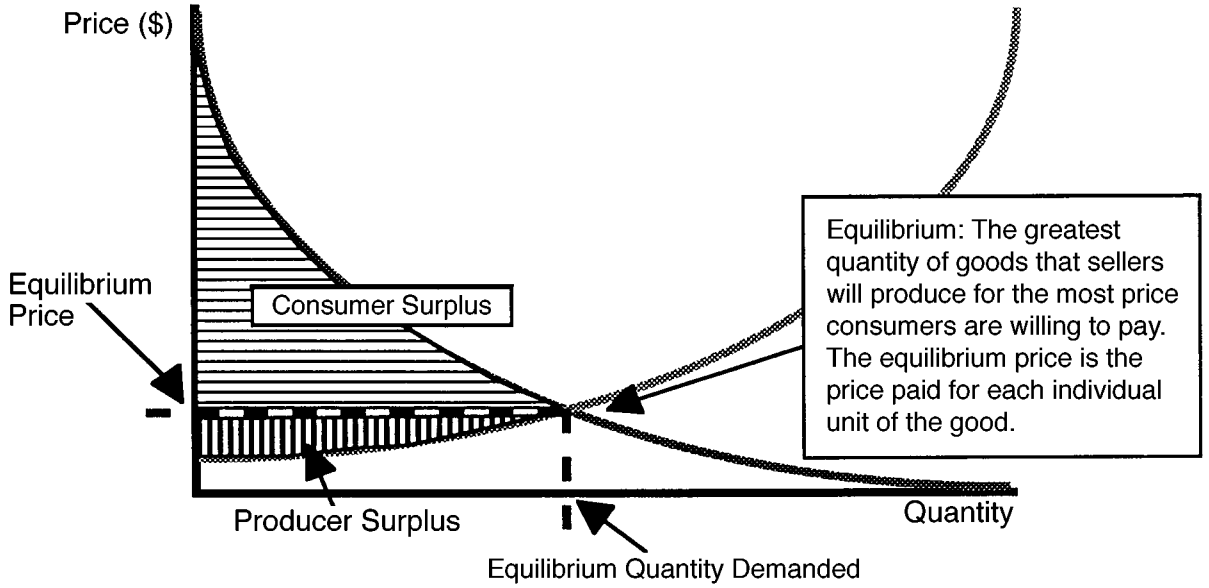


Figure 2.3. Consumer and Producer Surplus



of the natural resource values that we all know exist into the trade-off decisions that are made by government agencies and by courts.

ENVIRONMENTAL VALUATION

Environmental valuation is a series of techniques that economists use to assess the economic value of market and non-market goods, namely natural resources and resource services. It applies the *welfare economics* concepts of producer and consumer surplus to issues involving natural resources and the state of the environment. Welfare economics tries to answer the question "Is society better off?" Environmental valuation is the application of welfare economics when the differences in circumstances relate to the uses or states of natural resources or the quality of the environment.

When economists refer to evaluating societal benefits, it is necessary to recognize two "states of the world": *with* and *without*. *Without* is the base state if an activity, circumstance and policy does not change. *With* is the state when the change occurs. A distinction is made between *with* and *without* and *before* and *after*. *Before* and *after* does not control for changes in the state of the world that do not result from the action or policy in question. Economists try, for exam-

ple, to weigh social benefits associated with a commercial development project against environmental benefits that would be lost should the project be implemented. Such a *social accounting* analysis tallies all real costs associated with an activity, including the cost of lost or damaged environmental assets and quality of life. Desirable characteristics of this social accounting scheme are these: it is internally consistent (i.e., the underlying theory does not change with circumstance), usually intuitively appealing, and acceptable in major courts of law.

The measurement of gains or losses is a *net value* (i.e., the value of a site's services over and above the next best alternative). As we will see, the estimates of benefits are not restricted to losses in commercial enterprises, such as losses to commercial fisheries. Benefit measures attempt to account for the subjective preferences of society regarding the use and existence of coastal or marine resources. For example, in siting a proposed development project, the location should be where the net benefits (commercial gains from the development) minus the costs of production and environmental damages it causes, are maximized. If benefits are negative, then the development would represent an inefficient use of society's resources. For example, a shopping mall built on wetlands provides less net benefits than the same project, just as convenient to shoppers, built on common uplands.

As a general rule, the fewer substitutes available for a good or service, the greater the loss. Thus, a site that provides excellent recreational experiences might be adjacent to another site that provides equally good recreational experiences. The loss to the recreationist from losing one site would be smaller than if there were no close substitute. However, if elimination of one site causes congestion at another site and lowers the quality of the recreational experience for everyone, then those losses must also be taken into account.

Gains from development will be higher where substitutes are fewer and more costly. Take again the simple case of a shopping mall: gains from a new shopping mall would be the extra profits the retail stores could make plus the gains to consumers from having shorter distances to travel to shop. However, if another mall exists nearby, consumers will gain little from the additional mall and the retail stores in the first mall may lose almost as much in profit as those made by stores in the new mall. The net value to shoppers, real estate, and stores owners is the figure that should be compared to the losses from building the mall.

THE SOCIAL ACCOUNTING SCHEME: A CASE STUDY

Orian Corporation v. State of Washington Department of Ecology illustrates how environmental economists employ social accounting techniques as a first step in doing an economic valuation The case provides an example of the role environmental valuation could play in decisions related to development of environmentally sensitive areas and, potentially, to the determination of compensation in the event of a regulatory taking.

In the 1960s, the Orian Corporation proposed to dredge and fill lands that they owned in the Padilla Bay tidelands of Skagit County in northwestern Washington State to create a Venetian-style community. According to Charles Lean, former Assistant Attorney General and counsel for the State of Washington in *Orian*, the planned community would have been the most populous town in Skagit County.

Padilla Bay is home to the largest contiguous expanse of eelgrass in the state, serves as a salmon and dungeness crab nursery, and is critical habitat to thousands of ducks and geese, as well as endangered bald eagles and peregrine falcons. Recognizing the importance of these natural resources, Skagit County's 1976 Shoreline Master Program (administered by the Washington State Department of Ecology), required by the State's Shoreline Management Act, designated Padilla Bay tidelands "aquatic," which prohibited all uses except nonintensive recreation and aquaculture. The use restrictions in Skagit County's Shoreline Master Program essentially barred Orian's plans to dredge and fill the bay for an overwater housing development.

Orian Corporation argued the shoreline regulations constituted a "regulatory taking" and sued for the right to develop the property. The courts had to determine whether state interference with Orian's use of the property was sufficiently restrictive to deny Orian any reasonable use of the land without offering fair market value. The Washington Supreme Court held that the shoreline regulations did not cause an unconstitutional taking on two grounds.

First, the court held that "the public trust doctrine would have prohibited the intended development anyway, despite the Shoreline Management Act. Therefore, since there was no right to place fills or

Desirable Properties of a Social Accounting Scheme

- **Accounts for all real costs or benefits from an activity**
- **Internally consistent**
- **Intuitive**
- **Accepted in courts**

build houses in the first place, there was no taking. The state does not have to pay for taking a property right which never existed." Second, the Supreme Court declared that the shoreline regulations did not violate the Constitution because "whenever the state imposes land use restrictions in order to safeguard the public interest in health, the environment, and the fiscal integrity of the area," it is a legitimate use of police power and is "insulated" from takings claims.

The court, however, also recognized that regulations intended to protect the Padilla Bay National Estuarine Research Reserve may have prevented reasonably profitable use of Orian's tidelands. Because the regulations were not intended to protect public health and safety but instead served to enhance the value of the publicly owned Reserve, they could have caused a temporary taking. The Court sent the case back to a lower court to resolve factual issues, where a jury held that the Padilla Bay Reserve caused a temporary taking and Orian was due compensation.

The final settlement included the cost of the acreage plus interest accrued since the creation of the Padilla Reserve in 1980, in addition to attorney fees. In exchange for $3.6 million, Orian released all claims against the Department of Ecology and transferred all rights in Padilla Bay tideflats to the state. Thus in June 1993, the Padilla Bay National Estuarine Research Reserve in Skagit County quadrupled in size with the acquisition of 8,004 acres from the Orian Corporation and its Padilla Bay associates.

Now, suppose Washington wished to assess the potential benefits and costs of allowing the Orian Corporation to proceed with this

Stakeholders in Padilla Bay Development

LOSERS	GAINERS
▶ **Commercial Fishers**	▶ **Orian Corporation**
▶ **Recreational Fishers**	▶ **Wildlife Viewers**
▶ **Fish Consumers**	▶ **Consumers of Housing**
▶ **Wildlife Viewers**	
▶ **Nonusers**	

development project rather than incur legal costs and takings compensations. If this situation were analyzed from the environmental economist's perspective, the first step would be to ask: "Who are the players that would be affected by the decision?" That is, "Who are the gainers and losers of limiting Orian's ability to use the tidelands as they wished?" Here is a summary of how some of the stakeholders could be affected. First, the losers.

► **COMMERCIAL FISHERS.** Development activities on or near the shoreline could destroy salmon and dungeness crab habitat, ultimately resulting in reductions in the stocks of these species and subsequent loss of profit to local harvesters. In this market case, it is the lost profits (lost revenues minus costs) that matter — what harvesters would be willing to pay to avoid the development.

If development occurs unchecked, harvesters may move to other grounds (necessarily less desirable, or they would have already been fishing there) and so they may continue to make some profits (but probably less than they would have made). The appropriate loss to measure takes this move into account. It is a measure of how much worse off fishermen are after they make all the adjustments they can. Additionally, if their adjustments affect others (e.g., deplete other's fishing grounds), then those losses must be counted.

Economics has empirical methods for approximating all of these losses. Commercial harvesters may also have other non-commercial values associated with this environment. Harvesters may value the aesthetic setting, the wildlife they see while fishing, etc. These values are typically measured along with other people's values of this sort.

► **RECREATIONAL FISHERS.** The same ecological disruptions that harm the commercial fishers may also harm the recreational salmon and crab fishers. As a result of development by the Orian Corporation, the recreational fishers may have fewer grounds to fish and their catch rates may decline.

Substitution is again an issue. Recreational fishermen will have other alternative fishing sites and target species, possibly less desirable. We must measure the net effect of the development on these alternatives as well. Note that if the result makes remaining grounds more congested, this loss must be taken into account.

Unfortunately, there is no market that captures how much worse off recreational fishermen are as a result of the development. The measure we seek is the maximum amount of money recreational fishers would be willing to pay to avoid these damages. How we get

this measure will be discussed in Chapter 5, Measuring the Value of Non-Market Goods and Services.

► **Fish Consumers.** If Orian's development were to affect the fishery for salmon and crab so that significantly fewer salmon and crab were available in the market, fish prices would rise and the consumers of fish would be negatively impacted.

Here, substitution possibilities are very important. The crab and salmon consumers will substitute other products but will, by definition, be worse off (or they would have made these choices to begin with). In addition, if their substitution causes prices of other species of fish to rise, this rise should also be taken into account.

► **Wildlife Viewers.** If the Orian overwater housing development on Padilla Bay were to destroy the critical habitat of migrating shorebirds, bald eagles or peregrine falcons, the available area to view these birds may be reduced, as may the number of birds themselves, thus creating an overall reduction in birdviewing opportunities. There is no market to capture these losses directly and we will need to resort to non-market techniques.

► ***Nonusers*: Naturalists and Others Who Care about the Environment but Don't Use the Tideflats of Padilla Bay.** Padilla tideflats are a relatively rare ecosystem and provide critical habitat to endangered bald eagles and peregrine falcons. There may be individuals who do not visit this area but to whom the existence of these important natural resources is valuable. These people may be willing to pay some dollar amount to prevent the destruction of this habitat. Thus, in the event that the Orian development was allowed to occur and the unique resources of Padilla Bay were impacted or injured, these individuals would experience a loss of value.

If development did occur, the following stakeholders might be gainers:

► **Orian Corporation.** Orian Corporation would probably be able to increase its profits from the development over and above what they would have made in the next best alternative (i.e. developing housing somewhere else). Most, if not all, of the gains from development will be measurable in markets.

► **WILDLIFE VIEWERS.** The Orian development could enhance access to the tidelands and thus improve bird-viewing opportunities. If these prospects were to occur, the benefits to wildlife viewer might increase. Again there is no market to capture these losses directly and we will need to resort to non-market techniques to measure them.

► **CONSUMERS OF HOUSING.** If the Orian development was to have sufficient impact on the Skagit County housing market, the price of housing might drop with the increased availability of housing provided by Orian. Thus, the consumer would gain by the amount of the reduction in housing prices. Again, these gains could be measured using market prices.