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SUMMARY OF PRINCIPAL PLANKTON INVESTIGATIONS
UNDERWAY IN THE RESEARCH CENTERS OF THE
NATIONAL MARINE FISHERIES SERVICE

UNITED STATES
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1. ICHTHYOPLANKTON SURVEYS

1.1 MARMAP Program

Since 1971 the National Marine Fisheries Service has been developing a nationally coordinated program for Marine Resources Monitoring, Assessment, and Prediction (MARMAP). Surveys are conducted for ichthyoplankton, groundfish and pelagic fish to measure changes in the distribution, abundance, and condition of principal fish stocks of the continental shelves off the U.S. and in selected oceanic regions. The surveys support comprehensive analyses of the effects of fishing on the stocks and other oceanographic and biological studies underway in the National Marine Fisheries Service (NMFS), several universities, State agencies, and international organizations. In 1973, as part of the MARMAP program, ichthyoplankton surveys were conducted in the Atlantic from the Gulf of Maine to Florida Straits and from Cape Mendocino to the Gulf of California.

1.2 Joint International Surveys and Operations

International Commission for the Northwest Atlantic Fisheries (ICNAF)--A joint larval herring (*Clupea harengus*) survey in the northwest Atlantic from the Gulf of Maine to the Nantucket Shoals was completed in autumn 1973. As in the preceeding 3 years, participating nations included Canada, Federal Republic of Germany, France, Poland, and the U.S.S.R. On the surveys standard sampling procedures were followed using paired 60cm bongo plankton nets fitted with 0.333mm and 0.505mm mesh apertures; all tows were oblique from a maximum depth of 200M to the surface. Neuston collections were made at each station with a 2x1M rectangular frame fitted with 0.947mm mesh apertures. Environmental observations included hydrographic casts for temperature, salinity, and ancillary meteorological measurements. As in former years, small larvae were concentrated principally within the 200M isobath on Georges Bank. Significantly, greater numbers of larvae were found in 1973 than in 1972. For the entire survey area the average increase in abundance was about 5 times greater than in 1972. The 1973 year-class will be carefully monitored to determine the impact of larval survival on subsequent recruitment to the juvenile and adult herring fisheries. The results of the 1973 survey were available for discussion during the June 1974 ICNAF meeting, where plans were made for another joint survey in autumn 1974.

Eastern Pacific Hake--Cooperative surveys for larval hake were conducted with the U.S.S.R. on the research vessel EKVATOR (EQUATOR) based in Vladivostok. Sampling was conducted from San Francisco Bay south of Punta Eugenia, Mexico, during February-March 1974. Collections of eggs and larvae of hake were subdivided with half of each sample to be analyzed in Vladivostok and the other half by scientists of the Southwest Fisheries Center, NMFS, La Jolla, California. The results of the survey will contribute to the development of a management policy that will allow for modifications of harvest levels based on monitoring changes in recruitment and estimates of the size of the commercial stock.

United Kingdom--As part of a continuing joint program with the Institute for Marine Environmental Research (IMER), Plymouth, U.K., monthly sampling has been initiated by the MARMAP Field Group, NMFS, Narragansett, R.I., with the Continuous Plankton Recorder (CPR) on a route from Boston to Bermuda, and with the U.S. Coast Guard from Chesapeake Bay to ocean station Hotel. The CPR data are used to monitor changes in plankton populations in the North Atlantic in relation to the availability, abundance, and condition of fish stocks. Annual reports on changes in plankton populations are submitted by IMER to ICNAF for consideration in fish stock assessment investigations. The CPR transects made off the U.S. coast will be analyzed in Narragansett, and the results reported to the June 1975 ICNAF meeting.

Poland--In July 1974, NMFS and the Sea Fisheries Institute, Gdynia established a Plankton Sorting Center. The Center, located in Szczecin, Poland was established jointly with a contribution of U.S. counterpart funds allocated to NOAA and a large contribution of funds from the Polish Government. A building has been constructed on the campus of the College of Agriculture and Fisheries in Szczecin that includes a lecture room, three scientific laboratories, and a large sorting room capable of handling up to 3,000 plankton samples per year. During the first 6 months of operation an ichthyoplankton sorting and taxonomy training program will be initiated that will involve the exchange of scientists between the U.S. and Poland. Drs. Stefan Grimm, Leonard Izemont, and Idzi Dryzycinski assigned to the Sorting Center will be visiting the Northeast Fisheries Center, Woods Hole, and Narragansett, for training in plankton sorting and taxonomy for 3 weeks, in September 1974. Mr. David Kramer, NMFS, La Jolla, will visit the facility in Szczecin for several weeks in October 1974 to provide training in larval taxonomy. The Center will provide sorting services for plankton samples collected as part of the accelerated ICNAF fish stock assessment studies now underway in the Northwest Atlantic. The facility will be engaged in special studies to advance plankton sorting techniques. The time-consuming and expensive hand sorting methods now in use impose severe limits on attempts to gain a better insight on the food-related factors controlling larval fish survival in the ocean. In addition to routine sorting operations, rapid means for sorting plankton, including automated density gradient generator systems and counting and sizing systems will be employed and tested by the Center staff.

1.3 Atlantic Coastal Surveys

In 1973, spring and autumn surveys for groundfish and ichthyoplankton using standard MARMAP sampling methods were conducted from Nova Scotia to Florida. The coordinated MARMAP surveys included the vessels ALBATROSS IV from the Northeast Fisheries Center, NMFS, Woods Hole; the DELAWARE II and the ATLANTIC TWIN from the Middle Atlantic Coastal Fisheries Center, NMFS, Sandy Hook, New Jersey; and the DOLPHIN operated by the State of South Carolina. Samples collected off the New England coast are being sorted at the Northeast Fisheries Center, Narragansett. Results will be available in late 1974.

Mid-Atlantic Coastal Region--During spring 1973 survey, the dominant larvae from New Jersey to Cape Fear, were spot Leiostomus xanthurus and weakfish Cynoscion regalis; off the South Carolina, Georgia, and Florida, coasts larval spotted hake Urophycis regius, spot, and croakers Micropogon dominated the catches. During the autumn 1973, survey in the mid-Atlantic Bight, 98 plankton samples and 166 neuston samples were collected. Sorting and identification of larvae and juvenile fishes from these samples has been completed. Hakes of the genus Urophycis predominated. the center of their abundance was off the southern New England coast, over depths between 36 and 90M.

Analyses of 10 years of larval survey data for summer flounder Paralichthys dentatus, hake Merluccius bilinearis, bluefish Pomatomus saltatrix, and mackerel Scomber scombrus has been completed recently by the staff of the Mid-Atlantic Fisheries Center, Sandy Hook. The most productive spawning ground of summer flounder, was located off New York and New Jersey. Spawning of this species begins in southern New England and New York waters in September and progresses southward with the season. Eggs occur north of Chesapeake Bay from September to December, and south of the Bay from November to February; larvae are found north of Chesapeake Bay from September to February and south of the Bay from November to May. Although spawning occurs offshore, the young are estuarine dependent. Bluefish spawn offshore, near the inner edge of the Gulf Stream from Florida to North Carolina in the spring, and in Middle Atlantic Bight waters in mid-summer. The relative importance to the population of these two spawnings is as yet unknown. Those spawned in the spring spend their first summer in estuaries along the Middle Atlantic Bight and are caught as "snappers" (20 to 25cm) in later summer and early fall. Bluefish spawned in summer remain at sea and are transported south of Cape Hatteras in early fall when they are (5 to 7cm) long. Silver hake spawn between New England and North Carolina from May until November, with peak in June; most spawning takes place off southern New England and the eggs and early larval stages are carried to the southwest along the continental shelf.

Southeast Coastal Region--The coastal waters from North Carolina to Cape Kennedy were surveyed by the South Carolina Marine Fisheries Department, as part of the MARMAP program. The dominant larvae in spring were mullets (Mugilidae), bluefish Pomatomus, jacks (carangids), flyingfish (exocoetids), and dolphin (coryphaenids). Mulletts were abundant inshore of the 40M isobath all along the coast. In contrast, bluefish and dolphin larvae were concentrated in a newly discovered area of upwelling 100 to 125 kilometers east of Charleston, South Carolina. In autumn, the dominant ichthyoplankters were hakes (urophycids), followed in decreasing numbers by sciaenids, clupeids, and bothids.

Menhaden--At the Atlantic Estuarine Center, NMFS, Beaufort, North Carolina, ichthyoplankton studies focused on characterizing the spawning areas and larval dispersal of Atlantic menhaden Brevoortia tyrannus. Progress was made in the application of meteorological and oceanographic data to the delineation of processes responsible for the transport of menhaden larvae from offshore spawning grounds to inshore nursery areas between Long Island, New York, and Cape Canaveral, Florida. Initial analyses showed a significant correlation between onshore Ekman transport, computed from historical world-wind-field data by the NMFS' Pacific and Atlantic Environmental Groups, and

the strength of menhaden year-classes on the Atlantic coast. Intensive field studies on Onslow Bay, North Carolina, to define the larval transport processes were completed in April 1974.

1.4 Eastern Pacific Surveys

CalCOFI time series analyses--A review and analyses of the data from CalCOFI ichthyoplankton survey operations over the last several decades is underway at the Southwest Fisheries Center, NMFS, La Jolla. The task is expected to produce a bibliography of about 2,000 entries, including: (1) a summary of existing time-series data, (2) assembly of data in computerized and uniform tabular format, and (3) a book containing a critical evaluation of the CalCOFI program especially in respect to future work on other oceanic regions under the NMFS-MARMAP program. Among the data assembled for the project are larval records for inshore sportfish, including white seabass Stereolepis gigas, California halibut Paralichthys californicus, halfmoon Medialuna californiensis, ocean whitefish Caulolatilus cyanops, California yellowtail Seriola dorsalis, and California barracuda Sphyræna argentea. A time-series describing changes in seasonal and regional differences in distribution of chaetognaths has also been assembled for the same time period. Using a time-series of environmental parameters, an index has been developed of the degree of flushing which occurs in the southern California Bight by virtue of variations in the southern California Eddy. The index will be used to evaluate dispersal rates of fish eggs, larvae, and chaetognaths during periods of favorable and unfavorable environmental conditions.

Using 25 years of the CalCOFI larval data, calculations have been made for sampling means, standard errors, and negative binomial k-factors for inshore sportfish larvae collected on CalCOFI surveys. The statistical parameters will be used to determine spatial and temporal survey effort required to assess sportfish populations. A set of sardine and anchovy egg and early larva mortality rates has been developed by season and by geographic area for 1951-1960. Egg and larva census data corrected for escapement and temperature-dependent growth rates were used to study the regional, seasonal, and annual mortality rates from field samples. This time-series will be extended to a 20 year set of CalCOFI data and compared to upwelling and secondary productivity estimates to develop criteria for determining the importance of these environmental events to the early stages of these fish. In an associated study concerning the effects of egg dispersal on survival, it was found that sardine eggs are spawned in a mosaic pattern of fish-school proportions, and the eggs at the perimeter subsequently disperse to a condition of randomness in a large corona around a concentrated centrum. Horizontal mean space between nearest neighbor eggs is on the order of 1 or 2cm at spawning and changes to 15-20cm mean space between most several day-old larvae.

1.5 Estuarine Studies

Newport River, North Carolina--During 1974 ichthyoplankton studies in the Ecology Division of the Atlantic Estuarine Fisheries Center, NMFS, Beaufort, N.C., have continued to emphasize assessment of larval fish abundance and distribution within the Newport River estuary, and the

feeding ecology and physiological relationships of the more abundant larval fish species. Larval fish abundance studies have utilized both 20 and 60cm bongo tows, tidal bridge nets, 2mm mesh portable drop-nets and a series of comparative samplings using the above gears. Studies of feeding ecology of larval fishes in estuarine waters have included determining the effects of prey density on food consumption with changes in day-night, tidal velocity, and turbidity. This information combined with data on the rates of evacuation of copepods has been used in estimates of the daily rations of selected larval species. Physiological studies have stressed determining the effects of temperatures, biocides, and metals on larval fishes during simulated entrainment in power plant condenser cooling systems. In addition, studies on: (1) the effects of temperature, salinity and food availability on larval fish growth, and (2) the carbon, nitrogen and caloric content of estuarine larval fishes were completed, and a manuscript dealing with the biomass of zooplankton in the Newport River estuary and the influence of post-larval fishes on those zooplankton has been published.

Florida Coastal Waters

Identification of fish larvae from plankton samples taken in Tampa Bay, and adjacent coastal waters by the Gulf Coastal Fisheries Center, NMFS, Galveston, was completed. A manuscript is being drafted that will cover 16 key stations from May 1971 through April 1973. Based on the total number of larvae caught and the species diversity, lower Hillsborough Bay was the most productive area within the Tampa Bay estuarine system. A total of 21 families, 29 genera and 28 species were recorded; 86 percent of the total catch consisted of larvae of the families Engraulidae, Blenniidae, Clupeidae, Carangidae and Sciaenidae.

Identification of juvenile fishes collected during May and June 1974 from one intake pipe at the Crystal River, Florida Power Plant was completed. A total of 25 families, 36 genera and 47 species was recorded. Five species of fishes (thread herring, bay anchovy, tidewater silversides, dusky pipefish and the spottin mojarra) accounted for 73 percent of all the fish sampled. All these fish will probably be killed as they pass through the turbines and condenser system of the plant. This mortality is expected to reduce the estuarine fish population in that area.

Columbia River, Washington--Data for 1972 and 1973 are currently being summarized at the Northwest Fisheries Center, NMFS, Seattle. The results will be of particular significance because river flow varied considerably between years--1973 was a year of unusually low rainfall and river flow whereas heavy flooding occurred in 1972. The study for 1974 will entail moving up the food chain, concentrating on larval fishes of the Columbia River estuary, and defining populations of the brackish water copepod Eurytemora, especially E. affinis.

2. LARVAL SURVIVAL

Anchovy larvae, Engraulis mordax, produced in the laboratory by laboratory-reared fish have been used to detect concentrations of larval fish food in situ along the California coast. First-feeding

larval anchovies, brought to this condition by controlling developmental temperatures aboard ship, were placed in samples of Los Angeles Bight water from the surface and from the chlorophyll maximum layer. Surface feeding was minimal in all experiments, but extensive feeding occurred when the chlorophyll maximum layer contained phytoplankton with a minimum diameter of 40 microns and at a density of 20 to 400 particles per milliliter. In March and April of 1974, the chlorophyll maximum layer along the California coast from Malibu to San Onofre (a distance of about 100 kilometers) consisted chiefly of a bloom of the dinoflagellate Gymnodinium splendens. The seaward extent of the bloom was at least 14 kilometers. A storm which caused extensive mixing of the top 20 meters of water obliterated the chlorophyll maximum and effectively destroyed the feeding condition for the larval anchovies. This was demonstrated before and after the storm aboard ship using the larval fish bioassay. This work suggests that specific criteria can be established for the survival of first feeding anchovies and perhaps other fish larvae as well. Cruises to determine this are planned as part of the upcoming 1974-1975 CalCOFI surveys.

As part of the stock-recruitment studies at the SWFC, the maturation and spawning of a number of important species has been altered to ensure that adequate supplies of larvae would be available on demand for mortality studies. Marine fishes which have been successfully matured and spawned include the northern anchovy Engraulis mordax, Pacific sardine Sardinops sagax, croaker Bairdiella chrysoura, Pacific mackerel Scomber japonicus, and the striped bass Morone saxatilis. Rearing of larvae through metamorphosis has been achieved using cultured marine food organisms such as the dinoflagellate Gymnodinium splendens, the rotifer Brachionus plicatilis and the harpacticoid copepod Tisbe furcata, or with wild plankton sieved from sea water. Combinations of selected photoperiods and temperature are environmental cues used to mature these marine fish. Anchovy can be induced to mature and spawn daily throughout the year if kept under a constant daily 4 hours light--20 hours dark cycle at 15 C. Other fishes may require long light and short dark daily cycles and different temperatures. Although the anchovy spawns eggs spontaneously under laboratory conditions throughout the year, this is not common in other fishes. Under normal circumstances, mature fish require injection of human chorionic gonadotropins to induce mass spawning. Despite its anadromous nature striped bass have been induced to mature and spawn out of season in full sea water.

3. MARINE CONTAMINANTS

3.1 Transfer of Pollutants Through Food Chain

Fishery Biologists at the La Jolla Laboratory, IMFS, are testing the properties of chlorinated hydrocarbons (CHC's) in sea water as part of a study of the transfer of pollutants through the marine food chain. C-14 labeled DDT was introduced into sea water in the vapor phase and absorbed on aerosol particles. Experiments were designed to measure the transfer of C-14 DDT from the water onto phytoplankton (Dunaliella). A method developed for recovering small quantities of CHC from sea water onto charcoal-celite was compared to the Harvey Method which recovers CHC's onto amberlite columns. Both methods were found to be equally

efficient in their ability to recover C-14 DDT. However, the charcoal-celite method was found to be more convenient because the sample to solvent ratio is larger, fewer changes of glassware are necessary, and there are fewer manipulative steps.

3.2 Study of Effects of Pollutants in the New York Bight

As part of the Marine Ecosystem Analysis (MESA) program in the New York Bight, the Middle Atlantic Coastal Fisheries Center, NMFS, Sandy Hook, New Jersey, initiated investigations of phytoplankton and primary productivity in Raritan, and Sandy Hook Bays. Salinity, temperature, dissolved oxygen, pH, total alkalinity, and inorganic carbon, chlorophyll, nutrients, C-14 primary productivity (both particulate and dissolved), and light penetration of the water column are measured at 9 stations each month. Water samples for phytoplankton identification, cell numbers, and species diversity are also collected.

Continuous underway fluorometry of the surface water of Raritan, and Sandy Hook Bays was undertaken to investigate the horizontal distribution of chlorophyll in this heavily polluted waterway. These data will be important in understanding man-induced changes in the bays and may help explain the extensive local variations in abundance of such important gamefish as the weakfish as well as spot, striped bass, and butterfish.

3.3 Physiological Effects of Oil Contamination in San Francisco Bay

Studies are underway at the SMFC Laboratory, NMFS, Tiburon, on the effects of crude oil fractions on the survival of larval fish. Accumulation and depuration of xylene by juvenile herring exposed to isotope-labeled xylene ranging from 0.9-1.0ppm has shown accumulations highest in brain, liver, and muscle tissue after 6 days of exposure. At the end of a 24-day experimental period concentrations of xylene were lower than any other time during the experiment. The accumulated residues were rapidly lost, but there are indications that the xylene was being metabolized to benzene and toluene. Methods for detection of possible toxic metabolites are presently being investigated and should aid further definition of potential problems surrounding exposure of larval fish to crude oil.

3.4 Alaskan Coastal Waters

The Northwest Fisheries Center is investigating the effects of oil on important fish stocks in Alaskan coastal waters. At the Centers' Auke Bay Alaska Laboratory experiments are underway on the relationship among acutely toxic doses of oil, doses that cause physiological stress, and doses that stimulate behavioral changes. Pink salmon eggs, alevins, and fry have been the organisms used in the majority of studies; herring eggs and larvae and Dolly Varden fingerlings have been used in other experiments. Bioassays on several life stages of pink salmon indicate an increasing sensitivity to oil and benzene from eggs to alevins to fry, if death is used as an end point; studies with herring eggs and larvae indicate that hatching success may be a more proper criterion. Hatching of herring eggs was inhibited at the lowest doses of oil tested (100ppm). A chronic bioassay

testing the long term exposure of pink salmon eggs, alevins, and fry to benzene is underway and is expected to further define the impact of oil and benzene on these life stages of pink salmon in both the freshwater and intertidal environments.

4. TAXONOMY AND ZOOGEOGRAPHY OF LARVAL MARINE FISH

4.1 Handbook of Fish Eggs and Larvae of the California Current

The NMFS, SWFC, La Jolla, reports that several series of illustrations were prepared during 1973, for the proposed handbook of fish eggs and larvae of the California Current. The handbook will treat approximately 100 species. Adequate illustrations and descriptions are available in the literature for only about 20 of the species to be included in the handbook, less-complete accounts are available for approximately 40 species, and no published information is available for the remaining species.

4.2 Nomeid Taxonomy

Work is continuing on the pelagic trawl collections made on Tropical Pacific of the DAVID STARR JORDAN in May and October 1972. Meristics including vertebral counts obtained from x-rays are being obtained for a number of species for inclusion in a manuscript, including the species composition of nomeid fishes which are among the abundant epipelagic oceanic fishes in tropical and subtropical waters. The most common species, Cubiceps panciradiatus, attains a length of only 12 or 13cm. Nomeids are a primary prey fish for apex oceanic predators.

4.3 Scorpaenid Taxonomy

Progress has been made by the SWFC on the preparation of a guide to the identification of scorpionfish larvae (family Scorpaenidae) in the eastern Pacific. Introductory sections of the manuscript are completed and the generic and species descriptions are finished for some species of rockfish (Sebastes). Descriptions of the remaining species of Sebastes should be completed in April and those include S. paucispinis, S. macdonaldi, S. levis, S. jordani, two species from the Gulf of California, S. capensis, S. oblongus (a Japanese rockfish) and S. marinus (the Atlantic rosefish). Descriptions will be prepared for the remaining genera and species to be included in the guide, which should be completed by the end of summer. A manuscript describing the early life history of the channel rockfishes (Sebastolobus) was completed. Sebastolobus larvae occur in CalCOFI samples and the juveniles are common constituents of mid-water trawl hauls taken off the coast of California. Adults of Sebastolobus altibelis are deep-living (550-1,300M) and this species has a prolonged pelagic juvenile stage that remains in mid-water for more than a year. Adults of S. alascanus are shallow-living (180-550M) and have a pelagic juvenile stage of short duration. The manuscript describes development of these stages and gives information on growth of the two species.

4.4 CalCOFI Neuston Collections

A report was recently completed on the results of neuston net hauls taken on CalCOFI cruise /205 made during May 1972 from the research vessels DAVID STARR JORDAN (NMFS) and ALEXANDER AGASSIZ (SIO). This cruise surveyed almost as extensive a part of the eastern Pacific as the CalCOFI contribution to Norpac (August 1955)--from 20° to 46°N and offshore to 145°W. This is the first report on neuston collections made on CalCOFI surveys. Larvae occurring in largest numbers in the neuston collections were those of the northern anchovy, Engraulis mordax and of the Pacific saury, Cololabis saira. An interesting point about the collections of Engraulis mordax is that they contained a much larger proportion of large larvae than are taken in regular oblique plankton hauls. In the latter type of haul larvae 15mm long consistently made up about 1 percent of the total anchovy larvae (Ahlstrom 1965), whereas in the neuston hauls the large larvae contributed over 15 percent of the total. Larvae and early juveniles of the sablefish, Anoplopoma fimbria were taken in larger numbers than in oblique plankton hauls, especially in a collection made off northern Oregon (45° 50'N, 125° 38'W) which contained 443 specimens ranging in size from 9.0 to 32.5mm. This single collection contained more specimens of sablefish than were obtained altogether in about 30,000 oblique hauls made over the CalCOFI pattern from 1949 to 1972. Obviously, neuston collections are excellent for locating the areas of occurrence of sablefish young. Other species that occurred in some abundance in neuston hauls include Sebastes sp., Trachurus symmetricus, Mugil sp., Auxis sp., and flyingfishes. Several kinds of myctophid larvae were taken in surprisingly large numbers in neuston hauls as compared to their abundance in oblique hauls, particularly larvae of Taaningichthys minimus, and of Lampadena urophaos.

5. TRAINING IN ICHTHYOPLANKTON TAXONOMY, SAMPLING, AND PROCESSING

5.1 Visiting Scientists, NMFS, La Jolla

The La Jolla Laboratory, NMFS, continues to serve as a Center for the study of fish eggs and larvae. Dr. Leslie Knapp, Supervisor Vertebrates at the Smithsonian Sorting Center, arrived at the La Jolla Laboratory on January 14 to work with Dr. E. Ahlstrom, Senior Scientist, on the identification of fish larvae. Mr. Keiichiro Mori of the Far Seas Fisheries Research Laboratory at Shimizu, Japan, visited La Jolla for about 6 months continuing his studies on identification of fish eggs and larvae. Several graduate students from the Scripps Institute of Oceanography also continue to work on ichthyoplankton under Dr. Ahlstrom's supervision. Ms. Thalia Castro, Biologist at the Escuela de Ciencias Marinas at Ensenada, visited the La Jolla Laboratory several times during the year to consult with Dr. Ahlstrom on larval fishes.

5.2 International Training Course in Fish Eggs and Larval Studies

During September 3-28 an FAO/MARMAP-sponsored International Training Course dealing with fish eggs and larvae brought participants from 12 nations to the Southwest Fisheries Center, NMFS, La Jolla. The course was divided into two subject areas, one dealing with identification of fish eggs and larvae, the other with their collection, processing and quantification. The identification section was taught by Dr. E. Ahlstrom and the quantification section by Dr. Paul Smith. Dr. Elda Fagetti, FAO representative, arranged the attendance of most participants and prepared a report on the course which will be processed and distributed by FAO. Practical work sessions included such topics as designing sample surveys, the techniques involved in taking quantitative plankton hauls, standardizing sampling data, sorting fish eggs and larvae and reporting results. Also covered were statistical techniques for evaluating sampling methods, intercomparison of historical and new plankton sampling methods, and the use of assigning confidence limits to additive or multiplicative error distributions. A highlight of the course was the actual rearing of fish eggs in the laboratory at controlled temperatures, and calculations of the relation between temperature and time of development to hatching. Participants represented the following countries: Mexico (3), Panama, Colombia, Peru, Chile (3), Indonesia, Thailand, Taiwan, Japan, Italy, Spain, and Finland. Fourteen participants took the full training course, while six additional participants took either the Identification Program or the Quantification Program. A 20-hour cruise was made aboard the NOAA research vessel DAVID STARR JORDAN.

5.3 CICAR Workshop on Fish Eggs and Larvae

A workshop on Fish Eggs and Larvae was held at the Mexican Sorting Center from July 17-26 sponsored by UNESCO, CICAR, and IOC. There were 33 participants and 12 observers representing the following countries: Mexico, U.S.A., France, Jamaica, U.S.S.R., Panama, Cuba, Venezuela, Brazil, Colombia, Scotland, U.K. Lectures were presented on ichthyoplankton sampling; handling ichthyoplankton and oceanographic data; taxonomy; and application of ichthyoplankton studies to fisheries research. The lecturers included A. Saville, MAF, Aberdeen; A. Aboussoun, Marine Station, Endoume; E. Ahlstrom, NMFS, La Jolla; E. Houde, University of Miami; R. Marak, NMFS, Narragansett; B. March, NOS consultants Pittsburgh; D. Smith, Marine Biomedical, Galveston; P. Wilkins, NOS consultants, Houston. The taxonomy sections covered the common families found in the CICAR area. Most participants brought samples which were looked at by the expert taxonomists and some of the problems of identification were worked out immediately. Each participant had the opportunity to discuss their problems with the invited experts. At the conclusion of the workshop the group recommended that the CPOM (Mexico Sorting Center) be used as a repository for the exchange of samples and data collected in the CICAR area. MARMAP standard log sheets are being sent to all the institutions to assist in the effort to standardize sampling and reporting methods.

6. TECHNICAL DEVELOPMENTS

6.1 Automatic Plankton Sorting Developments

Testing and evaluation of an automatic plankton sorting system utilizing iso-pycnic sedimentation in gradients of colloidal silica is continuing at the Northeast Fisheries Center, NMFS, Narragansett. Present efforts are directed towards the testing and refinement of the recently-designed gradient generator which is capable of generating up to 20 simultaneous gradients of 13 liters each in about an hour and a half's time. The gradients generated, however, are not linear but S-shaped, with the actual density varying at times from the theoretical one. This results in the compression of certain bands of the plankton spectrum. Elimination of the S-slope is being achieved through modifications to the gradient generator. Recent difficulties with the system are under investigation. Satisfactory separation of Gulf of Maine larval herring samples in which the copepods Pseudocalanus minutus and Centropages typicus were also present in significant numbers were not possible because of the similar densities of the invertebrates and larval involved. Future work will be focused on selectively shifting the mean density of these groups through modifications of the silica gradient by the addition of small amounts of polymers, osmotica or charged small molecules.

6.2 Undulating Oceanographic Recorder (UOR)

In cooperation with the Institute of Marine Environmental Research, the UOR system was tested at sea in May 1974, to evaluate its components including the towed vehicle, Oceanographic Data Acquisition System (ODAS), power generator, dive control unit, and the plankton sampler. Nineteen tests were made during 14 launches of the instrument--10 of these launches were successful. The UOR moved between a maximum 70M to 8M. Undulations from 0.8 to 15.0 kilometers were made. Translation of sensor data from analog to digital read-outs aboard ship was successful. Malfunctions were corrected aboard-ship without difficulty. No problems were experienced with the sensors for depth, temperature, and salinity; the plankton recorder failed to operate satisfactorily on only a single tow.