The author gratefully acknowledges the assistance of colleagues on the staff of the Radiobiological Laboratory in collecting data for the laboratory and field experiments.

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# MULTIPLE UTILIZATION OF GULF COAST ESTUARIES

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ABSTRACT

It is estimated that some 7500 square miles or 4,800,000 acres of estuarine area exist on the periphery of the Gulf of Mexico. Gulf commercial catches of fish and shellfish in 1960 consisted of over 1 billion pounds of estuarine dependent species. The contribution of Gulf estuaries toward these catches amounted to approximately 230 pounds per acre. The evaluation of estuaries is discussed in terms of total production including other forms of organic matter. Beneficial and detrimental uses of shallow-water coastal areas are cited.

In selecting topics for the marine panel we chose to highlight the present status of estuaries, their economic and biological benefits, and some of the research being directed toward them. Discussions of fish, oysters, and shrimp were included because they are items demanding the greater portion of estuarine research effort in recent years. They also constitute the most obvious product associated with coastal and shallow water zones. Man's pleasure and relaxation is frequently related to these areas, so a discussion of recreational aspects is warranted when considering the multiple utilization of estuaries. Uncontaminated estuaries are becoming scarce and for that reason a portion of the panel discussion is devoted to pollutant dispersal.

In addition to the panel reports on fisheries, recreation, and pollution, we shall examine briefly some other uses of estuaries and the direction which research is taking. Recent scientific advances confirm the necessity for fundamental biological research as a means of evaluating the estuarine resource. Attention is now being paid to the mechanics of self-fertilization and nutrient utilization. Also being considered are possible ways and means of modifying or controlling engineering structures and projects so often detrimental to the resource.

Most estuarine research in the Gulf of Mexico area is motivated by a quest for knowledge regarding the dependence of commercially important species upon estuaries. In working toward this objective spe-

cialized studies in the physical, chemical, and biological disciplines play an important role. Estuarine problems and research viewpoints may be illustrated by commenting briefly on the four following questions:

1. What are estuaries?

A dictionary definition states that an estuary is "A passage, at the mouth of a river or lake, where the tide meets the river current; more commonly, an arm of the sea at the lower end of a river." Ketchum (1953) and Pritchard (1952) developed definitions based on the variety of coastal shallow-water systems encountered over a wide geographical area. At a recent estuarine conference features of these definitions were modified to produce the following:

> "Estuaries are those shallow waters with fluctuating salinities that differ from those of the adjacent sea. Usually, but not always, they are semi-enclosed bodies of water. Physical factors resulting from the mixing of fresh and salt waters and the resulting nutrient enrichment and high productivity of these waters constitute the unique features of estuaries."

Each ecologist has his own definition of an estuary; nevertheless, the one above takes into account the most salient features of those estuaries in southeastern United States. It is particularly important in the Gulf of Mexico to consider also the economic significance of the vast areas of salt marshes and alluvial plains which are adjacent to estuaries. These add to the productivity of estuaries by supplying structure, nutrients, and periodic habitat for estuarine animals.

2. What is the value of estuaries?

It would appear that in recent years little thought has been given to the present and potential value of estuarine areas except as natural features available for conversion to industrial or real estate sites. Odum (1961) stated that estuaries, plains, and marshes are among the most naturally fertile areas of the world. Planimeter determinations show that approximately 23,000 square miles of this type of coastal complex exists on the periphery of the Gulf of Mexico. There are approximately 7,500 square miles of estuarine area and 15,500 square miles of marsh area.

In 1960 the commercial catch of fish and shellfish landed at ports of the Gulf states amounted to 1,266,000,000 pounds, having an ex-vessel value of $85,000,000 (Power 1960). Five species which are known to be estuarine-dependent (menhaden, shrimp, crabs, oysters, and mullet) constituted 89.3 percent of the catch or 1,131,000,000 pounds. This amounts to an estimated annual contribution of 230 pounds of marketable fish and shellfish per acre of estuarine area, after discounting 27,000,000 pounds of shrimp (heads-on) caught off the Mexican coast and landed in United States ports (U. S. Fish and Wildlife Service 1960). Doubtless, the estimate varies considerably between estuaries, depending upon depth, salinity gradient, food availability, and other factors. It does not account for sport fish catches or forage species not utilized directly by the fisheries and is therefore, minimal.

Although an estimate of 230 pounds of fishery products per acre per year is a fairly impressive yield for waters not fertilized artificially, it is small in comparison to the yield of lower tropic biota. For instance, Odum (personal communication 1963) stated that the net primary productivity of coastal estuaries in the vicinity of Sapelo Island, Georgia is 2400 grams of dry organic matter per square meter per year. This amounts to approximately 21,000 pounds or over ten tons per acre per year. The yield per acre is about four times that of the average annual United States corn crop including stalks and roots. Assuming that the organic yield in Gulf estuaries approaches that on the Georgia coast, it becomes evident that the resource remains relatively untapped. The problem then is not one of seeking means by which productivity may be increased but rather of seeking better utilization of the available resource and protecting that which exists.

Most estuarine research reports have dealt with identification, abundance, and distribution of forms or groups of taxa. Few, if any, have calculated total or long-term value by the methods which industry

uses in arriving at estimates of capitalized value. Estuaries have too seldom been considered a thing of economic value. The worth of these areas cannot be based completely upon the harvest of species originating therein. The evaluation must also include all present and potential production of organic material plus estimates of monetary benefit derived from recreation.

The demand for additional protein from the sea in the United States is not great at present. The average per capita consumption of commercially caught fish and shellfish is 10.5 pounds per year (Power 1962). The U. S. population is expected to increase from the present 190,000,000 to 225,000,000 by 1975 and to 331,000,000 by the year 2000 (Investor's Reader 1963). Eventually—perhaps within 40 years—increased production of protein will be necessary regardless of the source. In view of these predictions it is clear that the true worth of estuaries as potential protein producers should be determined and publicized.

3. How are estuaries being used?

In addition to the use of estuaries for recreation, biological production, and other positive benefits, there are uses which are detrimental. Some of these may appear temporarily to benefit the human population. It is usually more convenient and less expensive to pump industrial and domestic refuse directly into an adjacent body of water than to dispose of it in some other fashion. Attractive cities are built at the water's edge on land which has been pumped from the estuary. It then becomes necessary to construct connecting fills, causeways, and bridges, disrupting the normal circulatory regime and creating stagnant pools which are no longer estuaries. The present rate of progress in reclaiming "waste lands" such as marshes and intertidal plains so necessary in the production of marine animals will eventually destroy these areas as a resource. Such misuse will continue, however, until the value of estuaries in their natural state is calculated and recognized.

4. How can we guarantee continued estuarine benefits?

The approach to this question can be logically defined but the steps involved are numerous and painstaking. First, there is a need for research which will result in a firm knowledge of the value of estuaries. Here we cannot think in terms of esthetic values. By the dictates of our economic society, estuarine values must be expressed in dollars, since estuaries are frequently in competition with profit-making industrial enterprises. The estimate of dollars must be derived from the amount of organic material produced, including fish and shellfish, but also including all organic material whether or not it is presently utilized in full.

Second, our knowledge must reach a point at which we can predict accurately the effect that an engineering project will have on an estuary in terms of organic production and in terms of dollars. As this knowledge is gained, we must disseminate it to governing agencies and to those agencies engaged in estuarine rearrangement. This should tend to strengthen and encourage stricter adherence to the Fish and Wildlife Coordination Act.

The future of estuaries need not be so dismal as present forecasts infer. The ensuing panel reports on shrimp, oysters, recreation, and contamination are examples of research now being accomplished. They represent a portion of the initial step which has to be taken in evaluating coastal, shallow water systems. In addition five laboratories of the U. S. Bureau of Commercial Fisheries have plans for coordinated estuarine research. The laboratories are located in Texas, Florida, Georgia, and North Carolina. The first phase of that study will consist of determining primary productivity in estuarine systems of the Gulf and South Atlantic Coasts. The study will begin in January 1964 as a part of the International Biological Year. Estuarine research is presently under way at each of these laboratories and it is anticipated that coordinated studies of primary productivity will be expanded to encompass other aspects of estuarine problems.

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# PRELIMINARY STUDIES ON THE EFFECT OF DYNAMITING FISH POPULATIONS

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Presented at the 17th Annual Meeting,
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September 29-October 2, 1963
Hot Springs, Arkansas

## ABSTRACT

During 1963 a series of experiments was conducted to determine the effect of dynamite on fish populations. One set of these experiments consisted of placing various species of fish in cylindrical wire baskets which were suspended vertically in water ranging from six to 15 feet in depth. A dynamite charge, consisting of one stick of 60% ditching dynamite, was placed at a point 10 feet from the nearest line of baskets and was detonated. Nine experiments were conducted using this arrangement of baskets in various depths of water with the dynamite charges ranging in depth from 2.5 feet below the surface to one foot from the bottom.

The results of these experiments indicated the effective killing range of the dynamite charge and the most desirable depth at which to set the charge. From these tests it was found that some fish were killed up to a distance of 50 feet from the charge and that the greatest number of kills occurred when the charge was placed 2.5 feet below the surface.

The second set of tests consisted of applying this technique in farm ponds. Three such ponds were dynamited, and the results are indicated. When rotenone was applied after dynamiting to remove the remainder of the fish population in Pond No. 1, it was observed that 38.7% of the total number of fish and 52.4% of the total weight of fish were eradicated with the dynamite technique. After rotenoning Pond No. 2 it was found that 84.2% of the total number and 73.3% of the total weight of the fish population were killed by the dynamite blast. In Pond No. 3 it was noted after rotenone was applied that the dynamite