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SALT WATER FISHERIES DIVISION

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REVIEW OF RECENT PROGRESS IN DEPARTMENTAL MARINE RESEARCH

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REVIEW OF RECENT PROGRESS IN DEPARTMENTAL MARINE RESEARCH

INTRODUCTION

Calendar 1963 saw the marine research program of the Salt Water Fisheries Division grow to new and higher stature, not only in the number of scientists and supporting personnel but in the scope and diversity of the work. It is appropriate, after twelve months of accelerated development to pause and summarize the findings that have been established, the current status of the various projects and the orientation of the various programs that may be expected in the future.

For greater clarity and for a more clear-cut organization of the material to be presented, each project will be discussed separately.

Discussions will be very general as befits a year end report. It is expected that all of the facts mentioned here will appear in later publications at which time detailed treatment will be made available.

SHELLFISH NUTRITION

In April 1963, twenty-three oysters were placed in circulating, aerated, daily filtered artificial sea water. The water was changed several times during the year. At the end of December, nine months later, two still remained alive. These were in a debilitated condition as evidenced by the weakness with which they could close their valves. No attempt was made to control the temperature and the heat of the water was understandably high during most of the period, reflecting the subtropical climate of St. Petersburg. Although these experimental animals were taken from the natural beds during a season when they would be expected to be the highest in reserve glycogen, the period of time they were able to survive with no source of nutrition available to them was of unexpectedly long duration and may establish a new aspect of

intrinsic oyster vigor heretofore unrecognized.

The above facts relate to a controlled experiment to determine the ability of oysters to absorb dissolved glucose through the fleshy integument or by absorption in the gut without the necessity of ingesting particulate matter. The conditions of the experimental tank were the same as those of the control (see above) except that glucose was added to the artificial sea water several times each week.

At the end of December 1963, after ten and one-half months, oysters remained viable in the glucose treated tank of 23 at the start of the study in February. The average time required for death to occur, in the mortalities observed, was significantly longer than that noted for the control tank.

Although water of both tanks was filtered for four hours each day through glass wool and activated charcoal, there was undoubtedly a higher bacterial count in the experimental tank. As a result, it is possible for us to state that glucose added to the water of one tank resulted in increased longevity of the subjected oysters. But the exact mechanism by which this occurred is uncertain.

Experiments have already been set up to eliminate bacteria as a possible source of food. Artificial sea water to which soluble nutrients have been added will be circulated over ultraviolet ray tubes.

SHELLFISH DEPURATION

At year's end one privately owned oyster and clam depuration plant was under construction and another was on the drawing boards. The first was being built in Manatee County and the second in Pinellas County.

It is planned that the marine laboratory staff will assist the backers of these plants by checking the methods and advising on bacterial results of various methods of treatment. It is hoped that both installations will be

functional and trouble-free by the opening of oyster season, September 1964.

When finally in operation, oysters and clams will be taken to these tanks and treated with water purified by ultraviolet light, or chlorine sterilized water for a day or two and then be pronounced suitable for human consumption, even if they emanated from unapproved waters originally.

FISHERIES PLANKTON

For several years plankton samples, taken in the course of many projects along the coast of Florida, have been sorted and saved. Routinely, larval fishes, crabs, shrimps and phyllosoma larvae (all species, including unknowns) are separated.

Present investigations are concerned with shrimp and phyllosoma larvae and published reports on these are expected during 1964.

Larval fish studies will begin during the first half of 1964 and crab larvae work will probably get under way after 1 July 1964. Both of these will utilize accumulated specimens.

SPINY LOBSTERS

In addition to occurrence, size, seasonal fluctuation in abundance (if any) studies on Florida coastal plankton samples, trips were made to the Southern Gulf of Mexico and Yucatan Straits for additional material. Examination of phyllosoma larvae obtained has been completed and analysis of data obtained is now progressing. Preliminary findings that Florida's spiny lobster populations are derived from the Caribbean area are substantiated by the new information.

A station in the Florida Keys is operated as a field sampling headquarters and larvae rearing laboratory.

A station in Stuart, established during the year, has provided a center for:

- a) larval and post larval sampling
- b) growth rate studies of post larvae

- c) determination of basic ecological requirements for larvae and post larvae and population dynamics of post larvae, juveniles and adults.

FISHES

1. An annotated check list of all fishes contained in Marine Laboratory reference collection is presently being prepared.
2. A life history study of the red grouper is in progress. Growth rate and spawning characteristics are emphasized.
3. During a study of offshore shrimp populations in the vicinity of Pinellas County, statistics were collected on the fishes caught. These data, presently under analysis, will complement to some extent those developed at inshore stations in previous years. A publication on the offshore findings is expected by 1 July 1964.
4. Fish tagging sponsored by SCHLITZ Brewing Company was conducted for the third year in 1963 and will be undertaken again in 1964. A write-up of the results of the second year's program was completed and is in press. Publication is expected prior to 1 April 1964. Results of the third year's work are presently being analyzed. In the third year (1963) heavy emphasis was placed on the tagging of offshore species, particularly those commonly associated with reefs.

Massive offshore fish tagging carried out in the summer of 1963 by the Board of Conservation resulted in the tagging of several hundred deeper water individuals. Results of this work are currently under analysis and publication is expected by 1 July 1964.

SHRIMP

In addition to investigations of planktonic shrimp larvae (see above) post larvae, juveniles, and adults were under investigation as follows:

1. St. Augustine. Field work covering a period of one and one-half years

was terminated in November 1963. An analysis of the data obtained was immediately begun and it is expected that a manuscript suitable for publication will be available by 1 July 1964. The geographical area covered by this report will be the St. Johns River to a distance of about 100 miles upstream and protected coastal water shallows and embayments as well as offshore production grounds of Northeastern Florida. Several elements of population dynamics will be established giving insight into spawning periods, recruitment, growth, offshore migration and critical osmotic levels related to salinity. Also, all three of the principal Florida species are indigenous to areas of study.

In the past, biologists have conjectured much concerning the minimum levels of salinity that would sustain normal shrimp life. The upper reaches of the St. Johns River, supporting several shrimp species populations as it does, has provided an excellent natural experiment to evaluate low salinity tolerances.

2. St. Petersburg. Sampling for larvae, juveniles and adults in the offshore areas (out to 70 miles), including prominent passes to the Tampa Bay system, was carried out for a year and one-half, terminating in July 1963. Analysis and write-up of the findings are presently under way.

EXPLORATORY FISHING

Data developed on spiny lobsters (see above) strongly suggest that larvae wafted up from the Caribbean, in addition to colonizing the Florida Keys and the State's lower east coast, also settle in other rocky, protected areas, particularly along the middle and upper west coast.

Fragmentary evidence derived from incidental catches in shrimp trawls, occasional and accidental production by snapper fishermen, and, more recently, skindivers' encounters have all lent evidence that spiny lobsters may be offshore in commercial quantities.

Inasmuch as many species of phyllosoma larvae other than Panulirus argus,

our most important lobster, are carried into our waters, it would not be unexpected if one of the other species were found to be prominent in more northerly areas. In the few observations so far made, coincidental to existing commercial fishing operations, the shovel-nosed lobster or "bull dozer" (Genus Scyllarus) has been especially noted.

Traps will also be used in offshore stations to establish any significant fish populations hitherto unnoticed.

Later in the year 1964, a serious effort will be made to provide more information on the offshore clam population (Mercenaria compechiensis). Previous exploratory fishing by the U. S. Fish & Wildlife Service and private individuals has given some evidence that large, commercially exploitable populations exist from the latitude of Tampa Bay south to Fort Myers.

LIBRARY

Due to an expanding program, the book, journal and reprint collections have all been enlarged. The physical needs were such that a reading room was established in space next to the reprint collection, separated from the book and journal room.

MARINE SURVEYS, CONSULTATION AND PUBLIC EDUCATION

Ecological studies and reports are made for counties, cities and the Trustees of the Internal Improvement Fund when biological evaluations of waterfront projects, involving dredging and filling, are needed. Hydrographic and shellfish studies are made to aid oyster or clam lessees in choosing favorable sites. Shell and oyster planting operations are supervised for the State and counties. Close liaison is maintained with the U. S. Fish & Wildlife Service and the U. S. Army Engineers to assure that large federal, State or private projects are planned to be in the best interests of marine conservation.

Talks are made to civic, fraternal, educational and governmental groups

on conservation. Differences between sport and commercial fishing interests are arbitrated or ameliorated by the presentation of facts to combat prejudices. Professional writers are provided accurate subject matter to aid in the promotion of conservation and the seafood industry.

Recommendations for locations of artificial fishing reefs and sanctuaries are made to those who seek them.

Local governments are helped in the preparation of prospecti to attract new seafood industry or marine research groups.

Educational pamphlets are prepared for distribution to students, sport and commercial fishermen, and governmental units.

RED TIDE

Inasmuch as the projects covering Red Tide are only beginning, results are not yet coming in. A prospectus is therefore provided, outlining the scope of work as presently planned.

The key to our chemical and microbiological work is coordination. Each project serves the others and is, in turn, served by them. In order that these projects work in the greatest possible intimacy, communication among all segments must be strong, clear and unimpeded.

Minor changes in this plan will undoubtedly have to be made, but essentially this regimen is the one in effect for the microbiological area of our work as of January 1, 1964. The plan has been developed around the team concept. By its use, nutritional studies on shellfish may be made as a by-product that would be difficult to finance otherwise. Similarly, some Red Tide studies are possible because they can benefit from work that would normally be considered fisheries research. Properly conducted, the total of all of this research will be far greater than the sum of its parts.

Project: MICROBIOLOGY

The immediate goal of the work will be the isolation, identification and

quantitative evaluation of the bacterial flora of the coastal waters and muds of selected stations along the southwest coast of Florida.

The long term aim is to establish the nutritional needs of these organisms and their metabolic end products. The final use of this information is to construct an organic and biochemical pathways chart in which the Red Tide organism is, on occasions, a prominent part.

Secondarily, as the bacteria are isolated and identified, they will be produced in gross quantities for use in shellfish nutrition studies.

Project: ARTIFICIAL CULTIVATION OF PHYTOPLANKTON

As various components of the phytoplankton are brought in by routine sampling and identified, they will be grown in the laboratory by general media. At first, in order to determine their ease of maintenance, they will be cultured in small quantities. Next, they will be produced unialgally in gross amounts, still using generalized media. Eventually, each organism will be cultured on what will amount to differential media. Thus, an attempt will be made to determine the nutritional needs of each of the phytoplankters that appear prominently in the area under scrutiny.

The B₁₂ organic and inorganic projects will have an opportunity to check filtrates for their particular items of interest. The gross quantities of phytoplankton produced will be used in shellfish nutrition studies.

Project: PHYTOPLANKTON

Regular and incidental samples will be brought in from the field. Identification and quantification will be made of the phytoplankton encountered. Photographs, drawings and miscellaneous information will be presented. This will be a cumulative effort similar to that inaugurated in the 1930's by the U. S. Geological Survey. The latter dealt with Foraminifera and, until a few

years ago, was still in preparation. As they are prepared, each species leaflet will be published in limited numbers and sent to selected libraries and repositories for filing in specially prepared binders.

Project: INORGANIC CHEMISTRY

Literature references already exist listing unusual quantities of certain elements along the Red Tide Coast. An effort will be made to determine the relative concentrations of all elements likely to be encountered in the shores and water of the area and to compare these values with the established concentrations of the same elements found elsewhere in Florida and the rest of the world. We are searching for the unique quality of the water that might, directly or indirectly through the enhancement of growth of biochemically related organisms, stimulate Red Tide.

Heavy emphasis is being placed upon the element Sulphur in all of its combinations and transfers through the nutritional budget of the ecosystem.

Project: ORGANIC CHEMISTRY

Within the limits of practicality, time and manpower available, and equipment available, the scientists of this project will attempt to determine levels of concentration of carbohydrates, proteins and fats. The latter will probably be eliminated after preliminary efforts confirm present presumptions of minor or non-existing importance.

Later, more definitive tests will be run to identify in detail the component carbohydrates and free amino acids in sea water. (See, e. g., Palmark, K. H., Studies of the dissolved organic compounds in the sea. Fiskeridirektoratets Skrifter Serie Havunderskelser 13(6): 120-125). Also, Tatsumoto, M., Amino acids in surface sea water. J. Mar. Research, 19(2): 89.

Project: VITAMIN B₁₂

Regular samples have already been run on samples from water in which G. breve was identified and in areas which might be loosely identified as "Red Tide threatening". The threat never materialized so we have yet to sample extensively in an actual bloom. We also, in time, will wish to sample during a long-dry period to determine B₁₂ levels during a period of low run-off.

As other projects progress and can furnish samples, B₁₂ levels will be determined on:

1. filtrate and precipitate of bacteria free unialgal phytoplankton cultures;
2. filtrate and precipitate of pure cultures of bacteria;
3. samples of known concentrations of cyanocobalamin which have been subject to possible substitution of certain functional groups. For instance, H₂S will be bubbled through prepared concentrations and through natural sea water of previously established B₁₂ levels to see if biologically the vitamin becomes more assimilable as a result of being modified. Some of this will be done by F. S. U. Oceanographic Institute in connection with their bioassay studies (see below).

Project: BIOASSAY FOR RED TIDE NUTRITIONAL NEEDS

At the same time samples are obtained for other projects, additional samples will be frozen and shipped to F. S. U. There, a bioassay for Red Tide nutritional needs will be done, using G. breve as the indicator organism. Results of this test will be studied in light of what the other projects have discovered about the nature of the water of the samples concerned.

Various additions to, and modifications of, the samples will then be made to ascertain, if possible, supplements that might enhance the ability of the water to stimulate growth of G. breve.

In this project, as in several of the others, the project on marine derived sources of compost and fertilizer can be used to advantage.

Project: SCIENTIFIC AND PRACTICABLE CONVERSION OF MARINE TRASH MATERIALS INTO COMPOSTS AND FERTILIZERS

Each year tons of waste plant materials wash up on St. Petersburg beaches and other Florida beaches. In St. Petersburg, more than 95% of this matter is seagrass, especially Syringodium fileforme, manatee grass. It has been very successfully used by local horticulturists as mulches and in composts. Scientific evaluation of seagrasses for plant nutrition, disease resistance and insect repellance is scarce or lacking. Algae, or true seaweeds, have been studied much more extensively but mainly in Scotland or in other temperate areas.

Last April, during the Red Tide in Tampa Bay, nearly 200 tons of dead fishes were collected by the City of St. Petersburg and buried in a garbage dump. If there had been equipment, such as a heavy duty grinder, and techniques for handling such a quantity of dead fish and rendering them non-objectionable and suitable for municipal use in composts and fertilizers, the economic and horticultural benefits would be significant. Millions and millions of fish killed by Red Tides have been buried without benefits to anyone along the Suncoast after considerable expense by counties and cities in collecting them.

Field studies are located at the City of St. Petersburg nursery near Lake Maggiore where all collections of plant debris from local bays are deposited in piles for experimental use. Since no seagrass compost is yet available, plots have been initiated with seagrass plowed under virgin soil, regular nursery compost on virgin soil, and virgin soil with commercial fertilizer. Strawberry and tomato plants are being used in the different plots.

Laboratory and field studies will complement each other. Basically the research program will be divided into:

- A. Sea plants (mainly shore debris) - their chemical analysis, use and evaluation as compost and fertilizer materials.

B. Marine fishes (trash fish, those killed by Red Tides, poisoning programs, freezes, etc.) - their chemical analysis, use and evaluation as fertilizer.

C. Similar studies as in A and B above for combinations of plant and animal materials.

Within limitations of available trash materials, field and laboratory equipment and time, the procedures following will be used to carry out the goals of this project.

Compost heaps of "virgin soil" and seagrasses will be made. The beach sand in these grasses will not be washed off because this is not economically feasible. Analyses for N, P, K and trace elements in the compost components will be made before composting and regularly during the 3 to 6 months of composting time.

Using said composts, growth experiments (about 3 months) with strawberry, tomato and melon plants will be made and compared with results from using commercial fertilizers and composts made with land vegetation. During these experiments, inorganic and organic analyses of the different soil mixtures and leaves of the experimental crops will be made regularly but especially before and during fruiting.

Bacteria counts of the different soil mixtures will be made regularly to see if bacterial growth has been accelerated.

Seagrasses will be plowed under, mixed with virgin soil and different lawn grasses sown and growth will be compared with that resulting from the use of nursery compost. Chinchbugs will be introduced to those lawn plots to see if seagrass does discourage these serious pests as claimed by organic gardening enthusiasts. This work is requested by the City Park Department for very pertinent reasons.

Analyses of seagrasses at different seasons will be made for their year-around use for composts and fertilizers.

The liquefaction of seagrasses simply and inexpensively will be attempted. The use and value as a fertilizer of such liquid obtained will be tested.

All procedures above could be extended to algae if abundant supplies appear on local beaches or elsewhere and collection is feasible.

A method to liquefy fish will be studied and the use and value of any fish liquids as fertilizers will be determined.