

# Harvesting the Wild

Managing wild resources may require a new scientific, economic and political basis

by John H. Douglas

Two weeks ago, wildlife experts from the United States and Canada gathered near Washington to draw up new guidelines on the management of living wild resources (*SN*: 4/12/75, p. 237). To replace the simplistic concept of maximizing sustained yield of a single species, they drew up a set of four principles to guide wildlife managers: Focus should be on maintaining the ecosystem rather than concentrating on any one species; adequate safety factors should be provided; waste of other resources, including energy, should be avoided, and surveillance should be increased. In these two articles, *Science and Society* Editor John H. Douglas, who attended the conference, describes the growing problems of wild living resources and the scientists who are seeking new ways to protect them.

The plight of endangered species has been vividly described: The disappearance of several beautiful, unique, exotic species—usually before their full importance to an ecosystem was appreciated—has aroused the sympathy of many people who would not earlier have thought of themselves as “conservationists.” But what of the species, not yet endangered, which are harvested each year for the benefit of mankind, whose populations have not only been brought below the point of providing the fullest possible annual yield but whose role in nature may irretrievably have been upset? For the most part they have been ignored, except by a handful of wildlife management experts.

The price of such neglect is slowly becoming apparent. Off the historic New England cape that bears its name, the cod cannot provide the latest generation of Yankee fishermen a decent living. Where John Steinbeck once wrote about life along “Cannery Row,” on the California coast, the sardines once packed there have virtually disappeared, and the canneries themselves have been torn down or transformed into boutique complexes for well-heeled tourists. As if it were the object of a gangland “contract,” the virgin jungle of southern Borneo is being clear-cut below a given elevation, with little hope for the sort of sophisticated reforesta-



tion that would be necessary to preserve the forest Joseph Conrad once thought eternal, “bewitched into an immobility perfect and final.” Within another generation, concludes one British expert, the bulk of the great tropical forests will be gone.

To save these great wild resources—plant and animal—will require a new scientific basis for management and a deeper understanding of the economics involved in reaping a renewable, but finite wild harvest. To begin to meet this challenge in an organized way, a group of eminent biologists and wildlife managers met recently at the Airlie House Conference Center in the Virginia countryside west of Washington. Initially, they were to discuss and update the traditional concept of maximum sustained yield (MSY), but with forceful leadership (see box) and a refreshing absence of pedantry, they produced a declaration of new management principles that will be formally submitted to the Law of the Sea conference, now convened in Geneva, and may have substantial impact on anticipated legislation setting up new agen-

cies and regimes for managing living natural resources.

The idea that a plant or animal species could be overexploited has been around a long time. In 13th-century England, the King decreed that salmon nets had to be spaced widely enough apart to allow “a sow and her pigs to pass,” thus allowing some fish to escape to the ocean and live to spawn a new generation. The theoretical basis of conservationism progressed little beyond the “king’s gap” until the 1930’s when the relationship between sustained yield and species population became clearer.

The graph of the annual catch of a species looks like an inverted U, with yield falling to zero both at the extinction point (zero population) and again when no hunting at all occurs (maximum population). Somewhere between these two extremes—usually at a population level 40 to 60 percent that of the original—occurs the maximum sustained yield (MSY), the largest catch that can be maintained year after year. According to this simple theory, maximum profits occur at some optimum population level greater than that for MSY, since costs decrease when one has a larger population to choose from. Also, in theory, fishing or hunting would become unprofitable, because of rising costs, before a species would be reduced to some minimum viable population, below which it might become extinct. Unfortunately, neither nature nor economics is that simple.

The simplistic theory ignores several important biological factors that can cause calculation of the MSY point to be off by several times—assuming some regulatory agency is trying to set a maximum legal catch that is fair to both the species and the hunters or fishermen. First, some natural cycle may drastically alter population density from year to year; recent decreases of anchovies off Peru may be caused by such a cycle. Next, the simple theory does not take into account the age or sex distribution of a catch, or possible social structure of a species; some whale herds, for example, travel in harems, and killing a dominant bull may have a disproportionately large effect. Most important, effects of a catch

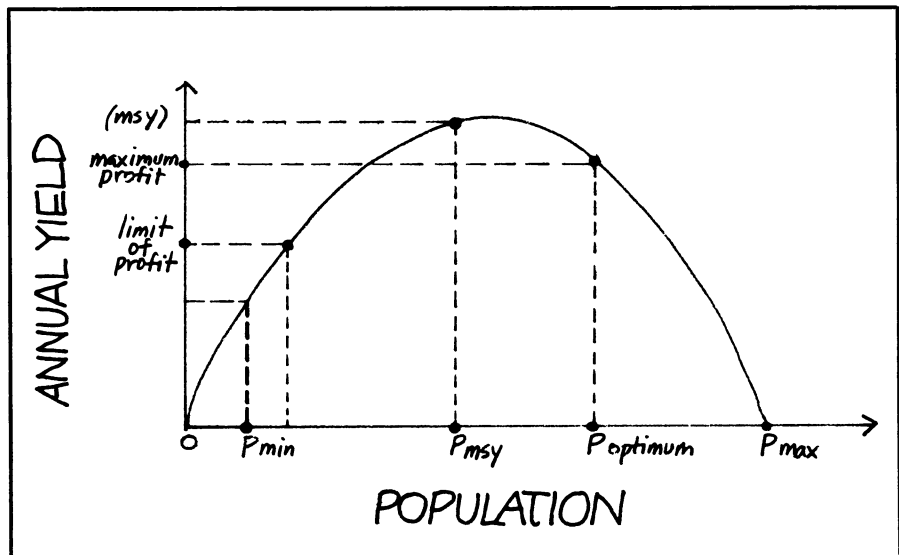
on other species must be considered; recent evidence indicates that killing dolphins could hurt tuna populations, for the latter apparently follow the dolphins to find food.

The economics of harvesting wild resources is in an even more primitive state, largely because biologists generally feel as comfortable with differential calculus as a mathematician with a scalpel and a squirming frog. One of the few men to bridge this gap is Colin W. Clark, an ecologically concerned mathematician at the University of British Columbia, who played something of a devil's-advocate role at the Airlie conference—arguing that conservation should not be pursued as a “motherhood thing,” based on an emotional appeal to finer sensitivities. Rather, conservationists should realize from the outset that preservation of natural resources demands at least a short-term economic sacrifice, and without this realization, he says, “we’re cutting our own throats.”

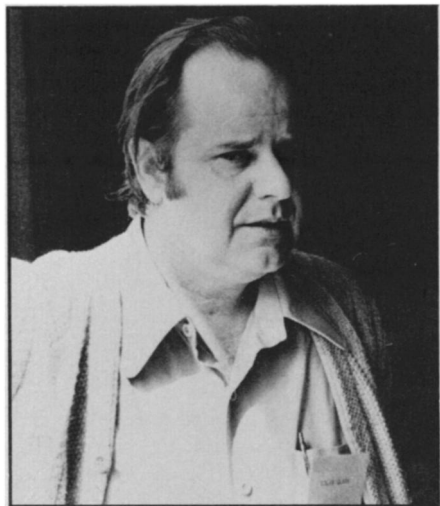
Clark's work has led to two far-reaching conclusions that are cheerless even by the current standards of the “dismal science.” The first is that competition between fishermen inevitably drives them to overfish to the point of diminishing yield, and that to reestablish MSY takes an even greater sacrifice than might at first be expected. Second, the argument that diminishing returns will halt overexploitation before the point of extinction is reached is incorrect, he says; and he derives a formula to predict when extinction will be economically profitable. The results fit the case of presently endangered whale species with foreboding accuracy.

At the heart of Clark's arguments is the fact that fishermen (or hunters or foresters) must invest large amounts of money, at high risk, into equipment, in hopes of large profit, rather than socking it away more securely in a bank, and settling for a smaller rate of return. The index a commercial fisherman would use to make this judgment is called the “discount rate”—simply the rate of return his boat must give him each year in order to have paid for itself by the time it wears out, while yielding more profit than would have been gained by investing the money elsewhere. Since fishing is a risky business (the boat may sink before it wears out), discount rates of 20 percent a year are not unreasonable.

Expressed in these terms, the higher the discount rate, the more fish a man has to take to stay solvent; and if he is in competition with many other fishermen who feel the same way, overfishing eventually results. But what happens when this overfishing causes a decline in the fish population? So long as one can make more money from sale of a fish than it cost to catch it, eco-



Calculating the maximum sustained yield is only part of the overall problem.



Clark: We're cutting our own throats.

nomics considerations alone offer no reason to slow down the fishing effort. Indeed, even if one owned all the fish, faced no competition, and could take them at leisure, Clark has derived a theorem that says overfishing to the point of extinction remains profitable so long as the discount rate is more than twice the annual reproduction rate of the species in question.

Thus, a whale herd, which has a reproduction rate of about 10 percent a year, will be placed in jeopardy of extinction whenever the discount rate rises above 20 percent—which explains why all eight of the world's great whales are now on the endangered species list. Similar arguments can be used to explain why several terrestrial animals are in danger of extinction and why foresters continue to clear-cut vast stretches of virgin jungle without concern over whether it can ever be regenerated. (Of course, other factors are also involved, such as human population expansion and local politics.)

Obviously new international management agencies and a more sophisticated

scientific base of management are needed, but these may already be too late to save some endangered species or ruined fisheries. Even as the scientists were gathered at Airlie, a national television news program called the New England fisheries a “dying industry.” Already, of favorite table fish, herring, cod, haddock, flounder, sardines and several others are severely overfished. Worse, “there is no effective action we could take at the moment that would guarantee recovery,” says Richard Henemuth, deputy director of the Northeast Fishery, National Marine Fisheries Service. Even if all catches of some fish (the yellowtail flounder, for example) were stopped completely, Henemuth says, the number brought up as a “by-catch” of efforts to take others (such as silver hake) would prevent re-establishment.

The problem of overexploitation of natural resources is only one of a series of newly perceived dilemmas involving what Garrett Hardin once called the “tragedy of the commons.” Writing in *SCIENCE* a few years ago, Hardin told a parable about some herdsmen who all grazed their stock on the village commons. The more cattle were added, the less productive each became, but an individual herder still profited by trying to increase his herd. Overgrazing eventually destroyed the commons altogether. Concluded Hardin: “Ruin is the destination toward which all men rush, each pursuing his own best interest. . . . Freedom in the commons brings ruin to all.”

Like the problems of pollution and overpopulation—where individual interest is pitted against the common good—the dilemma of overexploiting living natural resources will have to be faced by scientists, economists and policy makers, working in tandem. The scientists, at least, have taken a first step. □