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Conservation of Extinguishable Species

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CONSERVATION OF EXTINGUISHABLE SPECIES

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"The Moon Belongs to Everyone
The Best Things in Life are Free"
B. G. DeSylva, Lew Brown, Ray Henderson

INTRODUCTION

This paper will point out, as the above lyrics indicate, that there are more goods than we realize which "belong to everyone" or are *public* goods. Whether they are now, or will in the future be free is yet another question. Goods which are "free" may be labeled *free access* goods or *common property* goods because appropriation or pseudo-appropriation has not occurred. What is meant is that no one has been assigned the property rights to goods which are common property, nor has a government assumed property rights and control of access. Hence consumption or use of the services of the good is free to anyone. If the act of consumption of one person of a free access good in no way restricts or prohibits the use by another, then the good is referred to as a *public* good.

A lake full of fish is an example of a free access or common property good. In the absence of licensing or government restrictions any individual may catch the fish without charge. However, the amount of fishing activity (and catch) of one individual subtracts from the amount available to another. Hence this good would technically be called free access but not public.[1] Since consumption of the moon is of free access and since the consumption of one individual does not detract from the potential consumption of another, it is a public good.

We note that generally governments act as owners in the case of common property goods. In the case of fisheries they may limit the catch and/or charge a user fee which will act as a rent payment.

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1. It is appropriate to call this good either "free access" or "common property." However, common usage would refer to it as free access if it is consumed or used directly by an individual, and common property if it is used as an input in a production process. Hence game fish would be of free access; commercial fish would be referred to as a common property input in the production of fish product.

Property rights can easily be enforced by limiting access and enforcing bag limit laws.

Provision of Public Goods

In the case of public goods the situation becomes more difficult. The government could claim property rights to the moon and try to charge a moon watching fee. However, enforcement is impossible.

If enforcement were possible, how much rent should a government charge each individual? Clearly it should not be the same for all individuals if they derive different levels of enjoyment from moon watching. Adopting the criterion of charging each person according to his "willingness to pay" would mean different prices for different people.

A reasonable solution from the economic point of view is for the government to charge each person as much as it can—assuming people are honest about their preferences. This would involve asking each person to reveal his subjective evaluation of a unit of moon watching[2] and charging him that price or rental fee. The total rent collected at any specific time would be the sum of these values over all individuals.

The point is this: If enforcement were administratively feasible and if each person would honestly reveal his willingness to pay,[3] then it would be economically sound for the government to charge rental fees for the use of this public good.

The following question then arises: Suppose there is no moon. And suppose the government[4] is contemplating putting a moon (identical to the one of the previous case) into orbit. When will it be a financially viable operation?

Assume for simplicity that there are no maintenance costs, or that the cost is a once-and-for-all amount, C. Then as long as the present value of benefits exceeds costs the project is worthwhile. But future generations will consume the product and so must be considered in

2. In economists' jargon this is the marginal rate of substitution of individual i, abbreviated MRS_i.

3. We note that generally an understatement of one's willingness to pay will usually pay off. In that case a person would receive all of the public good, but pay less than his share. But of course, there may be reasons to overstate. *See*, Samuelson, *A Diagramatic Exposition of a Theory of Public Expenditure*, 37 Rev. Econ. & Stat. 350-56 (1955); Bohm, *An Approach to the Problem of Estimating Demand for Public Goods*, 1971 Sw. J. Econ. 56-66.

4. For simplicity assume there is only one government.

the evaluation of benefits. Call the amount of rent payable over all generations R.[5]

It would appear that R is very large, and that most such projects would be worthwhile. An obvious budgetary problem arises: how can the government collect today for the consumption of individuals many generations in the future?

A usual method is selling bonds or debentures. These have the effect of transferring costs through time. In fact the real method of making people in the future pay for such an asset is by making their endowment bundle contain less of other assets. If one generation passes on more public goods and less capital to a future generation, the future generation is "paying" for the public good through receiving less of an endowment of capital.

Put another way, in order to produce more public goods at any time, society must free scarce resources from the production of other things. Among those items which are cut back will be private consumer goods and physical capital. Whereas the next generation will receive more public goods, it will consequently have less production potential because of its smaller inheritance of plants and equipment (capital).[6] There is a trade-off between providing a future generation with public goods and capital. To give more of one, less of the other must follow.

Conservation of Extinguishable Species

The previous analysis relates to the problem of conservation in a direct way. There is little formal difference between the *existence* of the moon and the *existence* of a wildlife species (or of a virgin forest).

Existence of a species is a "public good." The analysis of its preservation, however, is more difficult because generally animal or fish species (or forests) have alternative private uses, either commercial or recreational.

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5. $R = \sum_{t=o}^{\infty} b_t \left(\sum_{i=1}^{n_t} MRS_i \right)$

assuming accurate evaluation of MRS_i where $b_t = \frac{1}{(1 + r_t)^t}$ for prevailing interest rates at time t of size r_t and population n_t.

6. In the 1960's economists once more addressed the question of who really pays the cost of a war—present or future generations? Or, can one generation transfer the costs of a war to the next generation? See, e.g., the following article on debt financed public goods, Bowen, Davis & Kopf, *The Public Debt: A Burden on the Future,* 50 Am. Econ. Rev. 701-06 (1970). The conclusion of such an argument is generally that future generations must pay if only through reduced endowments of capital.

The blue whale, for example,[7] has been hunted for its commercial value but is now protected by statutes because it is endangered. It is assumed that the value of its preservation now exceeds the value of its marketable commercial products.[8] It is only when a species becomes endangered that people become aware of their preference for preservation and become willing to pay for it.

An interesting distributional question is how much a government should spend for preservation of a species and whether the funds spent should come from those commercial enterprises which cause it to be endangered. Many endangered species are common property when exploited commercially.[9] It would seem that government regulation (through taxes, licensing or selling quotas) would naturally include an assessment to be spent on protection of the species from extinction. Generally this is not the case.

However, in many cases maximizing the present commercial value of a species implies preservation. Just as a farmer will not generally find it expedient to butcher his breeding stock, neither will a government, as protector of future generations and acting for commercial reasons alone, generally allow extinction of an animal species with high commercial value.

It is often the species with no commercial value that is endangered, as illustrated in the Appendix. Besides, prohibiting commercial exploitation may not be enough. For instance, allowing commercial use of oyster beds in the Gulf of Texas for construction material may lead to extinction of the whooping crane. Technically the government should devote scarce productive resources to preservation of whooping cranes according to a formulation such as given above for the moon. The cost of preservation may be real, in the sense that firms are prohibited from destruction of oyster beds, firms are paid reparation costs to relocate or use other available material, and new artificial environments are provided for the cranes.

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7. *See* Clark, Profit Maximization and the Estimation of Animal Species, 81 J. Pol. Econ. 950, 588 (1973); Clark, *The Economics of Overexploitation,* Science, Aug. 17, 1973, at 630. The blue whale is common property. Since it is also in international waters, regulation must be through international cooperation.

8. To evaluate the public characteristic "existence" in this case one should ask all persons currently alive and members of all future generations to reveal how much they would pay to revive the extinct species "blue whale."

9. Halibut is a good example. In the 1930's quotas were established to stop overfishing. *See e.g., Economics of Production from Natural Resources,* 58 Am. Econ. Rev. 418-33 (1968); Plourde, *A Simple Model of Replenishable Natural Resource Exploitation,* 60 Am. Econ. Rev. 518-21 (1970); Plourde, *Exploitation of Common Property Replenishable Natural Resources,* 9 W. Econ. J. 264-65 (1971); Vousden, *Basic Theoretical Issues of Resource Depletion,* 6 J. Econ. Theory 126-39 (1973); Neher, *Notes on the Volterra-Quadratic Fishery,* 8 J. Econ. Theory 39 (1974).

In the general formulation it was argued that the willingness-to-pay of future generations was to be included in evaluating the benefits of preservation but that these future values would be discounted to achieve present values. This indicates that future generations' preferences are to count, but at a value less than those of people existing today. Some economists argue against such discounting on egalitarian or equity grounds. The issue is one of justice and has not been resolved.

If preferences of future generations are not discounted, it is easy to see that for most species the value R will be infinite. This would be consistent with the view of most conservationists, who believe in preservation at all costs.

Irreversibility of Decisions

The problem of preservation of animal species becomes complicated by the fact that extinction of a species is irreversible. If one generation decides it cannot afford to protect the species "alligator," and some future generation would like the species to exist, it is out of luck. This clearly makes the solution to preservation[10] problems different in analysis from standard social or economic problems. "Prohibition" of liquor in one decade does not mean prohibition forever. Extinction of a species does.

In the interest of future generations it is the responsibility of all generations to preserve according to the following allocative rule: If $R \geq C$, then preserve. This rule is clearly not "golden." A "golden rule" is one which states: "Endow future generations with those stocks which you would have liked the past generation to have endowed unto you." While a golden rule would not require a generation which hates alligators to preserve alligators, the stated rule would require, in some cases, such a generation to preserve alligators.

In the case of development of primitive areas such as Hells Canyon, economic theory of irreversible investment has been used to show that when development is irreversible, i.e., a primitive state cannot be restored, the optimal rule for development is to underdevelop now if you anticipate increased future demands for preserved land. This is an intuitively simple principle but one which would not be valid in the reversible case.[11]

10. *See* Krutilla & Cichetti, *Evaluating Benefits of Environmental Resources with Special Application to the Hells Canyon,* 12 Nat. Res. J. 9-13 (1972) for an interesting example of the preservation argument.

11. An example involving irreversibility is that of many school systems in the sixties. Anticipating reduced demand after the post-war baby boom had passed by, many school systems built schools smaller than seemed necessary and installed portable classrooms.

This principle, of course, applies to extinguishable species. In its crudest form it states that a species should not be exploited below some critical level if future generations may value its existence.

The Role of Government

As suggested earlier, governments traditionally assume property rights to regulate the use of common property resources. Since their role in the case of commercially valuable resources is to encourage efficient exploitation, they generally impose quotas, as well as license fees, as regulatory devices. Licenses could be auctioned, and presumably efficient use of the resource would result. One can even envisage a futures market for licenses or quotas.

As a species becomes endangered it becomes much more valuable from the point of view of society, and the "rent" should rise (license fees or quota rights should rise and perhaps reach infinity at the critically endangered level). The process is *as if* future generations were to buy up licenses (and bid up their prices) but not exploit the resource, so that the resource is preserved. Theoretically it is the mirror image of a present generation buying "futures;" it is a future generation buying "*pasts.*" Since future generations are not available at the auction date, the government, in their behalf, should charge prices for exploitation rights which reflect the priorities of the future.

Concluding Comments

Commercial demands, expanding populations, and environmental problems all contribute to diminishing stocks of many wildlife species. If society cares about preservation and about the quality of life of future generations, it should address the problem of how much effort to put into wildlife conservation.

This paper has suggested an allocation rule to guide decision-makers. The rule is based upon the premise that *existence* of a species is an intemporal public good. Thus, the social cost of allowing a species to become extinct, as the sum of the subjective prices of all people present and future, may easily be infinitely large.

The rule is meant only as a theoretical guide. It is not suggested that one can measure the marginal rates of substitution of persons of future generations. It is at present not even possible for present generations. It is meant to indicate that care should be taken not to understate the benefits of conservation.

APPENDIX:
A FEW CASE HISTORIES OF EXTINGUISHABLE SPECIES

1. See "Brown Pelican on the Brink," *National Parks,* December 1974, pp. 21-23. In this case the pelican is high on a food chain which absorbs DDT. This consumption causes an upset of their calcium metabolism and hence thinner eggshells. Hence many eggs are crushed in incubation. Other human interferences are noticed. For example, boating interferes with nesting sites. The sightings of this bird in Texas went from approximately 65,000 in 1920 to 13 in 1968.
2. The bog turtle has become virtually extinct through habitat decimation and commercial exploitation. There is an effort being made in the United States to have the species classified as endangered and protected under The Endangered Species Act of 1973. See *National Parks,* June 1974, pp. 17-20.
3. In November 1974 an international agreement was signed by Denmark, Norway, Russia, Canada and the United States to protect polar bears in international waters. The agreement was to provide sanctuaries, although hunting may still be allowed outside of protected areas.
4. The swallowtail butterfly is endangered through collection and destruction of habitat. *National Parks,* July 1974, pp. 10-13. In 1974 the Office of Endangered Species (Department of Interior) requested a budget of $5.2 million, a large portion of which would have been devoted to the acquisition of habitat of endangered species. The President's Office of Management and Budget (OMB) released $1.3 million (*National Parks,* May 1974, pp. 27-28).