the support of specific research activities by others as an essential adjunct to our water resources development mission."

I have purposely quoted most of the above rather than rephrasing it in my own words so you and the Society may have this information in its original context and meaning which is so vital to cooperation needed by biologists and others interested in water quality improvement of our lakes and streams.

Cooperation in water quality control is largely dependent on the free exchange of information. Recognition of the primary objectives of a project must come early in its history. Likewise, secondary purposes of what is generally considered a better concept, "Compatible uses," should also be defined. Rarely does any project confine itself to a single purpose. The point here is that all necessary and potential uses must be recognized and considered when planning is started.

Field surveys must be made to determine the level of use which can be provided, the capacity for future growth, and the effects one type of use may have on the quality and quantity of water passed downstream or made available for other uses. This information and often more, must be in the hands of the designers of the project before their work has gone very far.

Frequently, operating plans for dams or other water control structures dictate the type of uses that a given body of water may serve but at least some beneficial fish and wildlife features can be included if technical data is furnished early enough in the planning stages. The extent of drawdown, seasonal and daily variations in flow pattern, and the effects of these on water quality, as well as quantity, must be understood in the light of available knowledge. The biologist must be able to think in terms of generating capacity, kilowatt hours, density currents, operation of the rule curve, and waste assimilative capacity. I can assure you from my brief tenure with the Corps that its engineers want and need your information on facts that can be substantiated.

ESTUARIES AND THEIR RELATIONSHIP TO RECREATION

WALTER A. GRESH, *Regional Director*
Bureau of Sport Fisheries and Wildlife
Atlanta, Georgia

America's interest in outdoor recreation is soaring upward at a tremendous rate. This interest has produced some surprising figures and portend the future. Let's examine some of the statistics for their significance to us.

Participation in outdoor recreation grew at a rate of about 10 percent a year in the 10-year period, 1950 to 1960. This was six times faster than the population grew.

By the year 2000 our population will likely double—from 180 million today to 350 million. It will be a more compact population, with nearly 75 percent living in urban areas. It will also be younger, with about 17 percent in the active 15- to 24-year age group as compared to the present 13 percent. This population is expected to have both more disposable income, i. e., income not needed for necessities and more leisure. All these factors point to greater demands for outdoor recreation. Furthermore, many most-wanted outlets require or are enhanced by water. In short, many more people will want to use water resource areas more frequently.

One index of the trends of outdoor recreation is the sales of outboard motors as reported by the National Association of Engine and Boat Manufacturers. In just 10 years, from 1950 to 1960, the number of outboard motors more than doubled from two million eight hundred thousand to six million 50 thousand. A corresponding increase has oc-

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curred in the number of boats in use—about eight million 25 thousand were reported in use in 1960.

From national surveys our Bureau found that fishing in the years between 1955 and 1960 grew at a rate of 4 1/3 percent per year. This was two and a half times faster than the population grew. In 1955, nearly 21 million anglers, 17.6 percent of the population age 12 and over, fished more than 397 million days. By 1960 25 million anglers, 19.3 percent of the population age 12 and over, fished almost 466 million days.

The upward rush is expected to continue, though it may decrease in rate. Even so, the Bureau's estimates for the future are impressive.

By 1976, the pressure is expected to increase by 50 percent to over 698 million days. By the year 2000, it is expected that 63 million anglers will spend one billion, 300 million days fishing.

How can the demand be met? ORRRC suggested three ways: (1) to increase the amount of inland fishing waters; (2) to improve the management of existing waters; (3) to increase salt water fishing.

To provide for the future, they set a high goal for marine sport fishing. This, however, is not without good cause. Available data show that salt water sport fishing is growing at a rate about twice as fast as fresh water fishing—about seven percent a year. In 1960, 17 percent of all fishing, 80 million days, was spent in marine waters. By the year 2000, it is expected that nearly 30 percent of all sport fishing—375 million days—will be spent in marine waters.

Meeting the demands of these many salt water anglers will be a perplexing problem. First, most will live in urban centers, creating "islands" of high demand where the people are. Already, 55 percent of the Southeast's population is urban and probably nearly 75 percent will be by the year 2000. Secondly, the demands must be met, if at all, by habitats within reach.

Most anglers, for physical and economic factors, are dependent upon estuaries. Comparatively few can afford the expense of equipment for offshore fishing. Large boats and motors, with attendant high purchase, operation, and maintenance costs, are required. Few anglers have the facilities for docking such equipment or the financial ability or leisure to use and maintain it. This is reflected in the results of recent studies.

In 1958 the Florida State Board of Conservation published a report on salt water fishing in that State. By its data, about 85 percent of the anglers fished inshore waters. This occurs in a State where a large proportion of the vacationing anglers have higher than average incomes.

The dependence of salt water anglers on estuaries is also reflected in their catches. In the Southeast, we have found the three top salt water species to be trout, red drum, and croaker in studies conducted for ORRRC. All are estuarine or estuarine dependent, as are many of the other top game fish—tarpon, snook, striped bass, shad, sheepshead, and spot, to name a few.

Estuarine waters are the spawning or rearing grounds for all the above and other species important to anglers. Through their contribution either directly to the life history of game species or indirectly through the production of forage species supporting a game fish population caught elsewhere, these brackish areas are the backbone of present and future salt water angling. Significantly, the young of marine species are most capable of invading the less saline waters where they seemingly find conditions best for their survival.

Despite their variations in forms and titles, inshore wafers along the South Atlantic and Gulf Coasts are generally shallow and have some mixing of salt and fresh waters. These common characteristics provide marine species important to us, essential niches during some phases of their life histories. Because of their common characteristics, we tend to loosely group all coastal bays, sounds, lagoons, and estuaries under the term "estuary" as I have herein.

In part because of their productive capability, estuaries sustain a significant share of the winter waterfowl population in the Southeast. Some of the most heavily used being Mobile Bay, Alabama; Indian River-Mosquito Lagoon, Florida; Currituck Sound, North Carolina;

Chesapeake Bay in Virginia and Maryland. The Upper Chesapeake Bay area alone winters nearly four percent of the continental or 23 percent of the Atlantic Flyway population. Robert Stewart, of the Branch of Wildlife Research, described 13 major habitat types in the Upper Chesapeake area and stated that brackish estuarine bays are the most important for waterfowl populations as a whole.

The value of estuaries for sustaining waterfowl populations and hunting is difficult to measure, yet in the Atlantic Flyway these habitat types are generally the most important. We can surely say that the production of these areas is vital to the national waterfowl program. This is not to overlook their importance also for the unmeasured hunting of rails and marsh hens or their importance to shore and wading birds.

Their importance to aquatic resources does not earmark estuaries for this use. Geographically, they are shallow and often close to urban centers which are expanding rapidly. These factors render estuaries vulnerable to noncompatible uses.

Destruction of estuaries is obvious along all coasts. Housing developments are springing up in former open water areas. Industrial sites are being filled along the bay shores. Posting against the taking of oysters for health reasons seems to grow more prevalent. Each year brings more schemes for channels, harbors, sewage disposal, industrial plants, mining, dredging, and filling. Destruction seems to be most complete in areas where most resources are needed—close to urban centers. Each year Region 4 reports on about 30 projects, public and private, significantly affecting estuarine resources. It reviews schemes for many more to affect areas where resources have been depleted.

To summarize, the prospect is for diminishing habitat in the face of soaring demands. Demands imposed not only by more anglers and hunters, but also by more boaters, skiers, and many others who desire access to clean water. Meeting the challenge will not be easy in the face of rising competition from exploitative uses.

Thoughtful leadership is needed. This, conservation agencies are in the best position to provide. No less necessary are the understanding of human needs and support at local, State, and Federal levels for the expenditure of all reasonable efforts to protect and develop estuarine resources.

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