NOAA Technical Memorandum NMFS

SEPTEMBER 1989

# The First 25 Years

Lillian L. Klyman

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Center

NOAA Technical Memorandum NMFS

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**U.S. DEPARTMENT OF COMMERCE**
Robert A. Mosbacher, Secretary
**National Oceanic and Atmospheric Administration**
John A. Knauss, Under Secretary for Oceans and Atmosphere
**National Marine Fisheries Service**
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# About the Author

The Southwest Fisheries Center was fortunate to have access to the writing skills of Mrs. Lillian Vlymen, who prepared this historical document. Lillian retired in 1988 after more than 37 years of service to the Center and its predecessor organizations. Her experience with the Center and first-hand information on matters of historical significance made her exceptionally well-qualified to prepare this document. As Special Assistant to the Science and Research Director, Lillian was in a position to closely observe the Center's evolution. In addition, she did a great deal of background research using Center records and corresponding with many persons who previously held positions of leadership.

Lillian's experience together with a delightfully readable writing style have made her contribution an interesting and lasting one. Sincere appreciation is expressed to her on behalf of the employees of the Center—past, present and future—for this accurate, thorough and personal history of the Southwest Fisheries Center.

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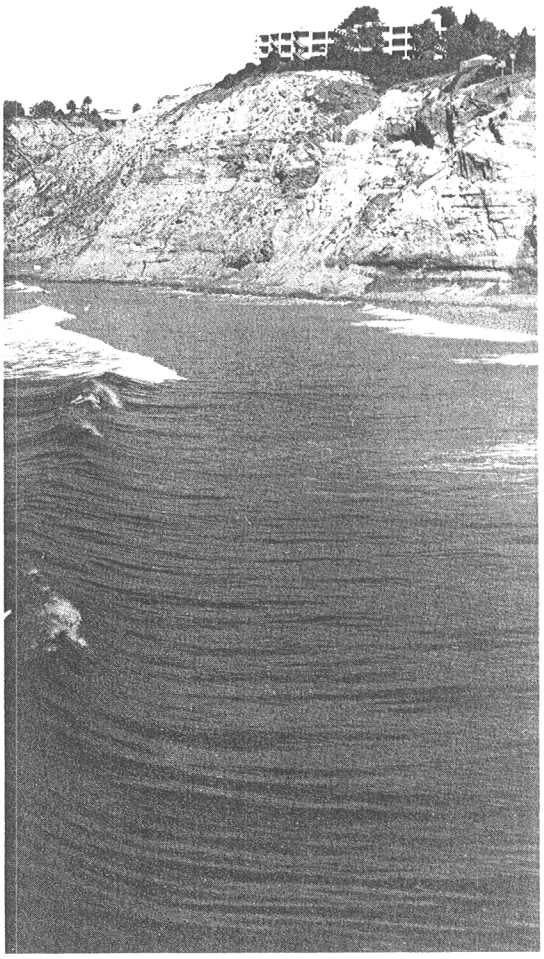
## The National Marine Fisheries Service

# SOUTHWEST FISHERIES CENTER

### THE FIRST 25 YEARS

## PROLOGUE

The National Marine Fisheries Service' Southwest Fisheries Center sits on a sandstone cliff 220 feet above the sea, commanding a view of the Pacific Ocean and the coast of California, curling away both north and south. Located one-quarter mile north of the main campus of the Scripps Institution of Oceanography of the University of California, San Diego, in La Jolla, California (15 miles north of San Diego, the second largest city in California), the Center is the dominant presence on the hill. From its vantage point it overlooks the NORPAX Building, the Hydraulics Laboratory, and various small laboratories housed in the gray clapboard cottages which were once the residences of faculty members at Scripps.



Southwest Fisheries Center

Biological Grade, once part of the main highway to Los Angeles, begins at the perimeter of the Center grounds and winds its steep, narrow way down hills dotted in the spring with orange aloes to the main, shoreside Scripps campus. Although officially part of San Diego, the small enclave of La Jolla, home to the NMFS Southwest Fisheries Center, the University of California, San Diego, Salk Institute, General Atomics, and many other research institutions, is one of America's most upscale and exclusive communities where million dollar homes are commonplace and the locals drive Bentley, Rolls, and Mercedes automobiles. The area surrounding the Center is one of great natural beauty. In winter, gray whales pass several hundred yards offshore on their annual migration to their birthing grounds in warm-water Baja California lagoons. Bottlenose dolphins swim offshore, sometimes catching a wave and elegantly body surfing in the shoreline. Occasionally, during the spring and summer, schools of anchovy appear close to shore as moving inky-black blots, attracting hordes of hovering sea birds. Over the ocean brown pelicans fly in synchronous lines, black cormorants flap along slowly looking for fish, and gulls wheel overhead. On the narrow beach below the Center willets, turnstones, and godwits hunt for food at the shoreline. At dusk, the night herons leave their roosts in the palm trees on the Scripps campus and fly croaking over the Center to nearby lagoons to feed. Ravens,

scrub jays, and various species of small hawks are frequent visitors. For several memorable years, the Center was the home of a family of ospreys, large fish hawks. San Clemente, one of the Channel Islands, located some 50 miles offshore from the Center, can sometimes be clearly seen after a cleansing rain has washed away the yellowish-brown smog on the horizon. On certain rare days the sea below the Center is completely obscured with a thick layer of puffy white clouds while above this fog bank the sun shines brightly in a blue sky. The rounded hills surrounding the Center are abundantly covered with lemonadeberry bushes, California coreopsis with bright yellow flowers, ice plant, cane cholla and beavertail cactus, and wild cucumber in the spring.

The series of events which led to the dedication of the Center on an October day in 1964 began more than 30 years ago with concerns about a fish, the California sardine. In later years, the politics of the distant water tuna fisheries based in San Diego figured importantly as well. The administration of President John F. Kennedy played a significant role since it was the policy of this President to combat the business recession of the early 1960's with direct infusions of government monies into the domestic economy by erecting federal buildings. Others who played important roles were a governor of California, Earl Warren, who appointed a group of nine prominent citizens to establish the Marine Research Committee, responsible for setting up the sardine research program, scientific entrepreneurs and biopoliticians, Washington bureaucrats, university administrators, fisheries scientists, mathematicians, oceanographers, fishery aides and plankton sorters, lawyers and legislators, environmentalists, sport and commercial fishermen, and not least, the interested public.

Although in time the Fishery-Oceanography Center became the Southwest Fisheries Center and grew to include laboratories in Tiburon and Monterey, California, and Honolulu, Hawaii, the focus of this account will be the La Jolla Laboratory, housed for the past 25 years in the Center on the hill.

The story of the Center really began in August, 1958 with a letter of intent from Dr. Roger Revelle, then the Director of the Scripps Institution of Oceanography, to John C. Marr, Chief of the Bureau of Commercial Fisheries (BCF), South Pacific Fishery Investigations, whose laboratory was then housed in the former Director's residence on the Scripps campus. Wrote Dr. Revelle:

> *We would like to see the Bureau of Commercial Fisheries activity located on our campus more permanently and adequately housed. There is land available for a laboratory building suitable to your needs on the lower campus; a long-term lease could be arranged, or possibly a transfer of title could take place. If a federal laboratory were to be established at the Scripps Institution, I am sure your Bureau would be able to operate more effectively under less crowded conditions and our mutual interests would better be served.*

Dr. and Mrs. Roger Revelle

Thus encouraged, Marr submitted a proposal to the federal government for a BCF Laboratory building on the Scripps campus in La Jolla to cost $825,000. Of this amount, $675,000 was for the building proper, $100,000 for a saltwater system, and $50,000 for outside improvements. Total work allowance was made for 100 people, plus service space used in common such as seminar

room, library, shop, dark room, and collection storage. When Dr. Wilbert M. Chapman (of whom more later) learned of this plan, he dismissed it as the work of "small thinkers," inadequate for housing the soon-to-be staffed Eastern Pacific Tuna Investigations (eventually renamed the BCF Tuna Resources Laboratory) and as a home for the Inter-American Tropical Tuna Commission. Chapman had a strong interest in both tuna groups since he played a major role in their founding. Using his considerable political clout, influence, and charm, Chapman energetically lobbied his friends in Congress to obtain the $2.45 million appropriation for the Center. The Kennedy administration supported the idea and Congress appropriated the monies. It can be fairly said that it was almost entirely due to Chapman's efforts that the fisheries building was built in its present form.

Dr. Wilbert M. Chapman

Revelle's invitation to the federal fisheries staff to locate on the Scripps campus met with considerable opposition from the Scripps staff. There is in the archives a letter to Revelle from a well-known professor, as follows: *"I can't but regret this and I believe a majority of your faculty agrees that this is far too fishy a group to further fill the very precious space we have."* Dr. Alan Longhurst who became the first Director of the combined Center also alluded to this attitude when he wrote, *"...some Scripps' people did not welcome the arrival on their campus of a federal research laboratory thought to be devoted to simple, applied research."*

Wiser heads prevailed and in due time the Regents of the University of California officially deeded 2.4 acres of land on the Scripps campus for a federal fisheries laboratory. Plans for the Center went rapidly forward although the project almost foundered in mid-construction on the inability of the University of California administrators, the Justice Department, the Bureau of the Budget and the General Services Administration to agree on the precise wording and terms of the reconveyance or return of the donated land to the University of California. The University originally proposed a lease of 50 years, then 99 years, but the government held firm on no mandatory reconveyance in the language of the deed. As it turned out after much discussion, the government prevailed and there is presently no mandatory reconveyance of the land *"together with improvements constructed"* to the University Regents as long as the government uses the property, *"for a marine biological research laboratory compatible with (purposes) of the (nearby) Scripps Institution of Oceanography."* If and when this condition is not met (no time limit is set), legislation passed by the 89th Congress authorizes a future Secretary of the Interior to return the buildings and the 2.4 acres of land to the University of California, or its successors.

## The Groundbreaking

Groundbreaking for the Center took place on June 8, 1963. In preparation for the ceremonies the building site at the north end of the Scripps Institution of Oceanography campus had been partially cleared, and a portable grandstand draped in bunting and adorned with the buffalo seal of the U.S. Department of the Interior erected at the west end with the Pacific Ocean as a scenic backdrop. A light drizzle was falling as California Area Director Donald R. Johnson opened the proceedings and introduced the honored

guests on the speakers' platform: Under Secretary of the Interior James K. Carr, Clarence F. Pautzke, Commissioner of the Fish and Wildlife Service, Edwin W. Pauley, millionaire oilman and Regent of the University of California, Hugo Fisher, Administrator of the California Resources Agency, Congressman Lionel Van Deerlin, Captain R.E. Thomas of the U.S. Navy's Bureau of Yards and Docks, F.L. Hope, architect and designer of the building, and R.M. Golden, whose construction company was awarded the contract to build the Center.

The keynote address was given by Secretary Carr who told the audience of several hundred, *"The fishery-oceanography laboratory here will be a place where men can inquire, think and probe the secrets of the sea. There is before us a bright horizon where the teamwork of scientists, engineers, and fishermen, pondering new findings from this and other laboratories, will bring us back a rich reward of new knowledge and of new health from the great frontiers of the oceans."*

At the conclusion of his remarks, Secretary Carr invited Regent Pauley (forever famous as the donor of Pauley Pavilion on the UCLA campus) to press a switch exploding red and green smoke bombs which marked off the boundaries of the planned fisheries research center. Later, wielding a ceremonial, chrome-plated shovel, Pauley, Carr, and Pautzke broke the first ground. Following the ceremonies, dignitaries and guests adjourned to the La Jolla Country Club for a lavish seafood luncheon sponsored by the Southern California Tuna Industry. The Honorable Clair Engle, U.S. Senator from California, flew from Los Angeles where he had presided at a breakfast for President Kennedy, in time to deliver the principal address.

Between the time of the groundbreaking and the completion of construction of the Center there occurred an event which could have affected the siting of the building. As the resident geologist Dr. George W. Moore of the U.S. Geological Survey wrote:

> *The possibility that a coherent landslide might underlie the Fisheries building of the National Marine Fisheries of the National Marine Fisheries Service, La Jolla, was noted in July, 1963 by geologists from the adjacent Scripps Institution of Oceanography during an informal examination of the excavation for the building, then under construction. Because it is a federal building, the structure had been exempt from local code requirements for a preconstruction engineering-geology study. After a letter was sent to the architects by J.D. Frautschy (then the Assistant Director of Scripps Institution), a thorough study was promptly made, including the drilling of a 0.8 meter hole, 23 meters deep, down which a geologist was lowered to examine the rock structure.*

On the basis of the geologists' report, a landslide was deemed to constitute little threat to the integrity of the planned structure, and construction continued as planned. In a paper written in 1973, Moore explained further:

> *A rock structure occupies the lower slope of the sea cliff fronting the building. An old photograph shows that the rockslide, which originated as a rockfall, was already in place in 1908. Photographs through the 60 years since then show little change in the rockslide, which is about 50 meters long. This rockslide poses no threat to the building; in fact, it is a useful protection against wave erosion of the rocks that underlie the structure, and it may act as a buttress to partly counterbalance the glide block. Recent instrumental measurements indicate that, as its toe is cut off by wave erosion, the surface of the slide is moving like a glacier at a rate of about one meter every three years.*

Moore concluded that the "gliding" could not involve the structure in a rockfall at the cliff face. Barring a major local earthquake, only small movements similar to those already recorded are expected to continue. Moore, however, did speculate on the fate of the Center in the event of such an earthquake and theorized that, *"perhaps the articulated design of the building would cause it to remain fairly coherent while bending. If so, this combined with the slow downward movement should reduce the risk of injury to occupants."* He

ended his paper with the wry remark, *"Inasmuch as my own office is near the east corner of subbuilding B on the ground floor, I am especially interested in the correctness of this conclusion."*

## The Dedication

More than a year later, on October 31, 1964, the Southwest Fisheries Center, then known as the Fishery-Oceanography Center of the Bureau of Commercial Fisheries, was formally dedicated by Dr. John C. Calhoun, Jr., Science Adviser to Stewart L. Udall, Secretary of the Interior, with appropriate remarks, to the discovery, description, development and conservation of the living resources of the global seas. Sharing the platform with Calhoun were Donald R. Johnson, now the Regional Director, BCF, who served as the master of ceremonies, Jack Gorby, now a Commissioner of the Inter-American Tropical Tuna Commission but then representing the California fishing industry, Donald L. McKernan, Director of the Bureau of Commercial Fisheries, and Dr. Herbert York, the first Chancellor of the year-old campus of the University of California, San Diego (UCSD). In this latter connection, Revelle, one of the founders of UCSD, had originally put forward the name, University of California, La Jolla, for the new campus and early planning documents refer to it as UCLJ.

As the Naval Training Center Band played, Johnson concluded the ceremony as he accepted the symbolic key to the Center (carefully crafted of wood and painted gold by Charles F. Wright, the first building maintenance supervisor) from the builder as a token of completion and formally presented it to Dr. Elbert H. Ahlstrom, co-Administrator of the new Center, to signify the formal opening of the laboratory complex. Thus, upon its dedication in 1964 the Center became the latest addition to the 30 or so biological fisheries laboratories operated by the U.S. Department of the Interior's Bureau of Commercial Fisheries and the inheritor of a national tradition of fisheries research in the United States that began in 1871.

## History of Federal Fisheries Research

It was in that year that President Ulysses S. Grant signed into law a joint resolution, *"...for the protection and preservation of the food fishes of the coasts of the United States."* At the same time he appointed Professor Spencer F. Baird, an official in the Smithsonian Institution, as the first Commissioner of Fish and Fisheries.

From the first small federal fisheries laboratory built under the direction of Professor Baird at Woods Hole, Massachusetts, the fisheries agency has grown and increased the scope and variety of its services. Originally known as the U.S. Fish Commission, it functioned as an independent agency from 1871 to 1903. In 1903, it was placed in the newly-established U.S. Department of Commerce and Labor and renamed the Bureau of Fisheries. In 1913, the Department of Labor was separated from Commerce but the Bureau of Fisheries remained in the Department of Commerce until 1939. At that time, the Bureau of Fisheries and the Department of Agriculture's Bureau of Biological Survey were transferred to the U.S. Department of the Interior. A year later, on June 30, 1940, the two Bureaus were merged to form the Fish and Wildlife Service. The Fish and Wildlife Act of 1956 created the Bureau of Commercial Fisheries and the Bureau of Sport Fisheries and Wildlife. The latest metamorphosis of the fisheries service occurred in 1970 when President Richard M. Nixon with a stroke of his pen created the National Oceanic and Atmospheric Administration (NOAA) in the U.S. Department of Commerce, and the Bureau of Commercial Fisheries became the National Marine Fisheries Service (NMFS).

The Center which had its beginnings 25 years ago was a laboratory building of unusual construction. It was designed by the architectural firm of Frank L. Hope and Associates of San Diego as a complex of four, pre-stressed concrete, multi-story buildings grouped around a central courtyard. Vertical, prestressed columns supported spans of concrete channels which were poured in place. The tops of the channels were the floors and the bottoms were the ceilings on each level. By virtue of the outside corridors and small, numerous utility columns, all 50,000 square feet of inner space were usable. This space was originally divided into central

administrative offices, individual units combining laboratory with office, and larger research laboratories. All of these were grouped into functional complexes suitable for each particular investigation.

Into this building moved the two BCF laboratories, the California Current Resources Laboratory, headed by Elbert H. Ahlstrom, and the Tuna Resources Laboratory from San Diego, directed by Gerald V. Howard. In addition, several tenant agencies also took up quarters in the Center: the Inter-American Tropical Tuna Commission (IATTC), Scripps Tuna Oceanography Research (STOR) of the Scripps Institution of Oceanography, the office of the Coordinator of the California Cooperative Oceanic Fisheries Investigations (CALCOFI), and a small field office of the U.S. Geological Survey. From its beginnings, the beautiful structure by the sea attracted notice form the public, many of whom in the early days after the opening of the building mistook it for a hotel and attempted to register as guests. As a result, the Center is still known locally as the Fish Hilton. The Center also won several awards for distinguished architectural achievement, including first place honors from the Navy and American Institute of Architects who cited the laboratory for "flexibility in design."

With the completion of the Fishery-Oceanography Center in 1964, Ahlstrom gathered his staff from their several locations on the Scripps campus, and the "wooden hut" at the Scripps Field Annex and with Howard and his group, also inadequately housed in yet another old wooden barracks building of World War II vintage at the Scripps Field Annex, moved their operations into the Center. Both the California Current Resources Laboratory and the Tuna Resources Laboratory continued as independent research entities, although shared responsibility for the administrative functioning of the Center rested with the two co-administrators, Ahlstrom and Howard.

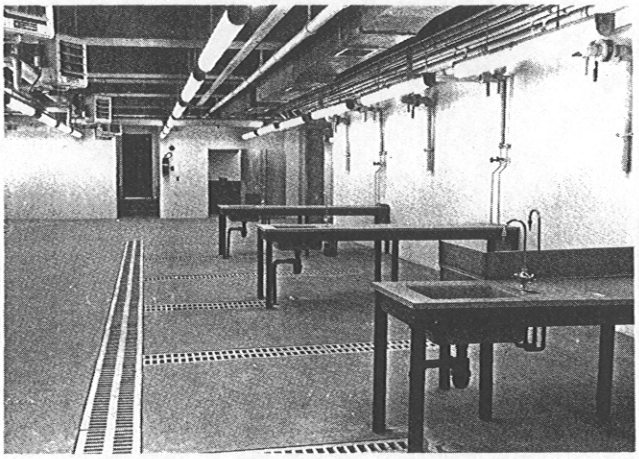
# FACILITIES FOR RESEARCH

The consensus of architects, fishery scientists and the general public is that the Center is one of the world's most attractive fishery laboratories. Twenty-five years after its dedication, the largest tenant agency in the building continues to be the Inter-American Tropical Tuna Commission, although there are also representatives of other NOAA agencies here: National Oceanic Service, National Environmental Satellite Data Information Service, Office of the NOAA Corps, and the California Department of Fish and Game, Liaison Office for Marine Mammals. The remainder of the space is fully occupied by the scientists and supporting staff of what is now the Southwest Fisheries Center and comprises scientists' offices, laboratories, an experimental aquarium, a library, mechanical workshops, computing and data communication facilities, administrative offices, and storage rooms for scientific collections.

As the staff can testify, the design of the building proved to be excellent as an environment for research. The credit for this should go largely to fishery biologists David Kramer of the California Current Resources Laboratory and Dr. Richard Whitney of the Tuna Resources Laboratory, who over a period of many months in 1961 and 1962 canvassed their colleagues to obtain their ideas and input for a fisheries laboratory building. Here, in brief, is a description of several of the important facilities which presently support research at the Center.

## Experimental Seawater Aquarium

Much thought and planning went into the design of the seawater aquarium by physiologist Reuben Lasker, behaviorist John Hunter and other fishery scientists on the staff. In operation since 1965, it occupies 9,300 square feet, most of the basement of two of the four adjoining buildings. Because it was too costly to construct facilities to bring seawater up the cliff face, 220 feet, the University upgraded and extended an existing sea-water pumping, filtering, and delivery system (most recently in 1988 when the new Scripps pier was built) to provide the La Jolla Laboratory and the Scripps facilities on the hill with seawater. The system, which is owned and operated by the University of California, extends from the end of the Scripps pier to the NMFS property line and consists of pumps, a



The seawater aquarium in 1965.

Fiberglas flume on the pier, sand and gravel filter beds, storage tanks and piping. The seawater intake is at the end of the Scripps pier, 900 feet offshore, 7 feet above the seabed and 13 feet below the lowest low-tide level. Pacific Ocean water temperatures off the pier range from from about 57 degrees in winter to a maximum of 70 degrees in summer.

Delivery of sea water was negotiated by a Memorandum of Agreement between the Regents and the BCF wherein the Bureau agreed to pay a connection fee of $146,500 to the University and to reimburse the University for the cost of seawater service based on a rate schedule established by the University. This arrangement, in force since 1964, obviated the necessity for granting seawater pipeline and tank easements on University property.

Fixed spaces in the new aquarium, supplied with running seawater included environment rooms, water tables and workbenches, a small food preparation room, and a storage space for gear. The remaining area was essentially in two large rooms with no fixed tanks or cross walls, permitting tank sizes, types and locations to be changed at will (in December, 1964, before the aquarium was actually in operation, the Center's annual Christmas party was held in this large open space). All utility pipes and conduits are exposed and hung from the ceilings. The pipes carry sea water, gas, and compressed air; the conduits carry 125-v and 250-v electricity. The floor is plastic-sealed concrete, sloped and crowned to drain water into gutters that run north to south for 100 feet in each building. The gutters are 10 feet from the walls to prevent salt-water contact with the building's foundations.

Researchers found that above-ground swimming pools made excellent fish tanks. A typical tank setup includes a circular plastic swimming pool with sides of steel. Most recently, cold water fish tanks of up to 15 feet in diameter are in use for holding bottomfish brood stocks. To maintain the requisite cold water temperatures, the tanks are constructed with two inches of insulation between the liner and the sides and bottom of the tanks.

Over the years, fishery scientists at La Jolla have used the experimental seawater aquarium to rear numbers of pelagic fish species from the eggs through juvenile stages, carried out complex behavioral and physiological experiments, feeding and starvation experiments with larval fish, successfully maintained brood stocks of anchovy and Pacific mackerel, studied schooling and feeding behavior of various pelagic schooling fishes, studied effects of ultraviolet radiation on larval fishes, maintained stocks of striped bass, reared abalone, measured oxygen consumption in euphausiids, and most recently, developed techniques for spawning Dover sole and sablefish.

## Information Technology Services

Although space for automatic data processing was not specifically planned in the design of the building, Director Barrett in the late 1970's set aside space and established a group to provide professional computer technology support services to the Center's management, research, and administrative staff. The staff of the Information Technology Services, under Dorothy Roll, provides the design, development, implementation and maintenance of data management systems for the Center. They also serve as consultants and technical advisors to the staff and provide computer-related training programs. Two of the major systems, designed and implemented by the staff and managed and used by Federal and State agencies are the Pacific Area

Cooperative Enforcement System (PACES) and the Pacific Fisheries Information Network (PacFIN) System. These systems are used to monitor and analyze commercial fishing activities along the U.S. west coast. Other ITS-developed systems are the Porpoise Data Base System, the California Cooperative Fisheries Investigations (CAlCOFI) Data System, and the Financial Reporting System (FRS). These systems provide the data for the monitoring of tuna/porpoise stock, the distribution of commercially important fish eggs and larvae, and the management of the Center's financial resources.

Computer resources available to the Center's staff include contracted services on UCSD's VAX systems, the San Diego Supercomputer CRAY system, funded by the National Science Foundation, and the in-house DOS-based microcomputers. During the past 18 months, the required backbone network cabling has been installed and a Local Area Network (LAN) implemented to link administrative and scientific microcomputers for an efficient automated office environment. The planned expansion of the LAN system will provide the gateway to the computer resources which will support the Center's needs into the 1990's.

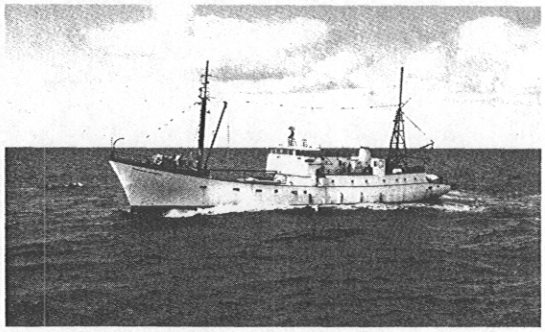
## Research Vessels

Operated by the Office of the NOAA Corps, the Center has access to two research vessels, the *David Starr Jordan* operating out of San Diego and the *Townsend Cromwell* with its home port in Honolulu, and a number of small workboats.

The *Jordan* is used principally by the La Jolla Laboratory. The ship was authorized by Congress in 1961 to replace the over-age *Black Douglas*. It was designed by Harco Engineering Co., of Terminal Island, California, based on the suggestions and research needs of fishery biologists from the California Current Resources Laboratory who wanted to use the ship for pelagic fish surveys and from the Tuna Resources Laboratory who had plans to locate and track tunas.

After much preliminary planning, coordinated by fishery biologist Robert S. Wolf, a design was approved and submitted for bid. The name for the proposed research vessel, *David Starr Jordan,* was

R/V *David Starr Jordan*



R/V *Townsend Cromwell*

suggested by Ahlstrom to honor America's most famous ichthyologist. Jordan, who became the first president of Stanford University in 1881, was one of America's great naturalists and scholars. He was the author of more than 1,000 scientific papers, including the monumental treatise, "Fishes of North and Middle America," prepared in collaboration with his student, B.W. Evermann, who achieved his own later fame as an ichthyologist.

The construction contract was let to the Christy Corporation of Sturgeon Bay, Wisconsin (home of the Green Bay Packers). The ship, which cost $1.75 million, is an all-welded steel vessel of 171' length, 37' beam, and 11' draft. Twin diesel engines of over 500 hp each drive the ship to a cruising speed of 12 knots. The vessel was designed to cruise over 8,000 miles and to remain at sea, without refueling, up to 40 days. More than a third of the ship's enclosed space was devoted to scientific laboratories and their support areas.

The ship was launched on December 19, 1964, completed in October, 1965 and arrived in San Diego on December 24, 1965. With its first captain, Charles W. Foerster at the helm, the vessel sailed out through the St. Lawrence Seaway with the winter ice closing fast behind it. There are entries in the log of the crew chopping ice from the superstructure as it traversed the Seaway. The ship made its first stop at the federal fisheries laboratory at Woods Hole, Massachusetts, then on to the Biological Laboratory at Miami, and through the Panama Canal to San Diego.

The ship was designed for work in tropical and temperate waters and was representative of the second generation of U.S. vessels specially built for oceanographic and biological research. Included in the *Jordan's* capabilities were the following: salinity, temperature, and depth sensing to 1,500 m with STD apparatus, continuous surface thermosalinograph with analog recorders, expendable bathythermograph system with automatic data logger and data transmitter, autoanalysis of water samples for nitrate, nitrite, phosphate, and silicate; chlorophyll determination by fluorometry, and shipboard data processing with desk top programmable computers. These capabilities were in addition to those designed and built into the vessel: normal equipment for hydrocasts and biological collecting; underwater observation chambers in the bow and on the port side; physiology laboratory and constant temperature culture room, both with temperature controlled sea water supplies, research fish-finding sonar and sounder; live bait tanks and precision depth recorder.

In January, 1966, the *Jordan* made its first cruise, a California Cooperative Fisheries Investigations (CalCOFI) survey, where it encountered heavy weather and lost both bilge keels (which kept the ship from rolling). On return to port the ship was tied up for repairs for 3 months but once put back into service continued to work uneventfully in the California Current for the balance of the year. In 1967, the *Jordan* embarked on the EASTROPAC operations; during these it completed six, 2-month cruises in the tropical Pacific with short turnaround periods.

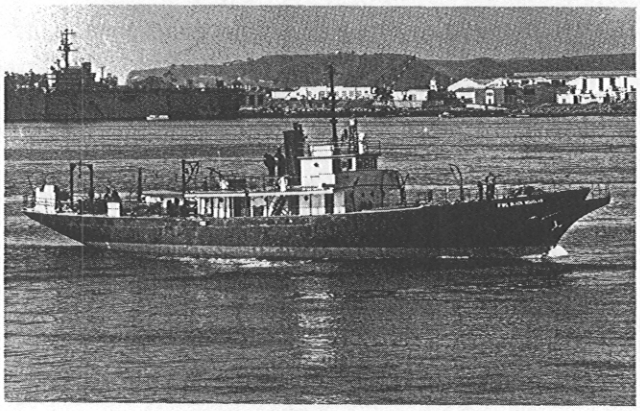
The *Jordan* which carries a crew of 17 and a scientific complement of 13 is at sea an average of 243 days a year, logging about 35,000 miles during that period. In recent years when the ship has been used for surveys to assess the population of porpoise in the eastern Pacific, the number of miles per year has increased to about 45,000. It has traveled as far west and south as Tahiti and as far north as British Columbia. Built with a special research hull, the *Jordan* is essentially a modified trawler with a stern ramp. It can and has been used for midwater trawling, longlining, bottom trawling, almost everything but purse seining, although it was equipped with a power block.

Although the ship has undergone minor modifications throughout the years, the most striking addition has been the installation of the helipad which required a major modification of the stern and a consequent reassessment of the ship's seaworthiness. The helicopter was first flown on scouting missions in 1987 in conjunction with the conduct of the porpoise assessment cruises.

The *Jordan's* 24 years of operations have been largely uneventful although some incidents stand out. In December, 1969, the *Jordan* was one of the first ships to venture into the major oil spill off Santa Barbara to assess how the small animals in the plankton were affected by the oil. Alan Longhurst's comments on this event are interesting. He wrote, *"The CalCOFI series found another use about this time when Paul Smith made a special voyage (known as the "Pouring Trouble on Oiled Waters" cruise) on Jordan. The finding that this major spill could hardly be detected statistically against the CalCOFI plankton record has stayed with me usefully ever since, as has a view of the size of the area contaminated by sheen as seen from a PSA flight to Los Angeles."* Measurements taken by Lasker and Smith showed that fish larvae hatched before the oil spill continued to grow and thrive under the slick.

The *Jordan* was also involved in several rescue attempts. On one occasion it took aboard four people adrift in a small boat off Baja California and in 1976 rescued two aged (81 and 77 years old) occupants of a small

native sailing craft in the Gulf of Nicoya, off Costa Rica, that appeared to be awash. At the time of the latter rescue, the *Jordan*, together with its sister research vessel, the *Townsend Cromwell*, was in the process of conducting a survey to map the boundaries of offshore porpoise distributions, particularly spotted and spinner porpoises, the principal species involved in the yellowfin tuna purse seine fishery outside the area of traditional tuna fishing grounds in the eastern tropical Pacific.



R/V *Black Douglas*

The old work horse of the sardine program, the 35-year research vessel, *Black Douglas*, was declared surplus and sold by the federal government to a company in the Cayman Islands to hunt for treasure. Some years later the ship went to Miami, renamed the *Te Quest* and painted dark blue, the three masts were replaced and it traveled under sail to the Mediterranean where unconfirmed reports said it was used as a training ship for seagoing cadets. Although the *Black Douglas* was used on CalCOFI cruises only until October, 1965 when it was laid up in anticipation of the delivery of the new research vessel, *Jordan*, the experience gained in operating the vessel for 16 years provided invaluable information when the time came to design a ship specifically for bio-oceanographic research. All told, the *Douglas* which was originally built as a 3-masted schooner in 1931 as a floating home for Robert C. Roebling, a member of the family who developed and manufactured wire rope cable and designed many great suspension bridges, traveled 400,000 miles on more than 100 research cruises for the CalCOFI investigations between 1949 and 1964.

## Center Library

In 1965, the Center Library on the fourth floor of Building A consisted of bare oak wood stacks and a haphazard collection of books and reprints in cardboard boxes acquired by the old BCF California Current Resources Laboratory during the years of its existence. Today, the Center Library, with its primary emphasis on fisheries literature, marine biology and oceanography, has become the sole fisheries library open to the public and to researchers in southern California.

Major credit for the creation of this library of 6,000 books, hundreds of periodicals, and many thousands of reprints, is mainly due to its first librarian, Daniel Gittings. Over a period of 20 years he put together from bare walls a first rate fisheries library based on consolidation with the holdings of the Inter-American Tropical Tuna Commission, accretion from closed Bureau of Commercial Fisheries libraries, and the old BCF collection. This collection is supplemented by access to the extensive libraries of the nearby UCSD and Scripps. In 1989, the Center library, equipped with computers and copying machines, is an invaluable research tool for the scientific staff at La Jolla.

Under the direction of librarian Debra Losey, the library is a magnet during the working day for visiting marine scientists, undergraduate and graduate students, high school pupils, commercial and recreational fishermen, lawyers, economists, conservationists and the public.

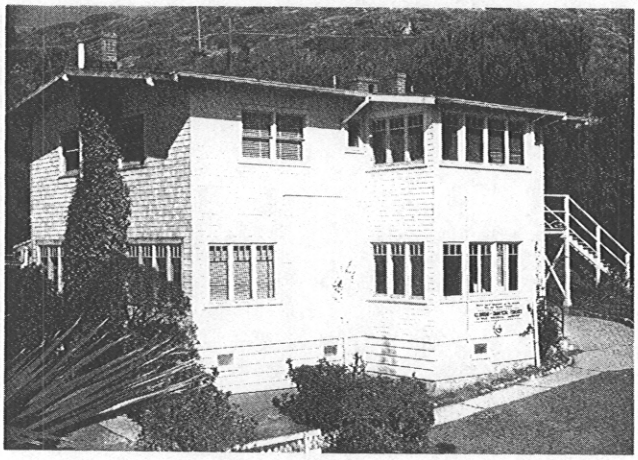
# INTRODUCTION

The Center did not spring into being full-fledged. Its history and antecedents, as that of its tenants, extends many years into the past and is intimately involved with the history of the California fishing industry. To understand

the present status of the La Jolla Laboratory, it may be useful to take a retrospective look, beginning with the California Current Resources Laboratory which was founded in 1937.

## California Current Resources Laboratory

It was mutual interest in a fish, the California sardine, which once supported the nation's largest fishery, which was responsible for bringing this federal laboratory to the campus of the Scripps Institution of Oceanography in 1954, although the sardine story began much earlier.



The California Current Resources Laboratory.

The California Current Resources Laboratory began as the sardine investigation although its official title was South Pacific Investigations. From 1937 until 1954, the staff of the Investigations was housed up many flights of steep stairs in the loft of David Starr Jordan Hall on the campus of Stanford University in Palo Alto, California. From the outset the research was directed toward obtaining an understanding of the population dynamics of the sardine. As the first laboratory director from 1937 to 1948, Dr. O. Elton Sette wrote that the primary objective of the research program was to understand the impact of the fishery on the resource. John C. Marr succeeded Sette as laboratory director and served from 1948-1959. In 1959 Elbert H. Ahlstrom became the laboratory director and served until 1967, several years after the move to the Fishery- Oceanography Center.

The laboratory at its beginnings entered a field where the California Department of Fish and Game was actively involved in sardine research under Dr. Frances Clark. In addition, the province of British Columbia in Canada had a small group headed by Dr. John Hart working on sardines ; Oregon had a sardine unit working under Vernon Brock, and the state of Washington cooperated by gathering landing statistics on sardines. Scripps Institution of Oceanography was also involved in early sardine research.

During the years 1939-1941, using the research vessel, *E.W. Scripps,* Dr. Harold Sverdrup, the Norwegian oceanographer who was then the director of Scripps, and Sette planned and carried out cooperative biological and oceanographic surveys between Point Conception and the international border with Mexico to discover the where and when of sardine spawning. Based on these cruises, Sette published a plan, considering all life stages of the sardine, which was the basis for subsequent CalCOFI field sampling protocol.

As Ahlstrom wrote many years later, at its founding the Fish and Wildlife Service laboratory was resented by other sardine researchers, particularly those of the California Department of Fish and Game (CF&G). Relations with the State gradually improved through such mechanisms as the annual sardine conferences which involved researchers from British Columbia to California and helped to develop better understandings. In addition, cooperative research programs proved to be helpful in establishing good relations, particularly in age and growth studies of the sardine, started with the CF&G in 1941. In recent years, the California Cooperative Oceanic Fisheries Investigations (CalCOFI), especially the CalCOFI Committee, composed of representatives from Scripps, the NMFS, and CF&G, became an excellent forum for joint research planning and coordination.

The Fish and Wildlife Service laboratory planned from the outset to augment rather than to duplicate the research of other agencies working on the sardine. In conferences with CF&G biologists, two areas of research were identified where the Service could usefully contribute--studies on age and growth of sardines, using scales and/or otoliths to determine age, and studies dealing with the success of recruitment, especially studies of the egg and larval stages. CF&G scientists had previously worked in each of these areas. W.F. Thompson as early as 1926 summarized early attempts to age sardines using scales; in 1934, E.C. Scofield summarized the work of the State in locating the time and place of occurrence of sardine eggs and larvae. Fishery biologists Lionel Walford and Ken Mosher established that sardines could be aged using either scales or otoliths. A cooperative study of aging sardines from the commercial landings was undertaken with CF&G in 1941 and continued through 1965. Thus, early cooperative sardine investigations with both Scripps and the State of California laid a framework that led naturally into the expanded research program of the late 1940's, now known as CalCOFI.

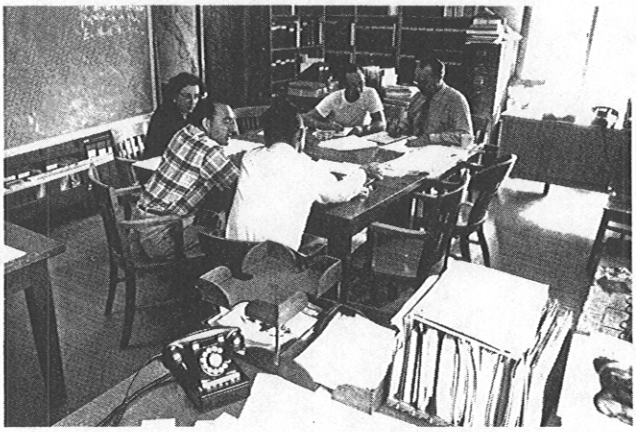
In the mid-1940's catastrophe struck the sardine industry. The large fishing fleet and once thriving canneries, described so graphically by John Steinbeck in his famous novel, "Cannery Row", gradually dwindled. An indication of the magnitude of this fishery and its subsequent collapse is evident from the following statistics: from just half a million tons of sardines landed in 1939, the total fell to only a few hundred tons in 1966. By October, 1945, the northern sardine fishery collapsed completely; by 1952, the southern sardine fishery was dead. As the sardine landings dramatically declined, the public, State legislators, and leaders of the fishing industry clamored loudly for a full- scale investigation into the causes of the spectacular decrease in sardine numbers.

In response, Earl Warren, then governor of California, established the Marine Research Committee in 1947, composed of nine citizens, and a program was started called the California Cooperative Sardine Program, later to be known as the California Cooperative Oceanic Fisheries Investigation (CalCOFI), thus formalizing sardine work started earlier. A technical committee composed of scientists from the California Department of Fish and Game, the U.S. Bureau of Commercial Fisheries, the Scripps Institution of Oceanography, and the California Academy of Sciences was selected to map out a research program. Based on the early Sverdrup-Sette sardine investigation, the Committee stated that its goal was to *"...investigate the sardine in relation to its physical and chemical environment, its food supply, its predators and its competitors...to evaluate the findings in terms of the survival of the young and, in terms of the distribution and availability of the sardines when they reach commercial size."* This, as Ahlstrom and others have written, became known as the oceanographic approach to fisheries research and strongly influenced the conduct of federal fisheries research in La Jolla for many future years.

In 1950, Ahlstrom, then a senior fishery biologist with the federal laboratory at Stanford, was asked by Marr to set up a small laboratory in a converted barracks building (Longhurst described this as a "wooden hut") at the Scripps Field Annex at Pt. Loma in San Diego, California, to compile biological data taken in plankton hauls on CalCOFI coopera-

Dr. Elbert H. Ahlstrom

tive research cruises as they related to fishes and biomass. As the center of the sardine population and fishery gradually shifted southward, the federal government decided to close the laboratory at Stanford.



Investigation Chief's conference room. Seated left to right: Lillian Vlymen, Dr. Reuben Lasker, Jack Marr, Bob Counts, and Dr. Elbert H. Ahlstrom.

In 1954, at the invitation of Revelle, Director of Scripps, Marr moved his entire staff--fishery biologists, secretaries, clerks--into Building T-16 on the Scripps campus, directly across the street from the newly-built (1952) Thomas Wayland Vaughn Aquarium. This 2-story, gray and white frame house, thought to have been built in 1911, was used as the official residence of Scripps Directors. Its last occupants before the federal laboratory staff took over its large living room, four bedrooms, dining room, and even bathrooms for offices and laboratories were the world-famous ichthyologist Carl L. Hubbs and his wife, Laura. (In September, 1989, the Marine Biology building on the Scripps campus was renamed the Hubbs Building. )

Although the decline of the sardine population was the motivating force behind CalCOFI, the investigations were designed to have a broad ecological base. The oceanographic-biological surveys, carried out principally by SIO and BCF, used three research vessels to delimit the extent and time of sardine spawning and to determine the amount of spawning and the survival rate of larvae in relation to oceanographic features. In support of the program, BCF operated its 150-foot converted yacht, the *Black Douglas,* until 1965 when it was replaced by the present research vessel, the *David Starr Jordan.* Although both BCF and SIO collected samples and data at sea, Scripps chiefly processed and analyzed oceanographic observations and studied the taxonomy and zoogeography of planktonic organisms other than fishes. At the beginning of the CalCOFI surveys, a decision was made, principally by Ahlstrom, to identify and enumerate the eggs and larvae of all species of fish obtained in the plankton collections in order to evaluate the ecological associates of the sardine.

The egg and larva surveys provided a revealing insight into the potential fishery resources off California and Baja California. For example, based on larval fish (tediously sorted out of the plankton by fishery aids working under a microscope) counts, Ahlstrom found that the northern anchovy was the largest fish resource and hake was the next largest. There were also large resources of rockfish, jack mackerel, saury, etc. The surveys also provided information about "ecological species," i.e. species which were abundant in numbers and essential in the basic ecology as fodder fish but unlikely to be exploited commercially, such as myctophid lanternfishes, gonostomatids, and bathylagid smelts.

In 1964 came CalCOFI's first success. Based in part on information on the dramatic increase in abundance of northern anchovy larvae in the plankton samples, scientists from CF&G, Scripps, and the BCF proposed a controversial ecological experiment to assist the return of the Pacific sardine by imposing pressure on what was at the time thought to be its chief natural competitor, the northern anchovy. After much bitter debate, a 75,000-ton reduction fishery for anchovies was authorized by the California Fish and Game Commission on November 12, 1965. The season ended on April 30, 1966, with less than 25% of the quota filled, due primarily to delays in outfitting vessels with appropriate gear.

Subsequently, according to CF&G records, reduction landings were 37,600 short tons in 1966-67, and 6,500 short tons in 1967- 68. Although conservative estimates of the anchovy population ranged between 4 and 5 million tons (50% of which occurred off California), there was agreement that the landings did not reflect low abundance, but rather low processor demands because of declining world fishmeal prices. The initiation of the small reduction fishery highlighted the problems facing multiple users of ocean resources, particularly the bitter conflict of interest between sport fishermen who vividly recalled the catastrophic collapse of the sardine fishery and who vigorously fought the existence of any anchovy fishery for reduction and commercial fishermen who saw grave threats to their livelihood in increasing State fishing regulations.

In retrospect, the California Current Resources Laboratory must be credited with a number of outstanding accomplishments during its 30 years of existence, although this judgment is in part subjective. The effort here was always to achieve a balance between basic and applied research with the rationale that basic studies must precede or complement most aspects of applied research. This Laboratory pioneered in several important areas of ocean research, including the taxonomy of fish eggs and larvae, the use of systematic surveys of oceanic areas for evaluating fish resources, the use of blood genetics for establishing the existence of genetic stocks (subpopulations) within the Pacific sardine population, the rearing of pelagic fish larvae, the increase in understanding of the hydrodynamics of plankton sampling gear, and studies on the responses of larval and adult fishes to their environment.

Perhaps with the benefit of hindsight, the most important accomplishment of the Laboratory was the demonstration that systematic egg and larva surveys were one of the best means then available for evaluating fish resources. Ahlstrom who played a major role in developing the technology for stock assessment of marine fishes by means of systematic surveys of the fish eggs and larvae believed that a necessary precursor to resource evaluation was the ability to identify fish eggs and larvae in the plankton. As a result of his effort and those of his colleagues, Geoffrey Moser, David Kramer, Barbara Sumida-MacCall, Elizabeth Stevens, Elaine Acuna, and David Ambrose, 98 to 99 percent of the larvae collected in the California Current region can be identified to genus or species. This work undoubtedly advanced the techniques of larval fish taxonomy, an important area of research in ichthyology, and brought the laboratory attention from scientists and students throughout the world.

## Tuna Resources Laboratory

The history of the Tuna Resources Laboratory has its antecedents in the Pacific Coast tuna industry which came into existence in southern California at the turn of the present century. In its first years, albacore was the only species marketable as a canned commodity. However, as the American consumer became educated to consider tuna as a high quality, fish protein product, the market and the tuna fleet expanded to include tropical tunas (skipjack and yellowfin) as well. The tuna sandwich has now became as integral a staple of the American diet as apple pie.

As the number of tuna vessels increased, operated mainly by fishermen of Portuguese and Italian extraction, many of whom migrated to San Diego from various fisheries on the east coast of the United States, the range of the tuna fisheries expanded further south to Mexico, central and south America and the Galapagos Islands. In 1920, the catch of several tuna species was about 20 million pounds; by 1930, 100 million pounds; in 1940, it passed 200 million pounds, 390 million pounds in 1950, in 1970, nearly 2.5 billion pounds, in 1980, just under 4 billion pounds, and in 1987, slightly less than 5 billion pounds.

With the advent of World War II, many of the U.S. tuna boats were mobilized by the Navy and put into service as patrol and supply ships (designated as YPs or patrol-clipper types) in the South Pacific. When the war ended in 1945, the YPs were declared surplus and sold at low cost to Pacific Coast tuna fishermen. With new tuna clippers being built in West Coast yards, plus the converted YPs,

The Tuna Resources Laboratory was originally housed in an old Navy barracks building on top of Point Loma.

the West Coast tuna fleet expanded rapidly into a new Pacific fishing fleet (from 140 boats in 1947 to 212 boats in 1952).

Until 1949, the West Coast tuna fleet faced no significant challenges from imports provided by foreign fleets. In the early 1950's, however, Japanese exporters shifted from exports of tuna canned in oil (which carried a 45% duty) to exports of tuna in frozen form on which no duty was charged. The U.S. tuna industry thus found itself in an adverse competitive position because of its high cost of producing fish compared with that of foreign tuna fishermen.

In response to this challenge, Dr. Wilbert McLeod Chapman, a noted fishery scientist and biopolitician who became director of research and chief political strategist for the American Tunaboat Association, a group representing tuna boat owners, used his considerable influence to prevail upon the federal government to assist the U.S. tuna industry through the establishment of a laboratory to address specific problems of the tuna fishing industry. In his voluminous letters to influential individuals, Chapman often pointed out that Japanese fishing operators enjoyed elaborate research programs sponsored by the government in contrast to what he regarded as highly inadequate research support for the fisheries in the United States. The pressures exerted by Chapman and others, in and out of government, are generally credited with leading to the establishment, in 1959, of the Bureau of Commercial Fisheries Tuna Resources Laboratory in San Diego, California. This laboratory was designated as the Bureau's center for oceanographic and biological research on the tunas of the eastern Pacific Ocean and for studies of tuna fishing operations. The stated objective was to apply biological and oceanographic research findings to the improvement of tuna fishing efficiency and to provide service functions to the American tuna fleet. Bell Shimada, a fishery biologist, widely experienced in research on tunas, then working for the Inter-American Tropical Tuna Commission (IATTC) was slated to become the director of the new laboratory.

Tragically, Shimada was killed in an airplane crash on a Mexican mountainside in 1958 as he undertook his final mission for the IATTC before entering on duty with the federal government. In his place, Gerald V. Howard, Deputy Director of the IATTC, was selected and became the director of the tuna laboratory in March, 1959. Howard speedily recruited a staff of 10 biologists and oceanographers, a secretary and a clerk, who began work in the usual converted barracks building at Pt. Loma in San Diego. In contrast to the conservation interests of the state agencies and the IATTC, Howard perceived the mission of his group as obtaining and disseminating information which would contribute to the improvement of tuna fishing efficiently by helping to get the fishermen on the fish quickly and in catching the fish when the schools were located.

During the years from 1959 to 1967 (when the Tuna Resources Laboratory and the California Current Resources Laboratory were merged under Alan Longhurst), the staff frequently worked in collaboration with scientists of the Institute of Marine Resources and the Scripps Institution of Oceanography, the IATTC, and the CF&G. A part of the Laboratory's oceanographic research was done by scientists of the Institute of Marine Resources and Scripps under contract with the

BCF, known as the Scripps Tuna Oceanography Research (STOR) program.

With the help and advice of representatives of the tuna industry and tuna scientists, Howard started four principal lines of investigation: oceanographic research to obtain information about the environment of tunas, the study of tuna behavior in order to obtain basic scientific information which could be applied to the improvement of fishing techniques, studies of life history, ecology, and population dynamics of the temperate tuna (bluefin and albacore) species, and an operations research program to develop an optimum fishing strategy which would be based on the integrated experience of all segments of the tuna fishing fleets and the results of biological and oceanographic research.

With these objectives, the staff of the new Tuna Resources Laboratory began in 1960 to carry out such service functions as the preparation and distribution of monthly sea surface temperature charts of the eastern Pacific useful to tuna fishermen in locating concentrations of tuna at sea. The preparation of an annual albacore tuna forecast by the staff for the onset and termination of the west coast albacore tuna fishery was widely recognized by the fishing and canning industry as a useful aid. Based on historical records, oceanographers on the staff directed their efforts to analyses of physical, chemical, and biological data to detect features of the environment that might have value in predicting occurrence of tunas in time and space.

In other studies, behavior research undertaken by the Tuna Resources Laboratory staff centered on the phenomenon of fish schooling. The laboratory experiments used juveniles of fishes closely related to tunas because of the difficulties in obtaining and holding tunas in aquaria near San Diego. Also, in what was a portent of the future program on marine mammals, support was also provided for studies of the taxonomy, life history and aspects of the behavior of porpoises associated with tropical tunas. The operations research group undertook a summary of the integrated experience of tuna vessel operators as determined from vessel logbooks and summaries of the biological and oceanographic findings as they apply to fishing situations revealed in the logbooks.

Howard was also responsible for beginning work on the temperate tuna species, albacore and bluefin, with the aim of assembling life history and ecological knowledge of these species which in the 1950's and 1960's contributed substantially to the U.S. West Coast domestic landings. Interestingly, anticipating by some 17 years the economic studies undertaken by NMFS under the Magnuson Fishery Conservation and Management Act, Howard's group put together information gathered from various sources to estimate the cost of operating a tuna purse seine vessel under various catch and effort conditions and market prices.

Gerald V. Howard

**EASTROPAC**—Among the significant undertakings of the BCF Tuna Resources Laboratory must be counted the planning and mounting of a multi-agency, international series of expeditions which came to be known as EASTROPAC. The proposal for such a study originated in 1960 when the Eastern Pacific Oceanic Conference (EPOC) selected

a committee with Howard as the chairperson to look into the feasibility, desirability, and scope of cooperative oceanic surveys of the eastern tropical Pacific. Howard and other planners envisioned that these surveys would extend from the west coast of Mexico to the northern coast of Peru and west of the Galapagos Islands. The committee originally recommended an ambitious $20 million oceanography program to begin in 1963 and run for 8 years.

Several years went by with little progress made for a variety of reasons. Ultimately, an ad hoc group revised and trimmed the original EPOC program. They recommended physical, chemical, and biological oceanographic surveys, recognizing a compelling need to include fishery surveys so that the fishing industries would receive benefits from the descriptive oceanography. The BCF was designated as the lead agency in EASTROPAC and Dr. Warren Wooster, an oceanographer from Scripps, selected as the EASTROPAC coordinator in June, 1966. Wooster's initial efforts were devoted to lining up the support of various Federal and scientific institutions and Latin American countries to help provide ships and personnel. Wooster was succeeded as Coordinator by Alan Longhurst, then of SIO, in May, 1967. The field surveys began in February-March, 1967, and continued through April 1968.

In retrospect it seems there were almost as many motives for mounting this expedition as there were agencies. The interest of BCF and the U.S. tuna industry stemmed from the conviction that further sustained expansion of landings of yellowfin tuna were unlikely. There was an imperative need, therefore, to increase the harvest of underutilized species of tunas or face an increasing dependence upon foreign-caught fish. The available data indicated that the skipjack tuna population was not fully harvested and that there was at least the potential for exploiting the oceanic tuna stocks as an offshore extension of the normal, mainly coastal fishing grounds of the U.S. fleet. The principal deterrent to developing the skipjack resource was a lack of understanding of skipjack availability--large catches of skipjack could be made in a particular area during one period but would not be available in the next period. The variation in availability of fish was (and still is) believed to result from variations in oceanographic conditions.

An important goal of EASTROPAC then was to describe and to define the seasonal variations in ocean conditions and to use these findings to provide insight into the availability problem of skipjack tuna. The planners of EASTROPAC reasoned that if optimal conditions for high skipjack availability could be defined and the variations in these conditions monitored, the information could then be provided to the tuna industry to help in their greater utilization of the skipjack resource. It should be noted here that the tuna FAX program conducted by the Tuna Resources Laboratory was the follow-on to provide information to the U.S. fleet. The idea was to obtain ocean and weather information from the fleet and to use these data collected concurrently with fishing to better understand the effects of ocean variability on skipjack.

Physical and biological oceanographers wanted to undertake a program of systematic observations, with "adequate sampling in time and space and over a sufficient period of time to describe monthly and seasonal variations" in this grossly undersampled region. Other agencies which contributed ship time to EASTROPAC simply wanted to support worthwhile oceanographic objectives. A number of Central and South American countries participated because of the importance of such surveys to Central American fisheries and the opportunity to explore new areas of the ocean with U.S. oceanographers and their advanced methods and tools.

Based on the number of stations and number of observations, EASTROPAC was a major oceanographic effort, comparable with the International Indian Ocean Expeditions, the NORPAC, and the EQUALANT expeditions. The total cost of the expeditions was an estimated $5 million. In addition to being the lead agency, perhaps the biggest contributor in terms of numbers of scientists and technicians was the BCF and the individuals they supported under contract. In all, six vessels from the United States worked observational lines. Five vessels from Mexico, Peru, Ecuador, and Chile participated in the expedi-

tions. In addition, five U.S. vessels which passed through the survey area were considered to be ships of opportunity and worked oceanographic transects which were incorporated within the EASTROPAC data base. A total of 621,590 observational miles was covered with 186,400 separate oceanographic observations; almost 5,000 plankton samples were taken in seven major observational periods.

Twenty-one years after the end of the last EASTROPAC cruise, it may fairly be asked what was accomplished and what were the implications for oceanographic science and the fisheries resources. The preponderance of opinion of scientists involved in EASTROPAC is that this expedition provided the first understanding of seasonal variation of ocean conditions in the tropical Pacific. Until EASTROPAC there had been no comprehensive studies of seasonal changes throughout the year. The expeditions provided baseline data that have been important in planning later investigations including the World Ocean Circulation Experiment (WOCE) program to understand world climate, the El Niño studies of the 1980's, and the tuna/porpoise program now underway at the Center.

Certainly a notable accomplishment was the view of the region provided by the 11 volumes of the EASTROPAC Atlas, 1230 charts in all, which detailed the observations made on the cruises. Volume 10 of the EASTROPAC Atlas published in December, 1975, listed 69 major papers published that were based on analysis of EASTROPAC data and that contributed significantly to a better understanding of this part of the ocean. As Wooster later judged the importance of EASTROPAC, he saw it as a major step forward in the strategy of studying the ocean, partially because it was the first expedition built around the automatic salinity-temperature-depth recorder.

Although, as noted, the scientific benefits of EASTROPAC were indeed substantial, the results did not indicate that there was a large, unfished skipjack resource in the area covered by the cruises. The purse seine revolution in U.S. tuna fisheries was well underway at the time of EASTROPAC. U.S. tuna vessels, freed from a dependence on bait for pole and line fishing, were converting their boats to purse seining and extending their fishing operations further offshore, fishing on porpoise accompanying tuna. The landings of yellowfin tuna at one time thought to be overfished continued to rise and in 1988 exceeded 300,000 metric tons.

## Scripps Tuna Oceanography Research

The Scripps Tuna Oceanography Research group, usually referred to as STOR, a resident in the Center from 1964, was a component of the Institute of Marine Resources within the Scripps Institution of Oceanography, University of California, from 1957 to 1972. Headed by oceanographer Dr. Maurice Blackburn, the normal complement was about five principal investigators and 10 assistants. Most of its financial support was derived from the Bureau of Commercial Fisheries which also subsequently provided space in the new Center. In general, the work of the program staff consisted of an oceanographic investigation of the eastern tropical Pacific Ocean and adjacent waters, with special reference to properties, features and processes affecting the distribution and abundance of yellowfin and skipjack tuna. The studies of the STOR group were important since their investigations were among the first to relate oceanographic conditions to the distribution and abundance of an important pelagic fish, particularly for tropical waters. This group of marine scientists were leaders in carrying out the field work of the EASTROPAC expedition which relied heavily in both methods and concepts on experience gained during previous STOR cruises off Baja California and Peru.

Funding agencies lost interest in STOR activities after EASTROPAC probably because no new significant fishery was discovered. Many years later, director Maurice Blackburn explained the demise of STOR as simply, *"We couldn't give them skipjack."* STOR scientists slowly left the group and drifted off to new pursuits and in some cases to other institutions.

## Inter-American Tropical Tuna Commission

Resident in the Center since the doors opened in 1964 is the headquarters office of the Inter-American Tropical Tuna Commission. The Commission is an international fisheries research organization which operates under the authority and direction of a Convention originally negotiated between the United States of America and the Republic of Costa Rica which entered into force in 1950. It is open to adherence by other governments whose nationals participate in the fisheries for tropical tunas in the eastern Pacific Ocean. The member nations of the Commission now are France, Japan, Nicaragua, Panama, and the United States.

As stated in the Convention, the principal duties of the Tuna Commission are to study the biology of the tropical tunas, tuna baitfishes, and other kinds of fish (this has been interpreted to include dolphins) in the eastern Pacific Ocean and the effects of fishing and natural factors upon them. The Commission also recommends appropriate conservation measures when necessary, so that these stocks of fish can be maintained at levels which will afford the maximum sustained catches.

Dr. Wilbert M. Chapman, who had figured prominently in the creation of the Marine Research Committee in California, was also a prime mover in the creation of the Tuna Commission and, with Acting Secretary of State James E. Webb, a signer of the IATTC Convention. As Chapman saw it, formation of the Commission extended to new areas the "principles and practices" already established and found effective in the management regimes for the halibut and salmon fisheries in the Northwest. Chapman also intensively lobbied Congress to obtain sufficient funding for the Commission to *"undertake broadly-based ecological research on ocean fisheries and environment."* It was also Chapman who was instrumental in the selection of Dr. Milner B. Schaefer as the Commission's first Director of Investigations. In the view of his contemporaries, Schaefer was a brilliant scientist with impeccable scientific credentials who represented the ecological approach in the study of marine fisheries and environment. He is generally credited with designing and developing an innovative research program on the Central Pacific's tuna resources during his tenure as the Assistant Director of the Pacific Oceanic Fishery Investigations (POFI) (now the NMFS Honolulu Laboratory, part of the Southwest Fisheries Center) from 1947 to 1950. After Schaefer moved to the Tuna Commission in 1950 as Director of Investigations, he integrated and coordinated the work of the Commission with that carried out by POFI.

Schaefer was succeeded in 1963 by Dr. John L. Kask whose position prior to becoming Director of Investigations was as Chairman of the Fisheries Research Board of Canada. Kask resigned in 1969 and was in turn succeeded by Dr. James Joseph, who was the Principal Scientist for the Commission at the time of his selection. Joseph is widely known and highly regarded nationally and internationally as an expert on tunas and other migratory fishes. In addition to his principal responsibilities as IATTC Director, Joseph serves as technical advisor to many international organizations, government Ministries and heads of State on matters pertaining to marine sciences as well as marine resource development, management, and conservation.

The formation of the Tuna Commission occurred at an auspicious time for the resource. As pointed out by Harry Scheiber in "Chapman and the Pacific Fisheries", *"The tuna studies led by Schaefer offered to scientists an opportunity...to investigate ocean fisheries in their "normal" relationships to the environment instead of in moments of crisis (the sardine investigation, by contrast, dealt with a depletion crisis)."*

Throughout the 39-year history of the Commission, its staff has maintained close working relationships with various international organizations; the staff also works with national fisheries and fisheries-related organizations in both member nations and non-member

nations which exploit tunas and billfishes of the eastern Pacific Ocean.

The results of the Commission's research have been published, in both Spanish and English, in its scientific Bulletin series (through 1988, 126 Bulletins have been published). More than 300 other reports have also been given world-wide distribution through publication in a variety of periodicals.

## Marine Research Committee, Office of the Coordinator of the California Cooperative Oceanic Fisheries Investigations

The Office of the Coordinator of the California Cooperative Oceanic Fisheries Investigations (CalCOFI) was also one of the initial tenants in the Fishery-Oceanography Center, and its history and antecedents parallel that of the federal fisheries laboratory. The first Coordinator was Dr. Garth I. Murphy who served from 1959 to 1964. He was followed by Dr. Marston Sargent who served from 1965 until his resignation in 1968.

The history of the Marine Research Committee (MRC) and of CalCOFI began, as have so many other scientific enterprises, with the formidable Wilbert Chapman. During the years from 1946 to 1948, Chapman undertook a major research effort to study the California sardine fishery, then in decline. As Harry Scheiber wrote in "Chapman and the Pacific Fisheries, "*...although survival of this major fishing industry was manifestly in danger, the long- standing divisions and rivalries among different sectors of the industry (northern vs. southern California, packers vs. boat owners, capital vs. labor) forestalled any significant agreement as to how the crisis ought to be handled. A division of opinion among agency scientists, with California's state laboratory people calling for regulation and the federal scientists advising against excessive alarm or response, reinforced the confusion of the day.*"

Into this breach entered Chapman who enlisted the eminent Dr. Carl Hubbs at SIO and Monte Pfister, vice president of Van Camp Seafoods, to work with sardine industry leaders and a group of federal and state scientists in devising a plan for a cooperative sardine investigation. Supervising the actual research would be the Marine Research Committee (MRC) composed of nine members selected by the Governor of California--five from industry and the remaining four from the agencies doing the research.

In 1947, the MRC was established by the California Legislature. Its purpose is suggested in section 729 of the State Fish and Game Code, "...and financing research in the development of commercial fisheries of the Pacific Ocean and of marine products susceptible to being made available to the people of California." The MRC consistently acted in the belief that resource utilization cannot be effective without man's understanding of basic processes in the sea. Accordingly, it encouraged and sought financial support in the California Legislature for Scripps Institution of Oceanography to embark on a program of physical, chemical, and biological oceanography in the California Current system, which led to the creation of the Marine Life Research Program, closely involved with the federal research in this area.

The BCF California Current Resources Laboratory was also aided materially by grants of research funds from MRC to supplement federal funds. For example, during negotiations between the University of California and the Federal government, the MRC, speaking for the people of California, clearly indicated to the Regents that it was of the highest public interest to locate the laboratory on the San Diego campus so that close collaboration with University scientists could be maintained. Similarly, the MRC supported the Pelagic Fish Investigations of the California Department of Fish and Game and smaller research programs at the Hopkins Marine Station of Stanford University and the California Academy of Sciences.

Although close collaboration existed among the several laboratories from the inception of the Marine Research Committee, there

was an apparent need for even closer coordination which led to the formation of the California Cooperative Oceanic Fisheries Investigations Committee. The Committee was comprised of a Coordinator who reported to the MRC and one member from each of the three major agencies. The Committee met monthly, or as required, and served as a communications link and as a research policy and planning board.

In 1978, the California Legislature did not renew the mandate of the MRC and it was permitted to dissolve. Since both funding and administrative arrangements for CalCOFI had their legal basis in the MRC, it was necessary for the participating agencies to substitute a formal agreement for the old charter if the cooperative research were to continue. Accordingly, on July 21, 1979, Dr. Izadore Barrett, representing NMFS, Dr. William D. McElroy, Chancellor of the University of California, San Diego, and E. Charles Fullerton, then Director of the CF&G, signed an agreement to continue their cooperative scientific investigations--pooling staff, facilities and research vessels, in the California Current, an area of the Pacific encompassing a quarter of a million square miles. With this new era in the 40- year history of CalCOFI, the position of Coordinator was rotated biennially, without pay, among scientists from the cooperating agencies.

# ABOUT THE FISHERIES CENTER DIRECTORS, 1964-1989

During the past 25 years, five men have occupied the position of administrator and director of the Southwest Fisheries Center and the La Jolla Laboratory. In the beginning there were Elbert H. Ahlstrom and Gerald V. Howard who shared the job of administering the Center while each continued to run his own laboratory. Ahlstrom was the director of the California Current Resources Laboratory from 1959 to 1967 when he moved into the position of Senior Scientist, the highest scientific recognition given by the National Marine Fisheries Service. Howard, as noted earlier, was the first and only director of the Tuna Resources Laboratory, from 1959 to 1966, when he was selected as the Director of the BCF Southwest Region in Terminal Island, California.

In 1967, the two laboratories were merged into a single unit called the Fishery-Oceanography Center under Dr. Alan R. Longhurst, a British-born marine ecologist, now a Research Scientist with the Marine Ecology Laboratory of the Bedford Institute of Oceanography in Dartmouth, Nova Scotia, Canada. Longhurst resigned to accept a high fisheries post in England in 1971 and was succeeded as Director by Dr. Brian J. Rothschild in July, 1972. Rothschild, an authority on fisheries and fisheries management, remained as director until 1976. Izadore Barrett served as the Acting Director until 1977 when he was selected as the Center Director. Rothschild is presently a professor at the University of Maryland's Center for Environmental Estuarine Studies, Chesapeake Biological Laboratory, Solomons, Maryland.

## Elbert Halvor Ahlstrom, 1964-1967

Ahlstrom, whose scientific achievements were recognized by Gold Medals from both the U.S. Departments of Interior and Commerce, was born in Sharon, Pennsylvania in 1910. He graduated from Marietta College, Marietta, Ohio, with an A.B. degree in 1930, an almost perfect scholastic record, and election to Phi Beta Kappa. He earned his M.A. degree in 1933 and his Ph.D. in Zoology in 1934 from Ohio State University, Columbus, Ohio. He spent five summers at Ohio State's Laboratory at Put-in-Bay, Ohio, working on freshwater plankton and produced a number of papers on the subject of rotifers (microscopic aquatic invertebrates), which have become standard references.

Ahlstrom, recognized world-wide for his contributions to larval fish biology, spent most of his life in government service. In 1939 he joined the U.S. Department of the Interior's Fish and Wildlife Service as a junior biological aid at $1,440 per year. He was sub-

# Southwest Fisheries Center construction & dedication

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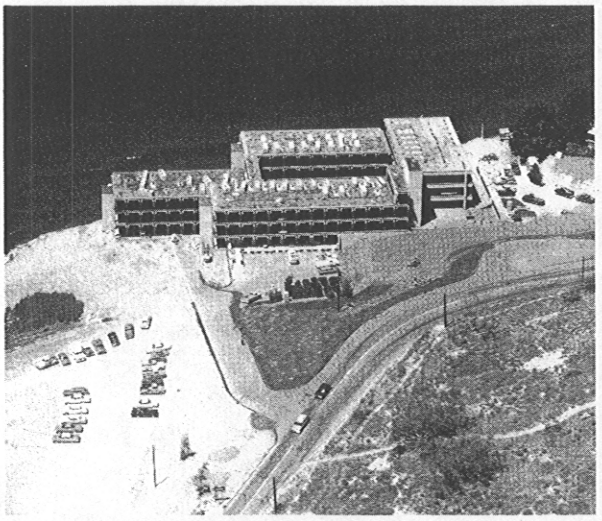

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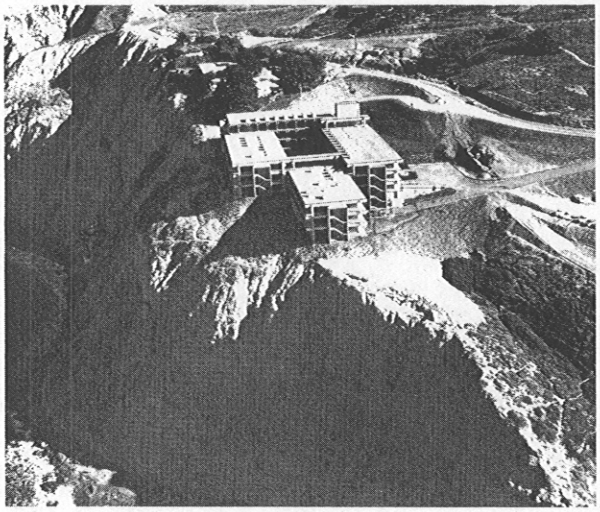

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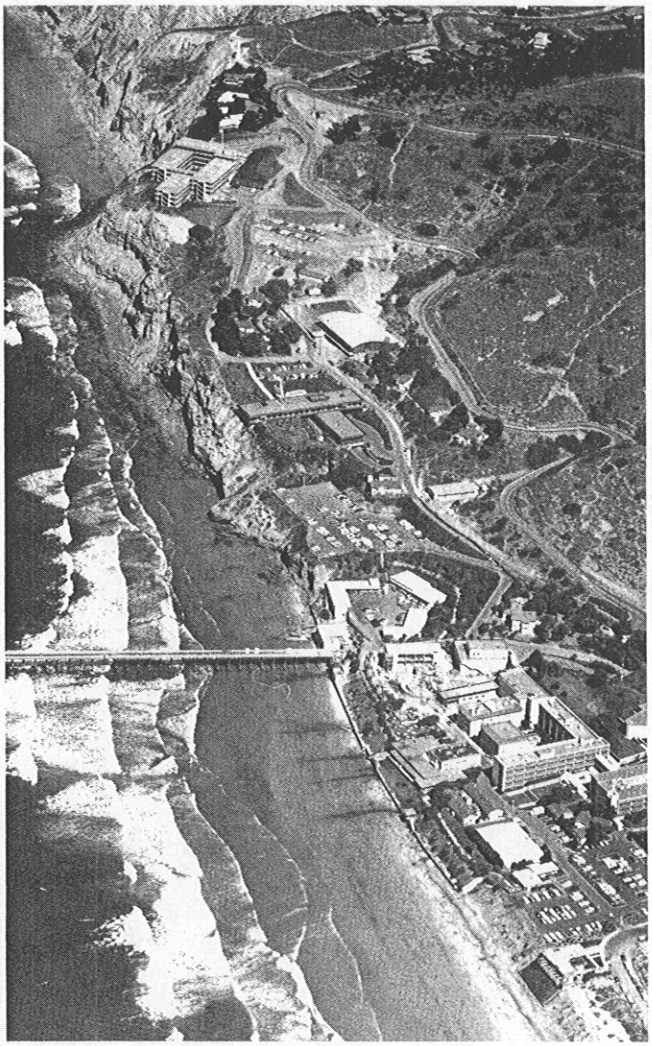

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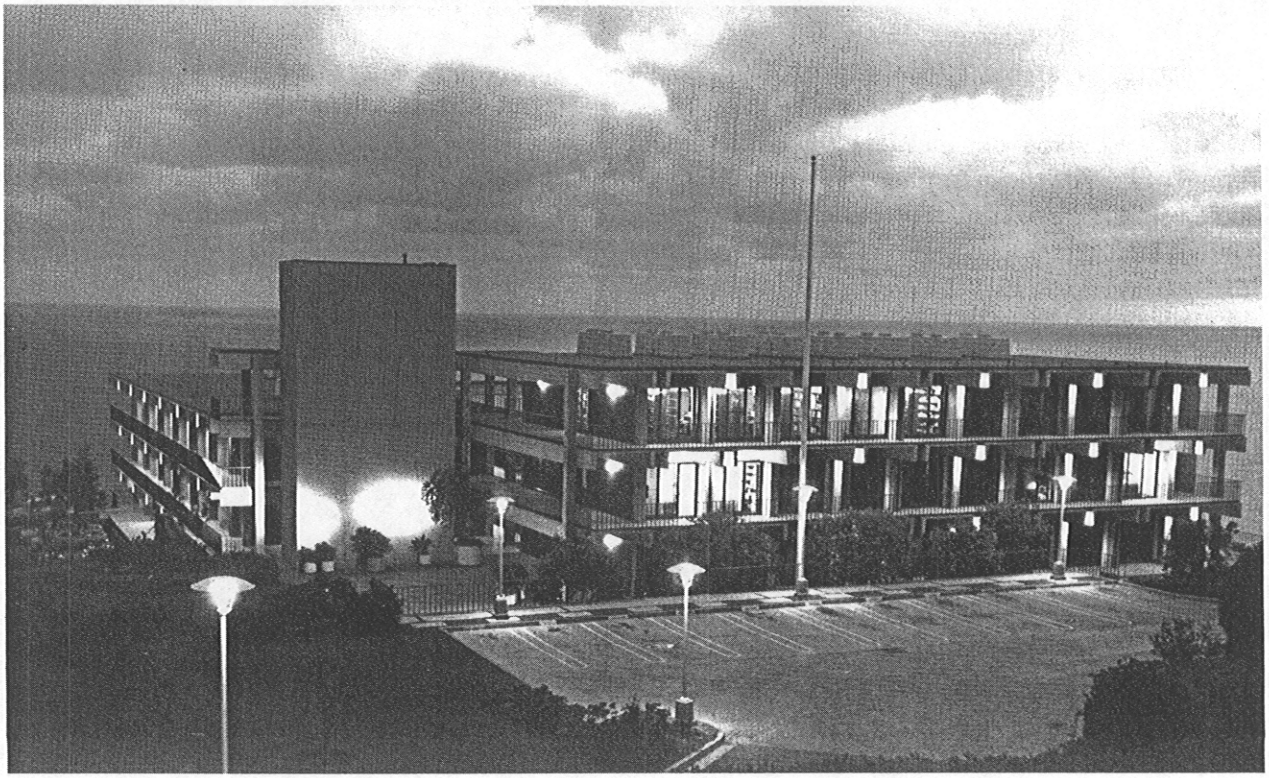

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sequently given continuing progressive responsibilities in carrying out major programs, and in 1959 became director of the biological laboratory at La Jolla, succeeding John C. Marr.

Ahlstrom was the major contributor in the development of an entire scientific technology, described as assessment of oceanic fish stocks by means of systematic surveys of fish eggs and larvae. The results of Ahlstrom's studies not only provided the major understanding of resources in the California Current ecosystem but also constituted a highly significant and fundamental innovation in the appraisal and understanding of the potential fisheries of the world's oceans. His research placed on a rational basis plans for the development of the fisheries of the California Current region by providing a measure of the size and location of the stocks of exploitable fish and also with an efficient and relatively inexpensive method for monitoring them.

In 1965, Ahlstrom received the highest award of the U.S. Department of the Interior, its Distinguished Service Award, in recognition of more than 25 years of outstanding service in fisheries research and oceanography; in 1973, he was the recipient of the U.S. Department of Commerce Gold Medal, for contributions of major significance to the Department and the Nation. His standing in the scientific community was recognized with an appointment as Adjunct Professor of Oceanography at the University of California's Scripps Institution of Oceanography. In 1975, Ahlstrom received the Outstanding Achievement Award of the American Institute of Fishery Research Biologists for his contributions to fisheries science. The last scientific work completed by Ahlstrom before his death in August, 1979, following a heart attack, was the meticulous editing of papers presented to the sessions on Systematics and Development in the Symposium on the Early Life History of Fish.

## Gerald Vincent Howard, 1964-1966

Howard, who was with Ahlstrom the first co-administrator of the Center, was born in Nottingham, England in 1918. He lived in England from 1918 to 1927 and in Canada from 1927 to 1948 before moving to Washington,D.C. as a fishery biologist with the United Nation's Food and Agriculture Organization. From 1951 to 1959, he served as a senior scientist with the Inter-American Tropical Tuna Commission.

In 1942, following his graduation with a master of arts degree from the University of British Columbia, Howard began his career as a fisheries scientist counting salmon in Canadian rivers for the International Pacific Salmon Fisheries Commission. In 1959, the BCF asked Howard to organize and direct a new laboratory, the Tuna Resources Laboratory, which would be its center for oceanographic and biological research on the tunas of the eastern Pacific Ocean.

An able scientific manager with an intimate knowledge of and background in the U.S. tuna industry, Howard recruited a first- rate research team of scientists. As director of the Tuna Resources Laboratory, Howard should be credited with many pioneering research initiatives. He was one of the first to recognize the need for oceanographic research to better understand the distribution of tuna species in relation to their environment and eventually to predict variations in availability and abundance. With his support and encouragement, the groundwork was laid for the present close cooperation on albacore research between NMFS scientists and the industry-funded American Fishermen's Research Foundation, acknowledged by fishermen and fishery scientists to be one of the most outstanding examples of joint government-industry research in the country.

In 1966, Howard was selected as the Director of the BCF Southwest Region in Terminal Island, assuming the position at a time of crisis both for the wetfish fisheries of California and for the U.S. tuna industry.

As one important event crowded upon another, the NMFS Southwest Region, with Howard at the helm, remained a highly visible focus of public attention. The move of NMFS into NOAA in 1970, the passage of the Marine

Mammal Protection Act of 1972, the Magnuson Fishery Conservation and Management Act (MFCMA) of 1976, and the realignment and redirection of the SW Region in line with the NMFS reorganization with the new requirements of the MFCMA, the complex and highly emotional tuna/porpoise issue, all required the exercise of Howard's personal skills to counsel and mediate among conflicting points of view.

In 1980, Howard resigned as Regional Director of the NMFS Southwest Region, a position he held for almost 14 years, because of ill health. In December, 1981 he died in San Diego of cancer.

## Alan Reece Longhurst, 1967-1971

Longhurst was the first director of the integrated Center, assuming the position in 1967. Under Longhurst the programs and projects of the California Current Resources and Tuna Resources Laboratories were merged into a single unit known as the Fishery-Oceanography Center.

Longhurst who was born in 1925 in England, came to the position of Director with an impressive academic background which included a Special B.Sc. in Zoology, with First Class Honours from Chelsea College, University of London, a Ph.D. from Bedford College, University of London, and a D.Sc., University of London, which was based on his numerous publications and contributions to the evolution of marine systems and the delineation of vertically stratified marine communities.

It was Longhurst's wide and varied background in fishery science and his experiences in Africa as a fishery scientist and administrator which brought him to the favorable attention of fishery administrators in the U.S. Longhurst, as noted earlier in this account, was the director of the EASTROPAC expedition from 1967-1970, an oceanographic investigation of the eastern tropical Pacific involving the research efforts of eight countries.

One major aspect of Longhurst's distinguished career is that he clearly recognized the need for detailed studies of the marine ecosystem and pursued this idea with great single-mindedness of purpose throughout his professional life. These scientific contributions are perhaps even more striking when it is recognized that Longhurst was at the same time involved also in the direction and management of major laboratories in the U.S., England, Canada, and abroad. In 1977, Longhurst became Director of the Marine Ecology Laboratory and in 1979 the Regional Director-General, Ocean Science and Surveys, Atlantic, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada. In 1987, Longhurst became a Research Scientist of the Biological Oceanography Division at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, the position he holds today.

## Brian James Rothschild, 1972-1976

Rothschild assumed his duties as Director of the SWFC in July, 1972, succeeding Longhurst. A native of Newark, New Jersey, Rothschild earned his B.S. at Rutgers University, his M.S. at the University of Maine and his Ph.D. and post-doctoral degrees at Cornell University.

He began his fisheries career as Chief of the Skipjack-Yellowfin Tuna Ecology Program at the Honolulu Biological Laboratory at Honolulu, Hawaii. From 1968-1971, Rothschild was a professor at the University of Washington's College of Fisheries, Fisheries Research Institute and Center for Quantitative Sciences in Forestry, Fisheries and Wildlife. He returned to NMFS in September, 1971 as the Deputy Center Director of the Northwest Fisheries Center, leaving that post to become Center Director in La Jolla in 1972.

In January, 1976 Rothschild became Acting Director of the Extended Jurisdiction

Planning Staff, NMFS, Washington, D.C., moved on in October, 1976 to the position of Director, Office of Policy Development and Long Range Planning and in January, 1978 became Senior Policy Advisor and Senior Scientist, Office of the Administrator, NOAA. In July, 1980, he moved to his present position as a Professor at the University of Maryland, Center for Environmental and Estuarine Studies, Chesapeake Biological Laboratory in Solomons, Maryland.

Author or co-editor of five books and 70 papers on fisheries and fisheries management, Rothschild received the First Annual Nautilus Award from the Marine Technological Society in 1980 for his contributions to the understanding of living marine resources.

### Izadore Barrett, 1977-present

Barrett, who became the director of the SWFC in 1977, has occupied this position for a longer period than any previous incumbent, although his association with the Center dates back to 1970, when he was selected as the Deputy Center Director by Longhurst.

Barrett was born in Vancouver, British Columbia, Canada in 1926. He received his B.A. degree in Zoology from the University of British Columbia in 1947, also his M.A. in Zoology and Marine Fisheries in 1949. He did his post-graduate work in experimental biology at the University of Toronto in 1949-1951. In 1980, Barrett received his Ph.D. from the University of Washington in Public Administration of Fisheries.

In 1948 Barrett began his work in fisheries as the head of a summer field survey party in British Columbia. He subsequently took on increasing responsibilities managing the trout hatchery system in British Columbia in the early 1950's, running the Inter-American Tropical Tuna Commission's (IATTC) field research station and vessels in Panama in the late 1950's, and progressing to Senior Scientist with the IATTC at its headquarters office in La Jolla, California. In the late 1960's Barrett served as Chief Fisheries Biologist with the UNDP/FAO Chilean Fisheries Development Project and it was in Chile that Longhurst met Barrett and asked him to apply for the position of Assistant Center Director.

The history which follows has been divided into years corresponding to the regime of each director of the integrated Center.

## THE LONGHURST YEARS, 1967-1971

*"Emphasis on a single discipline of fisheries science rather than to a geographical region or to a group of species"*

Some months after Longhurst took over as Director he issued a document in which he announced that the laboratories known previously as the California Current Resources and Tuna Resources Laboratory were now merged and that the former titles were no longer current. He stated further that the Center was concerned geographically with the fisheries resources of the California region and of those parts of the high seas actually or potentially fished by vessels based in California ports; for historical reasons, these areas effectively comprised the California Current region and the eastern tropical Pacific from Mexico to Peru, westward toward the Hawaiian Area of the Bureau Commercial Fisheries. Within this geographical area, said Longhurst, the Center would be concerned primarily with mission- oriented studies of the fisheries resources and in the fisheries for them.

Reminiscing about his early days as the Center Director, Longhurst recently wrote:

*It didn't take me long to understand that the Center lacked the usual mandate for (a) fisheries laboratory; we had no direct responsibility for any fishery, or even for providing quota advice to a management structure. The California coastal fisheries were under the jurisdiction of the State Fish and Game Department, while tropical tuna quota-setting was the responsibility of scientists of the*

*Inter-American Tropical Tuna Commission. So we could continue to use our resources on basic fishery science, particularly in continuing the CalCOFI investigations.*

*I can recall no pressure not to go on with basic research into the causes of fluctuations of California Current sardine and anchovies, or on operational predictive techniques in the tuna fisheries. Both of these were sufficiently difficult and innovative (and being done sufficiently well) that I quickly realized that the new Center was going to attract attention internationally and could become a respectable member of the Scripps' family of laboratories. It goes without saying that it didn't take long to realize that the physical plant matched the research opportunities in an exceptional way. The two outstanding seawater halls (devoid of any "pretty tanks"!) simply invited the kind of experimental work that subsequently went on there, and the new David Starr Jordan was a splendid research vessel capable of going anywhere in the eastern Pacific and doing anything we could possibly need. Significantly, the BCF scientists had been well consulted about the design of both ship and laboratories.*

*I recall that we held a series of lengthy "councils-of- war" to decide on our priorities for the next few years in two main areas of research. The outcome of several days spent discussing what to do next in larval fish research was quite clear: the key to progress would be an ability to handle larvae at will and in large numbers under controlled experimental conditions. This meant that the successful, but uncontrolled 'green water' techniques developed by George Schumann for tens of species of fish larvae had to be replaced by controlled experimental conditions for a limited number of species. We stated (as formally as we did anything in those days) that our first objective should be to spawn anchovy at will, and in any month, in the laboratory so that experimental work on their energetics could be reliably planned both ashore, and with supplies of larvae taken out to sea. Roderick Leong undertook the spawning task, and Schumann departed for aquaculture work with a San Diego utility company. I like to think that our decision was the key step that made possible the important body of research on the energetics of anchovy larvae that was produced from La Jolla over the next 10-15 years, and led eventually to the formulation of 'Lasker's hypothesis' and to the drafting of the International Oceanographic Commission (IOC) Sardine/Anchovy Recruitment Programme.*

Alan Reece Longhurst

In September, 1968, one year after taking charge, Longhurst reported with satisfaction that the Fishery-Oceanography Center which he had organized into four unified programs (Fishery- Oceanography, Behavior and Physiology, Population Dynamics and Operations Research) was a fully operational fishery laboratory. Under Longhurst, the already close links with the various agencies of the University of California, particularly the Scripps Institution of Oceanography, were reinforced with daily contacts with colleagues at seminars and informally in each other's laboratories, greatly influencing the direction of research undertaken at the new Center.

It was during the early Longhurst years that the research program expanded to include new programs and projects. Increasingly, the introduction of new tools--hydroacoustic surveys, computer simulation and modeling, systems analysis, satellite surveillance--were applied to help solve many of the traditional problems of fishery biology. For example, the use of sonar to map the size of fish schools in the horizontal plane was developed during the years from 1968 to 1970. Some of the highlights of these two years were as follows:

Among the important lines of research which came to fruition during the first two years of the Center's existence was the work on subpopulations of the northern anchovy. Results achieved by fishery biologist Andrew Vrooman showed that at least three genetically distinct subpopulations of northern anchovy exist off the coast of California and Baja California.

The seawater system in the experimental aquarium was put into operation and found to be a valuable tool for sea-going laboratory investigations. Development of the techniques for rearing pelagic marine fish from eggs in the laboratory permitted Dr. John Hunter to begin behavioral studies of larval anchovies and other pelagic species. It was also during this time that Dr. George Schumann's investigation of the methodology of rearing the larvae of pelagic fish in the experimental aquarium at the Center culminated in an effective, if empirical, rearing technique. An important advance in 1970 was Roderick Leong's first successful spawning of the northern anchovy under artificial conditions, freeing scientists from the necessity to go to sea at frequent intervals to collect material and providing henceforth an assured supply of anchovy eggs and larvae for physiological and other laboratory studies.

The long-term study of the energy budget of the Pacific sardine reached the stage at which a first synthesis could be made. Dr. Reuben Lasker found that respiration was the dominant energy-consuming process throughout the sardine's life, requiring 82 to 99 percent of the assimilated calories; reproduction accounted for only about 1.0 percent of this energy. Dr. Charles O'Connell brought his studies of the mechanism of feeding in the northern anchovy to completion during 1968.

One of the earliest efforts to deal coherently with the monumental CalCOFI data base was the work of mathematician J.R. Zweifel who processed the zooplankton biomass data from the CalCOFI surveys for the years 1951-60 for computer analysis. These data were later summarized by fishery biologists David Kramer and Paul Smith, and subsequently embodied in CalCOFI Atlases by Ahlstrom and Dr. Geoffrey Moser, for use as an environmental feature, in the same way as temperature and salinity, with which to associate spawning and larval survival of commercially important fish.

A new data telecommunications center was established to process weather and oceanographic information from fishing and research vessels and to feed these (as Longhurst put it, *"cunningly coded"*) to the Navy computers at Monterey. The merits of this system were later recognized by the Marine Technology Society which presented a special commendation to Captain Paul N. Wolff of Monterey and to Dr. Glenn Flittner, in recognition of their joint success in its development and operation.

Longhurst also made a decision to consolidate projects which had the objective of understanding and developing the operational aspects of fisheries of the Southwest Region. One of the group's important accomplishments was an analysis of the cost and earnings of the fleet of tuna boats based in California ports. Subsequently, Operations Research Analyst Roger E. Green undertook a second economic study to investigate the economic base of the California industrial fishery which was in a very depressed situation.

The cooperative cruises with the Soviets which continued into the 1980's began under Longhurst. In 1969, the Soviets detailed their 275-foot research vessel, *Professor Deryugin*,to work in the CalCOFI area in a study of the distribution of hake spawning stocks off central and southern California and Baja California.

It was in February, 1970 that Longhurst made what later proved to be a fateful decision when he started a program of research to develop methods for reducing the mortality of porpoise involved in the tropical tuna purse seine fishery. As he later wrote:

> *Perhaps the most sensitive issue I had to deal with in the scientific programme was Bill Perrin's exposure of porpoise mortality in the tuna fishery. He asked my advice about publishing an account of the techniques of 'setting' on porpoise schools and I remember telling him to go ahead. I think neither Bill nor I expected anything like the full consequences to flow from his paper--the Marine Mammal Act, the observer programme, the new seine-net technology, and perhaps even the departure of U.S. flag vessels to foreign registration. I can't think of any scientific paper in the marine sciences that had greater political and economic consequences. It was a whistle-blower that I'm glad I didn't have the good sense to veto.*

In the early 1970's, there was clear evidence that the pelagic ecosystem had been seriously contaminated by pesticides as shown by the disastrous die-off of fish-eating sea birds in California and the difficulties in marketing DDT-contaminated commercial species of fish in the California region. In response, Longhurst (who had a keen personal interest in birds as well as the marine ecosystem) started a program to track the routes and transfer of DDT and other pesticides into the offshore ocean pelagic ecosystem and to monitor the effect of the observed contamination upon the pelagic fish resources off California.

Plankton samples have been routinely and systematically collected by CalCOFI at stations in the California Current since the early 1950's. It occurred to fishery biologist John MacGregor that it might be possible to use this unique plankton bank to trace the historical origin of DDT contamination of the ecosystem. Two target species, both small myctophid fishes, were chosen and sorted from selected samples taken from all the major sections of the California Current and extending back 20 years in time. These samples, together with special samples taken over the current year with plankton nets over the same grid of stations, were subjected to analyses in order to trace the routes of transfer of hydrocarbon pesticides. Results demonstrated that this approach was completely feasible and provided an excellent record of progressive DDT contamination over time of the offshore ocean pelagic ecosystem.

Under Longhurst the work on tuna centered on research to investigate and develop techniques on which tuna fishery predictions could be based and on tuna fishery advisory sources. The cooperative program between the American Fishermen's Research Foundation and the Center began during Longhurst's tenure, initiated by Drs. Michael Laurs and Izadore Barrett, then the Deputy Director of the Center. This program provided scouting for industry and also yielded a substantial amount of environmental data useful for albacore fishery-forecasting studies.

While all this was going on, Congress was beginning deliberations on the creation of a new agency, the National Oceanic and Atmospheric Administration, destined forever to change the way fisheries research would be conducted at the national level. As Longhurst put it, *"The most visible change was the carve-up of the U.S. Fish and Wildlife Service, so that the Bureau of Commercial Fisheries could be incorporated within NOAA."*

On October 3, 1970, President Richard M. Nixon signed Executive Order No. 11564 to consolidate various ocean and atmospheric-oriented activities into a new agency, NOAA, in the U.S. Department of Commerce. The Bureau of Commercial Fisheries was among the agencies affected. Most of its functions, together with some new ones, were transferred to NOAA and it was renamed, the National Marine Fisheries Service (NMFS).

Longhurst became involved in the reorganization of NMFS and made frequent trips to Washington to assist in the change-over. *"When it was all over, I was somewhat stunned,"* Longhurst wrote, *"to find that Tiburon, as well as the Honolulu Laboratory, had been added to my responsibilities."* He was not, however, in agreement with many of

the changes and for personal as well as professional reasons Longhurst and his family made a decision to return to England. He resigned as Director of the Fishery-Oceanography Center in 1971 to accept a position as the Deputy Director of the Institute for Marine Environmental Research in Plymouth, England. Izadore Barrett, who had served as Longhurst's Deputy Director since 1970, was the Acting Center Director until July 5, 1972 when Dr. Brian J. Rothschild became the Center Director.

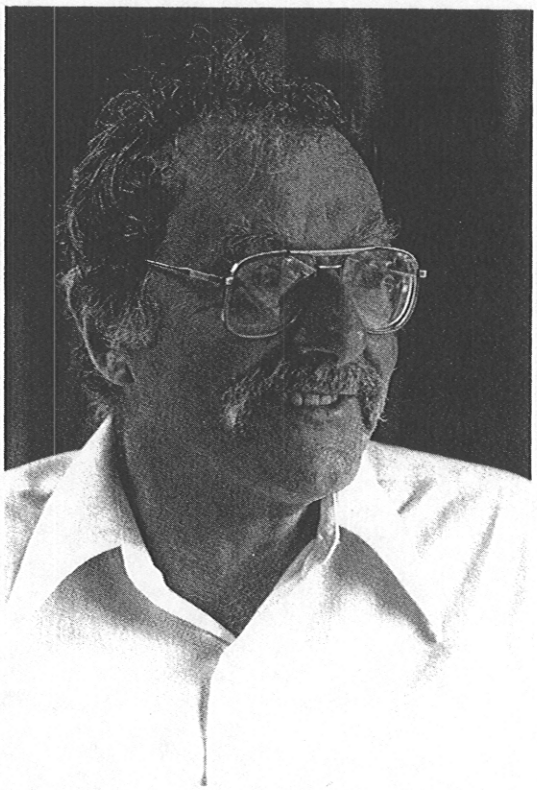
## THE ROTHSCHILD YEARS, 1972-1976

### *From fish to fisheries management*

The arrival of Brian J. Rothschild as the Director of the Southwest Fisheries Center in July, 1972 coincided with several important events in the history of NMFS and of the Center, which significantly shaped and influenced the course of its future history. Of major importance were the changes resulting from the formation of NOAA, the passage of the Marine Mammal Protection Act of 1972, and not least, a sizable reduction in the research budget that accompanied cuts in federal spending.

In his message to Congress transmitting the details of the plan which created NOAA, President Nixon stated:

> *We face a compelling need for exploration and development leading to the intelligent use of our marine resources. The global oceans, which constitute nearly three-fourths of the surface of our planet, are today the least-understood, the least-developed, and the least protected parts of our earth. Food from the oceans will increasingly be a key element in the world's fight against hunger. We must understand the nature of these resources, and assure their development without either contaminating the marine environment or upsetting its balance. Establishment of NOAA...would enable us to approach these tasks in a coordinated way...by employing a unified approach to the problems of the oceans and atmosphere.*



Brian James Rothschild

The passage of the Marine Mammal Protection Act (MMPA) of 1972, which mandated that the porpoise kill be *"reduced to insignificant levels approaching zero"* galvanized the existing program at the Center, presenting the staff with major opportunities and challenges. The story of marine mammal research at the Center which actually began in 1969, fully three years before passage of the MMPA, is an outstanding example of courage, initiative and timely response by a federal agency to public awareness and concern regarding the so-called "tuna- porpoise problem", and is worthy of the highest commendation.

In response to these momentous events, Rothschild wrote some months after taking over as Center Director: *"Changes are needed to meet new national fisheries management and research goals of the NMFS, to move into new fisheries studies, and to consolidate some ongoing ones at the Center. They are also in response to serious funding cuts at the Center."*

Reflecting on his tenure as Director, Rothschild wrote in 1989, *"It was necessary to build coherence and direction...we tried to put together a management setting where each major problem was addressed by a "critical mass" of people; where there were maximal communications; and where the scientific focus was "above" and outside the "walls" of the Center. We made hard quantitative analysis and publication into a work ethic."* As he viewed the overall program, each investigation was multidisciplinary, *"designed to solve fisheries problems of national or international nature."* The principal studies of these groups included the tunas of the Atlantic and Pacific, whales, porpoises, and the fisheries of the California Current and the Pacific Islands.

In essence what Rothschild attempted to do was nothing less than a 'sea change' in the overall program. The emphasis which in the Longhurst years had been on the various disciplines of fisheries science changed to fisheries management science under Rothchild. In his turn, Barrett extended and amplified the Rothchild approach, ultimately introducing formal planning procedures as a "feedback" mechanism.

Based on his own strong interest and background in tuna research and quantitative studies, one of Rothschild's first actions as Director was to develop a proposal, "Global Tuna Studies--A National Program" which he first presented to members of the U.S. delegation attending the Inter-Governmental Tuna Meetings in Panama in November, 1972. In introducing this document he explained that the program was an attempt to integrate U.S. government tuna research involving the scientific and economic studies of the commercial/sport fisheries and to accelerate the application of advanced technology in computer processing of data of stock assessment and innovative quantitative methodology in general and of fisheries management science to tuna management.

Although for a variety of reasons--budgetary, political, philosophical and economic--this ambitious and integrated tuna program was not fully implemented, it influenced the ways in which the Center approached tuna research. The staff continued to provide information and analyses to develop tuna fishery management systems and technical advice to support U.S. delegates at international tuna fishery management commissions. Under Rothschild, the Center became responsible for U.S. tuna research in all oceans. Rothschild himself symbolized this international focus when he was selected as Chairman of the Science Committee of Research and Statistics at the International Commission for the Conservation of Atlantic Tunas, the first American to hold this post.

The staff also continued their involvement in environmental and biological studies leading to the development of operational fishery systems for tunas, including laboratory and field studies to investigate variation in year-class strength in temperate tunas, variation in location and timing of migration patterns, and the quantitative nature of long-term environmental and biological cycles in the ocean which affected availability of the fish to the fishery.

Although in time Rothschild personally came to view the tuna/porpoise problem as a "no-win situation," he channeled a great deal of effort and research funds into gear dynamics and development since these appeared to offer the greatest promise of speedy and practical short-range reduction of mortality. As he wrote later, *"...we had to put together a really massive scientific program in an environment of new environmental awareness."* The immediate objective was to provide realistic solutions which would be applicable for use by foreign fishing fleets as well as those of the United States.

The research on the fisheries of the California Current continued to have high visibility in the Rothschild years with the continuation of the CalCOFI surveys, participation in the national marine resources monitoring, assessment and prediction program (MARMAP), improvements and advances in sampling methodologies, including sonar and hydroacoustics, innovative approaches in stock recruitment investigations such as Lasker's technique to use larval anchovies as a shipboard bioassay to determine environmental conditions which favor food

availability, and research into the basic causes of larval fish mortality. Considerable efforts also went into the development of the massive 25-year CalCOFI data base to achieve computer analysis capability.

In 1975, the beginnings of what would become the Fishery Conservation and Management Act (FCMA) were taking shape. Congress and the American public were becoming aware that U.S. coastal fisheries resources were being subjected to competitive harvesting by 14,000 U.S. vessels and more than 1,000 foreign ships. This fishing effort had depleted many valuable stocks of fish to a point where their future and that of the fisheries depending on them were in jeopardy. International mechanisms were only partially successful in protecting fish stocks. In 1975, the United Nations Law of the Sea Conference met in Geneva in a continuing effort to solve worldwide problems involving access to, and allocations of, marine resources.

While these international deliberations were underway, Congress was examining the need for extended fisheries jurisdiction. The House voted in favor of a bill to extend the Nation's fisheries jurisdiction to 200 nautical miles and to provide for management of marine fishery resources. The Senate was drafting similar legislation. It appeared likely that passage of legislation leading to the extension of U.S. fishery jurisdiction and fishery management would occur in early 1976.

Anticipating a management scheme for U.S. fisheries resources, Rothschild farsightedly proposed yet another reorganization of the La Jolla programs of the Southwest Fisheries Center. This reorganization would provide, he wrote, for a logical grouping of related and interacting programs within each of the proposed Divisions. The proposed Oceanic Fisheries Resources Division, under Dr. William Fox, would incorporate all activities dealing with the problems that related to the world-wide distribution of pelagic fishes, notably tuna, the interaction of tuna and porpoise, and the research directed toward porpoise mortality reduction. The proposed Coastal Fisheries Resources Division, under Dr. Reuben Lasker, would include the La Jolla programs that deal with California coastal fisheries, both commercial and recreational, and the programs dealing with MARMAP activities, including stock/recruitment and larval fish studies. The reorganization[1] within the Southwest Fisheries Center was approved by NMFS in Washington on July 18, 1975 and remained in effect in substantially this form until the relatively recent past.

Under this new arrangement, the federal commitment to CalCOFI-coordinated research continued as a central element in the La Jolla Laboratory's program with the work carried out in the Coastal Fisheries Resources Division, headed by Lasker. The mission of the reorganized Division was to perform the research and analyses required for management of the coastal recreational and commercial fisheries of the California Current with particular attention to the anchovy, the Pacific and jack mackerel, Pacific sardine, barracuda, and white seabass. The studies undertaken were balanced between laboratory and field work to help determine the basic causes of larval fish mortality This information, developed for the northern anchovy, as well as earlier work on the physiology of fishes by Lasker, Dr. John Hunter, Dr. Charles O'-Connell, Gail Theilacker, and many others, was incorporated into computer models for increasing the understanding of the process of recruitment to fisheries. In turn, the results of recruitment studies were incorporated into the stock assessments of the coastal recreational-commercial fishery resources undertaken in cooperation with the State of California.

In addition to stock assessment, the requirements for research and management information with respect to these fisheries resources were explored with the State of California and with Mexico who jointly shared them. The stock assessment efforts were based on a

[1]Since the principal objective of this account is to document the first 25 years of the Southwest Fisheries Center building and Laboratory in La Jolla, California, the activities and contributions of the other Center laboratories cannot, for reasons of space, be recounted in detail but referred to only peripherally as they contribute to the central history. The major contributions and accomplishments of the Center laboratories in Honolulu, Tiburon, and Monterey, California must therefore necessarily await another telling.

broad range of techniques open to fishery scientists and included ship surveys involving collection of fish eggs and larvae, acoustic assessment techniques, catch and effort analysis, and the analysis of existing fishery and biological data.

Basic to the objectives of the Coastal Division was the continued assessment of stock levels and the estimation and prediction of recruitment of fish into the fishery. Historically, these have involved egg and larva surveys which are one of the basic tools in fishery science for evaluating the kinds and amounts of fish resources. Since the beginning of CalCOFI, a group of researchers, first headed by Ahlstrom and later led by Moser, at the La Jolla Laboratory, has been devoted to increasing the efficiency of such surveys by increasing the number of larval marine fish that can be positively identified and by training persons in their identification and description.

Continuing public concern over porpoise deaths incidental to yellowfin tuna purse seining resulted in various responses in the courts, Congress, government, and industry. At La Jolla, work during the Rothschild years focused on evaluating and testing modifications in fishing techniques and gear, efforts to understand the make-up and status of porpoise populations in the eastern Pacific, life history research to refine estimates of reproductive and growth parameters for major porpoise species impacted by the fishery, and evaluation of the techniques or procedures required under government regulations during purse seine operations to reduce porpoise mortality.

All aspects of the research program on tuna continued as it had in recent years--cooperation with the American Fishermen's Research Foundation to investigate the shoreward migration of albacore tuna into the North American west coast fishery, progress in the cooperative study involving La Jolla and West Coast states to merge and standardize albacore catch and effort data collected by the individual states, continuation of the albacore fishery-advisory activities and in 1976, the completion of a structure of a tuna computer data base for worldwide coverage. Data from the base were used to assess the condition of the Atlantic yellowfin, bigeye, and skipjack tuna resources as part of the U.S. involvement in the ICCAT.

## Fishery Conservation and Management Act of 1976

In 1976, U.S. Commerce Secretary Juanita M. Kreps hailed the passage of the Fishery Conservation and Management Act as follows:

> *The Act provides a basis in law for a strong national program for the conservation and management of our fishing resources--prevent the depletion of our fish stocks through overfishing, to rebuild stocks that have been overfished, and to conserve and manage our fisheries so that the Nation may develop their full potential. And with such a program, to expand the U.S. fishing industry and provide new opportunities for recreational fishermen...**The 1976 Act is the most significant fisheries legislation in the Nation's 200-year history and is the keystone of a national program for our marine fisheries.***

Rothschild, Director of the Center since 1972, moved to Washington, D.C. in October, 1976 as Acting Director, Extended Jurisdiction Planning Staff, to head up the implementation of the Fishery Conservation and Management Act. As Rothschild later recalled, *"I remember Al Pruter (then the Deputy Director of the Northwest Fisheries Center) saying as the Act became effective that the organization of the implementation of the FCMA made him proud to be a member of NMFS."*

So ended the Rothschild years. He wrote recently about these times, *"When I came to La Jolla, The Center was good--when I left it was the best complex of fisheries research laboratories in the world--we had coherent programs, at the cutting edge of science, and a considerable depth enhanced by new people hired during my tenure."*

# THE BARRETT YEARS, 1977-Present

*Research applied to management of fisheries and the introduction of formal planning procedures*

The Barrett years began formally on May 23, 1977 when Robert Schoning, Director of the National Marine Fisheries Service announced the appointment of Barrett as the new Director of the Southwest Fisheries Center. Barrett, as noted earlier, replaced Rothschild who was by then the NMFS Director of the Office of Policy Development and Long Range Planning in Washington, D.C. Schoning's action was a ratification of the existing situation since Barrett had been the Acting Center Director for the past year. He had previously been the Deputy Director for four years and Assistant Director of the Center's predecessor facility, the Fishery-Oceanography Center, at La Jolla for yet another two years.

In 1977, struggling to respond to the broadened responsibilities acquired as a result of the Fishery Conservation and Management Act, the Marine Mammal Protection Act and the Endangered Species Act, yet another reorganization of fisheries in NOAA was underway (NMFS had been reorganized as recently as October 1, 1976; Alan Longhurst pointed out somewhat cynically that the *"new NMFS seemed to have an insatiable appetite for 1) new directors and 2) reorganization"*).

In his analysis of how and where the direction of research at the SWFC should lead in the new era of extended jurisdiction, Barrett believed that the starting point in the rational development of any natural resource was information. As he perceived it, the basic and continuing task of the Center was to *"provide fishery managers with descriptions of feasible options, based on the best scientific information available for managing the Pacific coastal, insular, and world tuna fisheries, and the marine mammals associated with them, together with analyses and best estimates of the biological, environmental, economic, and social consequences of these options."* Although targeted primarily for fishery managers, the information developed by the Center, as Barrett saw it, would be

Izadore Barrett

increasingly useful and used by a wide array of individuals and groups including academia, commercial fishing and trade organizations, conservation and environmental organizations, fishery commissions, fishery development foundations, recreational/fishing organizations, Regional Fishery Management Councils, Sea Grant, state marine agencies, and other federal, state, and local agencies.

Without abandoning what was best in the Center's past, Barrett formulated long-range plans to meld classical fishery biology with an emphasis on quantitative methodologies to support conservation and management of the Nation's fishery and marine mammal resources. As will be seen, with the help of Planning Officer David Mackett, he gradually created opportunities for joint planning of research and management programs for constituents, and introduced a strategic planning system and a project review, planning and budgeting system that relied on interactive participation and involvement of the staff for the development of the objectives, plans and budgets for each project.

The Southwest Fisheries Center reorganization that emerged (the Pacific Environ-

mental Group at Monterey was added to the existing Center laboratories in 1977) gave proper weight and visibility to the living resource responsibilities embodied in the congressionally-mandated MFCMA and the MMPA.

There were two major divisions: Oceanic Fisheries Resources Division under Fox and the Coastal Fisheries Resources Division under Lasker. To help meet the new obligations under extended jurisdiction, Barrett made a decision to expand the existing Recreational Fisheries Program into a new Recreational and Commercial Fisheries Research for Management Program, still in the Coastal Division.

As Barrett began his tenure as the Center Director, he inherited the leadership of a research entity that the National Academy of Sciences termed "a center of excellence" during their review in 1975. One-third of the staff had Ph.D. degrees or advanced degrees and represented the categories of fishery biologist, wildlife biologist, oceanographer, economist, statistician , systems analyst, computer specialist, electronics engineer, operations research analyst, and fishery methods and equipment specialist.

An important factor during the Barrett years, almost from the beginning, were the contributions of John F. Carr, formerly the Great Lakes Liaison Officer for NMFS in Ann Arbor, Michigan, who was selected to be the Deputy Director of the SWFC in 1978. Carr, who retired in June, 1989, played a key role in helping to establish research priorities, and in managing, planning and evaluating all phases of the Center's operations.

## Barrett Years in Review, 1977 - 1989

The 12 years of the Barrett era, still in progress, have been memorable ones of major changes and substantial achievements.

### Coastal Fisheries

Among the most important actions taken by Barrett early in his directorship was his establishment of a multi-disciplinary team of economists, fishery biologists, and statisticians to provide technical information and expertise on Pacific coastal fisheries in response to the requirements of the Magnuson Fishery Conservation and Management Act (MFCMA). With the assistance of scientists from the California Department of Fish and Game and the University of Washington, the staff, led by Dr. Daniel Huppert, and including Alec MacCall (now Acting Director of the Tiburon Laboratory) and Gary Stauffer (now head of the RACE Division at the NMFS Northwest and Alaska Fisheries Center), pioneered the concept of "framework" management plans in their production of a Fishery Management Plan for the northern anchovy. This plan, the first developed under the MFCMA, was widely considered an outstanding example of a FMP because it provided for management action in a multi-year plan, which avoided costly changes from year to year. The adaptive nature of the plan insured responsiveness to concerns of abundance and largely defused the commercial-recreational controversy on the anchovy. The plan was also responsive to changes in scientific knowledge and was revised to consider new scientific information in subsequent years. The staff also contributed to the development of management plans for jack mackerel, saury, and squid fisheries, and worked with the CF&G on Pacific mackerel using an approach similar to that used in the anchovy FMP. Since the mandated concept of optimum yield in the MFCMA required that the economic interests of resource user groups be considered, Barrett continued to give this aspect of his total program maximum support, with outstanding results. For example, Huppert originated the idea and was responsible for the unique configuration of a research data base on West Coast fisheries which is widely used by economists to describe and model the behavior of the commercial fleet. He also pioneered in the area of new resource management options such as limited entry for the valuable Pacific groundfish fishery and with members of his staff developed original approaches to multi-species fisheries management and to measuring the value of recreational fishing activities.

Although the key decision which made possible the important body of research on the energetics of fish larvae at La Jolla was taken by Longhurst, both Rothschild and Barrett actively supported experimental work both in the laboratory and at sea in the intervening years. The work can fairly be said to have reached fruition during the Barrett years, with profound results nationally and internationally such as the formulation of the "Lasker hypothesis" and the drafting of the International Oceanographic Commission's Sardine/Anchovy Recruitment Programme.

Execution of the work of the experimental group was heavily dependent on the unique environment of the La Jolla Laboratory in the mid-1970's. There was a convergence of scientific talents; a long tradition of annual ichthyoplankton surveys; a commitment to improve the precision and accuracy of sea estimates of mortality and abuandance; and the specialized skills of larval fish identifiers, sorters, and sea-going technicians; and a fine research vessel, the *David Starr Jordan*. Included in the pool of scientists were biological oceanographers Drs. Angeles Alvariño and Robert Owen; Lasker, Hunter, Theilacker, and O'Connell, who conducted laboratory and sea experiments, and Ahlstrom, Moser and Smith, who were committed to improving accuracy and expanding the use of the ichthyoplankton and oceanographic time series produced by the CalCOFI surveys.

Alan Longhurst had predicted that the success of the experimental work was predicated on the ability to artificially spawn anchovy, which would guarantee the availability of eggs for experiments throughout the year. Leong soon developed the spawning methodology, eggs became available, and methods were quickly developed to routinely rear anchovy to metamorphosis using cultured foods. These were remarkable events at the time, because few marine fishes had been reared from eggs and still fewer could be spawned on demand.

Scientific findings on early life history and reproduction of fishes rapidly proliferated over the next decade, with the SWFC the recognized leader worldwide in these fields. Of the entire corpus, two kinds of accomplishments seemed the most important: the development of a body of laboratory work on the feeding ecology of larval fishes that led to the Lasker hypothesis and the development and laboratory calibration of new methods that could be used to estimate vital rates in natural populations of marine fishes at sea. In this latter class of events were remarkable studies by O'Connell and Theilacker that provided methods for estimating the rate at which larval fish starve to death in the sea, immunological studies by Theilacker that provided a calibrated method for estimating the rates larvae are consumed by invertebrate predators in the sea, and work by Hunter that established a histological method for estimating rates of spawning of fish in the sea.

The subsequent use of these methods to estimate rates in the sea led to major changes in concepts and advances in knowledge. For example, the critical question relevant to recruitment: "Is starvation a major factor in fish survival?" was finally answered in the affirmative. Estimates of natural spawning rates led to development of the egg production method of biomass estimation and a major change in concepts of reproductive effort in marine fish populations. Application of these laboratory methods and findings to field conditions could not have been done in isolation; they were highly dependent on the continuing commitment to precise work at sea which provided sound estimates of larval mortality and egg production. These, in turn, could then be explained by estimating the proper rates using laboratory calibrated methods.

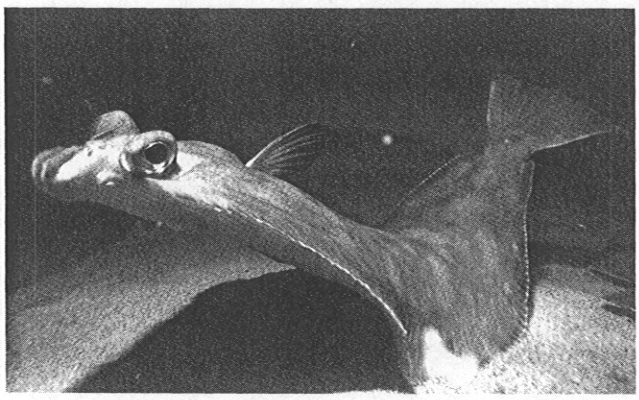
A dramatic illustration of how basic knowledge of fishes and their environment can be utilized in applied fishery science was demonstrated with the development, through the cooperative efforts of Coastal Division scientists, of an unique egg production method of biomass estimation, in which all of the parameters were measured, and none assumed. (In later years a Stock Synthesis Model was developed by Dr. Richard Methot when enough information was available from the fishery and other surveys.) As an example of the transferability and value of this research, it has been estimated that one-third of the world's yield of coastal pelagic fishes could be managed using plans and techniques devised by Division biologists. Many of these

ideas and significant research accomplishments of this group were discussed in a book, "Marine Fish Larvae" by Lasker, Smith, Hunter, and Moser, published by the University of Washington Press in 1981.

Another important landmark in the studies of the early life history of fish was the unique conference sponsored by the four NMFS Fisheries Centers and organized by the staff of the Coastal Division which was held at the University of California, San Diego in 1983. The meeting, "Ontogeny and Systematics of Fishes," two years in the planning, attracted 250 specialists from 10 foreign countries; it was dedicated to the memory of Elbert H. Ahlstrom, Subsequently, a book on this subject edited by Moser and several others was published. It was universally praised by fisheries scientists in the U.S. and throughout the world as a major and lasting contribution to the scientific literature on fish and fisheries.

Time, technology and events set in motion years earlier were gradually reshaping the research on coastal fisheries at the La Jolla Laboratory. In response to contemporary fisheries problems and the urgent needs of fisheries managers, Barrett was instrumental in 1982 in redirecting a large part of the Coastal Division's resources to research on groundfishes, a group of more than 100 species which occupy California coastal waters and which now supports the largest fishery on the U.S. west coast.

In 1986, continuing the emphasis on groundfish, Hunter prepared a 3-year plan for research on Dover sole, an important commercial species. He conducted a preliminary analysis on Dover sole reproduction and planned intensive work on reproduction of the commercially valuable sablefish. By 1987, the research emphasis had shifted almost completely from wetfish to more timely management-related projects and to groundfish research needed by the Pacific Fishery Management Council.



Dover sole

Barrett was also instrumental in developing a meaningful dialogue with Mexico on the biology and management of several economically important species of fish which the U.S. and Mexico share. Although Mexico had previously declined U.S. overtures, Barrett was successful in drawing up a general draft agreement in 1985 for a joint research program with the Instituto Nacional de Pesca regarding training agreements, scholarships for Mexican scientists, and research vessel permits. In 1987, a Mexican delegation, headed by the Mexican Secretary of Fisheries met with the U.S. delegation, headed by Dr. William Evans (then Assistant Administrator for Fisheries and subsequently head of NOAA) in La Jolla for the first formal MEXUS-Pacifico meeting which established cooperative fisheries research on projects of mutual interest.

No history of the La Jolla Laboratory can be complete without mention of Reuben Lasker. Lasker, a government scientist for 30 years and the leader of the Coastal Fisheries Resources Division since its beginning, died in 1988 after a valiant battle against cancer. His many achievements and contributions to fisheries science at the La Jolla Laboratory were recognized with high honors during his lifetime. Under his leadership, the Division developed into a first-rate research entity. He was succeeded as Division Leader by John Hunter, his colleague and friend of many years.

## Tuna and Tuna-Related Activities

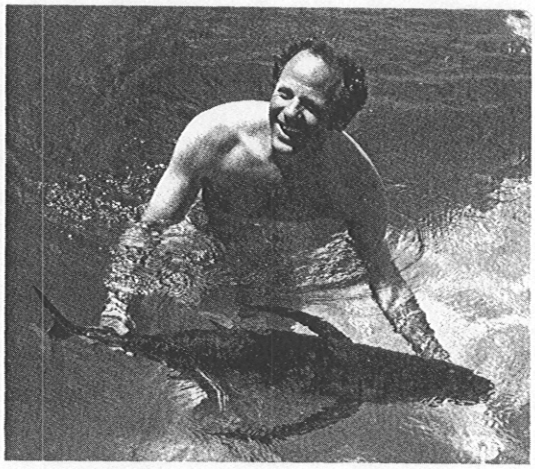
Under Barrett, tuna research continued to emphasize population dynamics of tunas to determine the effects of fishing and to provide management advice on tunas and billfishes to U.S. delegations to international tuna management commissions. In particular, the staff of the Oceanic Fisheries Resources Division

provided information on the status of albacore, yellowfin, skipjack and bigeye tuna stocks of the Atlantic Ocean, as required by the Standing Committee on Research and Statistics of the International Commission for the Conservation of Atlantic Tunas, to which the U.S. was signatory. A major accomplishment, beginning in 1979, was the involvement of the staff in the program known as the International Skipjack Year Research Project, developed and coordinated by ICCAT and supervised by Dr. Gary Sakagawa. In 1983, the findings were presented at an ICCAT meeting and supported the idea that skipjack, the most abundant of the commercial species of tuna in the Atlantic, are a single, widespread stock of high productivity characterized by rapid growth, early maturity, and a short life-span. Edited by Sakagawa, the Proceedings of the ICCAT Conference on the International Skipjack Year Program were published in 1987. A major accomplishment of the research program was the completion of comprehensive status of stocks reports in 1988 on five major tuna and billfish stocks of interest to the U.S. in the Pacific and Indian Oceans, including an economic overview on worldwide tuna production and trade. This 102-page volume made current information available for NMFS managers, other government officials, and the public for use in decision and briefing documents.

In response to major changes which occurred within the tuna industry, both in this country and abroad, there was a major realignment of tuna research responsibilities within the NMFS. Responsibility for tuna and billfish research in NMFS was divided with the SWFC responsible for all NMFS research for the Indian Ocean, Western and Central Pacific, and any federal efforts associated with the eastern tropical Pacific.

Two new Divisions were created at La Jolla from the former Oceanic Fisheries Resources Division: Tunas and Other Oceanic Pelagics Division under Sakagawa and the Marine Mammal Division, ultimately to be headed by Dr. Douglas DeMaster.

Albacore tuna research, conducted within the Coastal Division at the La Jolla Laboratory, during the Barrett regime has recorded many significant accomplishments both in basic research and in practical applications. In 1979, for example, marine biologists and oceanographers teamed with medical doctors aboard the *Jordan* to make discoveries that helped



Dr. Michael Laurs conducting physiological studies on albacore tuna.

explain how the extraordinary physiology of the albacore tuna affects where and when the fish will be found. Scientists demonstrated that albacore have the ability to regulate body temperatures, studied blood chemistry of the fish, and isolated chromosomes under an electron microscope to determine whether northern and southern albacore in the Pacific breed as one stock or two. Satellite imagery was used in albacore research studies involving the relationships between albacore and oceanic fronts. In nearshore regions off the coast of North America commercially fishable aggregations of albacore are found in warm, blue oceanic waters near temperature and color fronts on the seaward edge of coastal water masses. Fishery-oceanography studies were conducted to include a review of physical oceanographic features relevant to the migration of albacore and the relationship of albacore availability to changes in upwelling. Bi-weekly albacore fishery bulletins and daily albacore fishing broadcasts continued to be issued during the albacore fishing season, as they have since 1967.

Research studies with the American Fishermen's Research Foundation, a classic example of government-industry cooperation which began in 1971, continued with a wide range of activities including albacore tagging and release operations in the central and eastern North Pacific, exploratory longline fishery

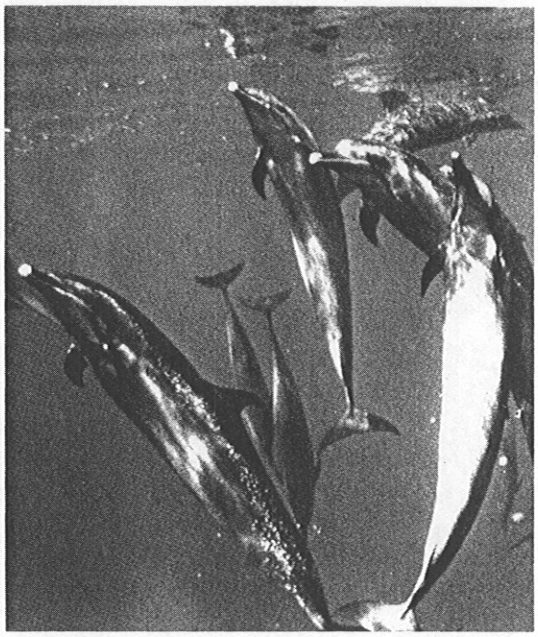
development for albacore in the eastern Pacific, collections of concurrent oceanographic and fishery data and collections of specimens, tissues, and organs for biological studies of albacore. In 1987, SWFC scientists joined colleagues from New Zealand, Tonga, Cook Islands and France for a 3-ship survey of the albacore resource in a band of water called the Subtropical Convergence, extending from Chile to New Zealand. In 1988, Dr. Michael Laurs, who leads the albacore research program, could write, *"A new albacore tuna fishery for U.S. jigboats has been successfully developed in the central South Pacific Ocean. The new fishery has resulted from exploratory fishing and scientific surveys conducted in 1986 and 1987 by the American Fishermen's Research Foundation and the Southwest Fisheries Center."*

The albacore fishery has had a tradition of international cooperation for research. At the La Jolla Laboratory this continued, as it has since 1974, through the informal, laboratory-to-laboratory agreement between the SWFC and the Far Seas Fisheries Research Laboratory in Japan which formed the basis of the Albacore Workshop series.

The North Pacific albacore fishery research and management program was selected by Barrett in 1985 as the subject of an intensive review and expanded planning effort. In 1988, an Albacore Management Document was completed which described the current knowledge of the resource, the status of the resource, and the status of the fishery. This was the first NMFS research program designed through an interactive planning process which brought together a wide range of public interests in the albacore fishery resource.

## Fishery-Marine Mammal Interactions

The tuna/porpoise problem continued to be of the most intense concern, public attention, and controversy. In 1977, at the beginning of the Barrett years, substantial progress had been made in alleviating porpoise mortality. As a result of the NMFS program of innovative purse seine gear modifications and marine mammal releasing techniques developed through the cooperative efforts of the U.S. tuna purse seine fleet, the numbers of porpoise killed by purse seine fishing dropped almost 95 percent in six years from an estimated mortality of more than 300,000 in 1972. In 1980, under continuing pressures from Congress and the interested public, Barrett organized tuna/porpoise



Spotted dolphins await rescue from the purse seine net.

research at La Jolla under two major groupings: Marine Mammal Biology and Technology Program and Marine Mammal Assessment and Monitoring Program. The first was devoted to problems of conflicts between fisheries and marine mammals and the second was characterized by such projects as the estimation of growth and reproductive parameters, research to develop improved porpoise rescue gear and methods, development of better research tools, monitoring of the incidental kill, and assessment of the condition of the stocks involved in the fisheries.

Through the diligent efforts of a dedicated staff, new techniques were developed for determining ages of individual porpoise, several new approaches were tested to improve stock assessment analysis, including precision aerial photographs, a number of biological studies were carried out including delineation of porpoise stocks and analyses of growth and reproduction. A new computerized tracking system, developed to improve precision of sighting angles and location of marine mammal schools sighted on vessel surveys was "road-tested" for the first time on the NOAA Ship, *Jordan.*

In 1983, a series of panel meetings were held with experts in the biology of marine mammals and analytical techniques to review the Center's research results and the completion of a census of the porpoise population. The information was to be used in the preparation of an Environmental Impact Statement to be issued in conjunction with regulations governing the taking of marine mammals associated with the fishery in 1986.

As Congress mandated in its 1983 reauthorization of the Marine Mammal Protection Act, the staff began activities to design a program to use research ships and helicopters to collect data for monitoring population size. Meanwhile, biological research continued with studies of age determination and growth, reproduction bioenergetics, and stock relatedness. Thus, through the combined efforts of the Marine Mammal Technology program at La Jolla and the U.S. tuna industry, the U.S. tuna purse seine fleet had (by 1985) reduced its incidental porpoise mortality rate by more than 10-fold.

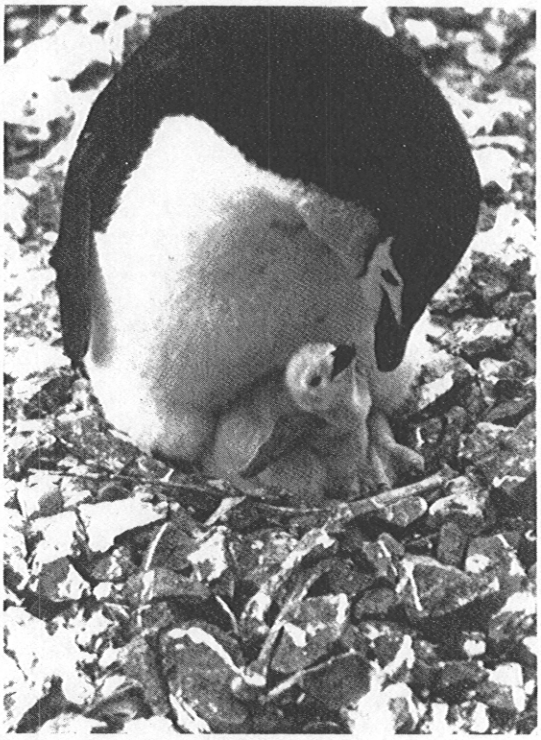
The following year Barrett brought together a committee of experts who recommended a 6-year program of annual surveys, using two survey vessels. This level of effort would be required to detect a significant decrease in porpoise abundance over a 5-year period. In response, the Division staff drafted detailed plans for a survey using two research vessels and one helicopter in six annual surveys. The first cruises, the culmination of years of planning, departed on July 29, 1986. Using line transect procedures, the *Jordan*, with the aid of the NOAA Ship, *McArthur* covered the 5-million mile square range of porpoise associated with tuna. The same two ships carried out the surveys in 1987 and 1988, with the most recent cruises departing July 29, 1989.

At the end of the 6-year period, scientists should be able to compare the sighting data from each cruise, detect changes in the distribution, number, size and composition of porpoise schools and determine if stocks of porpoise in the eastern tropical Pacific are increasing or decreasing.

The 1988 amendments to the MMPA directed the NMFS to contract with the National Academy of Sciences for an independent review to identify research necessary to evaluate potentially promising new methods for locating and catching yellowfin tuna without the incidental taking of marine mammals. To help develop terms of reference for this contract study, the Center will convene a workshop in October, 1989 to review what has been done and what more might reasonably be done to identify and evaluate possible alternatives to the practice of setting on porpoise schools to catch tuna.

## U.S. Antarctic Marine Living Resources Program

This Program was transferred to the Center in 1988. It is a congressionally-mandated Program which was assigned to the NMFS under the Secretary of Commerce in 1984. The Program provides a basis for U.S. policy on the management and conservation of Antarctic living resources, and is in direct support of U.S. participation in the international effort to protect the Antarctic and its marine life under the Commission and Scientific Committee of the Convention for the conservation of Antarctic Marine Living Resources (CCAMLR). Dr. Rennie Holt, formerly a Systems Analyst with the Fishery-Marine Mammal Interaction Division at La Jolla, was selected as the first Program Director.



Chinstrap penguins.

Research cruises aboard the NOAA Ship *McArthur*, organized by the Program staff at La Jolla, are directed at gathering biological information on fish, krill, seal, penguin, and pelagic seabird populations off the northernmost tip of the Antarctic Peninsula and South Georgia, and obtaining vital physical information on the Antarctic marine environment.

# EPILOGUE

It is now 1989--the first year of the administration of President George Prescott Bush who has identified himself as an environmentalist. Robert A. Mosbacher is the U.S. Secretary of Commerce and Dr. John A. Knauss has been confirmed by the Congress as the Undersecretary for Ocean and Atmosphere and Administrator of NOAA. Twenty-five years have elapsed since a staff of 70 moved into the newly-built Fishery-Oceanography Center on the hill overlooking the Pacific Ocean. In the intervening years there have been many NMFS directors, numerous reorganizations, (the latest major change in 1988 established a new field structure which combined the regions and centers into single organizational units), the passage of legislation which mandated major programs, changes in research directions, and tens of millions of tax dollars spent in implementing these programs.

By every rational measure, the SWFC has evolved into a fisheries research organization equipped scientifically and technically to obtain the information needed to improve forecasts of fish abundance, and to support the conservation and management of fishery resources.

Information now exists on how to assess certain individual fish stocks and their potential yield. Proven techniques are available to determine the effects of exploitation. Prime areas of emphasis have been research on fish groups from coastal pelagics to groundfishes; the development of techniques on how to sample eggs, larvae, and juveniles, and the identification and biology of early life stages; new, efficient ways to do biomass estimates at minimum costs such as the Egg Production Method, now an internationally-accepted procedure; integration and efficient translation and transfer of laboratory findings to field applications, and formulation of concepts of recruitment processes and population distribution strategy.

The La Jolla Laboratory has pioneered in response to the federally-mandated Marine Mammal Protection Act through studies on systematics, reproductive biology, age determination, and population assessment on porpoise stocks in an area of 5-million square miles. The research and field methodologies developed at La Jolla have established new standards in the field. Porpoise- saving methods in tuna purse seining have been developed and become standard recommended procedures for the U.S. fleet which leads the world in the lowest rate of kill per set.

With the passage of the Magnuson Fishery Conservation and Management Act in 1976, the Center began a rapid evolution to a mission-oriented laboratory primarily concerned with resource assessment and providing scientific and technical advice to fisheries managers, while at the same time creating and supporting opportunities for related basic research. Quantitative fishery assessment as developed here begins with a review of relevant biological, ecological, and economic data, proceeds through the design and conduct of specific surveys, and results in an estimate of the fish stock's potential productivity and the impact of the current fishery on the target population and associated species.

Central to this process is the development of mathematical models which integrate relevant data, suggest which data need to be collected, and progress to take advantage of new types of data. Particularly noteworthy is the interdisciplinary research approach pioneered at the Center whose teams of biologists and economists work jointly to provide management advice to the Fisheries Management Councils.

A key element in the success of the Center's research program was the belief that it was

only through the establishment of long time series of fishery data, survey abundance estimates and environmental measurements could the causes of variations in fish stocks be determined. These time series, now residing in massive data banks, such as the CalCOFI Data Bank (information on over 300 cruises, 50,000 plankton samples, 20,000 hydrocasts), and most recently, the creation of the Fishery Information Network (FIN) are perhaps the ultimate response to the needs of management for information in convenient formats. In the spring of 1988, the 38-year old CalCOFI data base was made available to all interested researchers through the development at the Center of a special computer-based data management system.

In achieving this outstanding record of research accomplishments at the La Jolla Laboratory, and throughout the Southwest Fisheries Center, there is a consensus that Barrett's establishment of peer review of Center science was and continues to be of paramount importance. The peer review mechanisms here constitute a continuing process--essentially a feedback loop-- among individual scientists, working groups and tasks, divisions and laboratories which shape and influence the quality and direction of research. Some of these mechanisms are necessarily informal, unstructured evaluations, others arranged and carefully planned appraisals of research in progress by constituents, paid consultants, and other research entities (academia, state research agencies, other federal agencies, etc.).

In 1989, the professional staff of the Center numbered 264, recruited from leading universities and institutions in the U.S. Of this number, 116 hold Ph.Ds or advanced degrees.

During the period from 1971 to June, 1989, 1,317 scientific papers were published by the staff of the Southwest Fisheries Center--the majority in peer-reviewed journals. Indicative of the quality of papers published by SWFC was the formal citation in 1977 by the National Academy of Sciences which commended the staff for the, "impressive volume and quality of its publications". There is also the impressive record of staff scientists whose papers have been selected annually for 8 of the last 9 years as constituting the best publication in the U.S. Fishery Bulletin.

The outstanding staff and facilities of the Center were further recognized when the Center was selected by the National Academy of Sciences as meeting their rigid standards for Resident Research Associateships (tenable within NOAA), administered by the National Research Council of the National Academy of Sciences. The SWFC has participated in this nationally-recognized science program for the past 18 years.

The Center's outstanding scientific staff has been recognized with many honors and awards for excellence in scientific research: 11 Gold, Silver, and Bronze Medals since 1970 from the U.S. Department of Commerce, the NOAA Administrator's Award, NOAA's Research and Achievement Award, and the Huntsman Award of Excellence of the Canadian Government.

In recognition of their scientific standing, many of the senior staff currently hold appointments as Adjunct Professors, Adjunct Associate Professors, and Research Associates of the University of California, Scripps Institution of Oceanography, and the University of Hawaii.

The Center has served and continues to serve as a world- renowned training center for fisheries scientists from countries in the free world and behind the Iron Curtain. Each year members of the scientific community from the world's leading universities and marine science laboratories come to the Center to meet and consult with the staff, on sabbatical leave, and sometimes to participate actively in the research work of the Center.

In February, 1989, in recognition of the Center's outstanding achievement in marine biological research, the American Institute of Fisheries Research Biologists (AIFRB), a professional association of U.S. and Canadian scientists, awarded the Southwest Fisheries Center their 1988 AIFRB Award for Excellence. The Center was cited for continued excellence in fisheries research and for valuable contributions in such diverse areas of

expertise as mathematical modeling of fish populations, fish stock assessment, scientific data base management and exchange, sea survey design, research planning, fisheries economics, and marine mammal research.

In summary, when viewed from the perspective of 25 years, the overall research program of the Southwest Fisheries Center reveals a balance which couples traditional, classical fishery biology with the latest and most advanced methodologies--a clear indication of the Center's abilities to translate accumulated information in the furtherance of its mission to develop, use, and protect the living resources of the sea.

# THE NEXT 25 YEARS

The title of this history, The First 25 Years, suggests that there will be a "next 25 years" for the Southwest Fisheries Center and for fisheries research in the United States. Assuming this, it appeared that a reasonable finale to this account would be essays by young, knowledgeable, intelligent, and prescient scientists, presently on the staff of the SWFC, on how they perceive or anticipate events in fisheries in their productive lifetimes. Drs. David Au, George Boehlert, Douglas DeMaster, Daniel Huppert, Pierre Kleiber, and Alec MacCall have kindly set out their views and ideas about the next 25 years in the following essays:

## Dr. David W. Au, Fishery Biologist, La Jolla Laboratory

I see two effects that will bring changes to fisheries research--the effects of growing environmentalism and the effects of erosion of credibility of stock assessment analyses. In the past we like to think of conservation as meaning "wise use" in a rather pragmatic sense; the future will force more recognition of the protectionist or non-exploitative ethic. The new management will require much better knowledge of how animals behave at different levels of abundance. There will be more research on foraging, migration, reproductive behavior, other species interactions (including with man and his gear), all as a function of population size.

Time series monitoring of communities will be reemphasized as being important for tracking ecosystem changes; this will be carried out in key areas (local, representative, index localities). There will likely be such monitoring areas established as one or more reduced sections of the present CalCOFI grid, and there will probably be a key monitoring area off southern Mexico for the tropical habitat.

In studying population processes, there will be fewer studies designed as multivariate-sampling/statistical-analyses- for-patterns and more as hypothesizing/testing-of-hypotheses. At fishery meetings, "how to calculate" papers will be outnumbered by "this is why" papers. Fishery biologists of the next generation (there will always be some, through thick and thin, as long as there are curious persons) will be better educated in population ecology; statistics and fishery-type population dynamics will be a narrowing portion of their repertoire.

Erosion of credibility of assessment proclamations is largely due to the public's realization that scientists are not infallible wizards, that they often disagree or simply don't know (and like education, most laymen can come to opinions about fishing). The "new" fishery biology must therefore become more deeply embedded into the body of science from which credibility arises. Credibility and usefulness of fishery research will grow as plausible explanations grow. Assessments will rely more upon converging conclusions from diverse approaches and less upon involved calculations and statistical adjustments to data.

Future assessments will still need to rely heavily upon fishery dependent data, but for its interpretation, there will be a heavier infusion of knowledge from animal behavior, direct population observations, and ecological theory.

In summary, fishery biology is likely to become more complex in the next 25 years. Fishery scientists must become more knowledgeable about habitats and behaviors, especially species interactions. They will realize that there are not equilibrium populations in fact. The effects of fishing must be explained within the context of natural changes that always tend to propagate other changes. Key area monitoring, financed largely by environmental (not fishery) concerns, will be important in this work.

As in all fisheries, the tuna fisheries of the eastern Pacific have been evolving very rapidly. The development of super purse seiners, use of helicopters and bird radar are all recent history. Catches have continued to climb. Night fishing will likely evolve next to produce a new dimension to the fishery.

## George W. Boehlert, Director, Honolulu Laboratory

Marine fisheries research has evolved through several phases. Early research efforts were principally concerned with understanding the biology of exploited fishes, fisheries development (finding stocks), and enhancing the capacity of fishermen to exploit those stocks. As fisheries grew, concern for the status of stocks increased, later paralleled by concern for status of marine mammal stocks; the associated research included stock assessment, population dynamics, and management efforts, but generally stopped short of what can be termed conservation. Today, growing concern for man's treatment of the environment, public realization of the negative ecological impacts of some fisheries (including impacts on protected species and seabirds), and shortcomings of traditional management methods require NOAA/NMFS to re-evaluate research approaches over coming years.

Over the short term, however, marine fisheries research by NOAA/NMFS may be viewed in a state of partial decline. The legacy of declining research funding over the last 10 years is now evident in the dearth of new talent in fisheries and population science. NOAA/NMFS faces the loss of future research leaders to academia as its pre-eminence as a marine fishery research entity erodes over the next 5 to 8 years. As a short term fix to complex problems, however, regulatory and enforcement functions flourish. As the complexities become evident and budgetary adjustments are made to enhance the research function, the lag inherent in training and recruiting skilled researchers will continue to take its toll for some years. Still, a core of dedicated scientists (including some trained within the system) will maintain sufficient vision to prepare for a resurgence of the research role of NOAA/NMFS with the help of academic allies. For example, continued analysis of the decades-long CalCOFI data base at the SWFC will demonstrate the prescience of Elton Sette and his associates, and after a short period of self- flagellation, the agency will find the wherewithal to reinstitute research vessel surveys with modern oceanographic equipment and meaningful frequency and spatial coverage. Following, rather than leading, the public outcry for enhanced governmental activitism in conservation of the marine environment, the research components of NOAA/NMFS will survive to play a role in a Cabinet-level Department of the Environment charged with technical, as opposed to political, approaches to conservation of the Earth's systems.

Over the longer term, the future of fisheries research will reflect concern for the health of the marine ecosystem and maintenance of an appropriate balance of species composition through judicious harvesting combined with conservation. Research information will be of increasing interest to the general public, who will have an enhanced appreciation of the marine environment. Public pressure, in turn, will force legislation in keeping with maintaining a quality environment. Dictated by accumulated research knowledge as opposed to bureaucratic fiat, scientists will make dramatic advances in mathematical modeling of population in selected ecosystems. Biological research at several trophic levels will be integrated with physical models to develop the first meaningful initiatives to manage marine ecosystems; resultant decisions on the manipulation of species balances will lead to better conservation of the marine environment.

## Dr. Douglas DeMaster, Leader, Fishery/Marine Mammal Interaction Division, La Jolla Laboratory

Between 1965 and 1990, there were some remarkable changes in the way we approached the management of marine resources. I think it will be difficult to continue to incorporate these changes in the conservation of marine resources over the next 25 years because of the extremely tight fiscal environment we are facing. One of the most important changes was a move towards using fishery-independent statistics in determining the status of commercially important species as opposed to only using catch- per-unit-effort statistics. A second major change was a move towards managing the take of non-target species (or by-catch). That is, it became obvious in the 70's and 80's that many non- target species were inadvertently being "over-fished". These include organisms from groups as diverse as turtles, birds, mammals, fish, shellfish, and even various plant species. In many cases because of limited resources, species or populations that genuinely needed additional management were not managed because they did not attract the public's attention, while other species, those that the general public (and Congress) are enamored with have been managed and studied at a cost not always commensurate with their value.

By the year 2015, it is not at all clear if we will have the resources within the agency to use fishery-independent methods to monitor the population status of all of the species that may be adversely affected by the operations of U.S. fishermen. Clearly, research vessel time over the next 25 years will be very difficult to secure. Given the likely increase in the cost of fuel and vessel support, the NOAA fleet itself may be disbanded or at least may not be available for fisheries research. What we are left with is the need to increase the amount of data collected by observers on commercial vessels.

I think fishery-dependent statistics will form the basis of management decisions in the future. These data will be supplemented with a greater reliance on data provided by satellite imagery. What research vessel time is available will have to be used to calibrate the data collected by observers on the commercial boats. The fishing community will generally consider this trend as an unwelcome intrusion of their property. The agency will have to involve these constituents in the decision process to secure the maximum amount of support for this change in policy.

Another change related to a likely shortage of funds by year 2015 will be the need to more closely prioritize research and management activities based on the principles that are being developed in a relatively new discipline, biological conservation. This field combined elements from the fields of population dynamics, population genetics, fisheries and wildlife biology. The current approach of the agency to manage ecosystems will certainly be refined over the next 25 years to one that is more pragmatic and less ambiguous. Specifically, managers and researchers will concentrate on managing the activities of the fishing community (and other users of the marine environment) to maintain populations of a select set of species rather than all of the species that comprise a particular ecosystem.

Funding will not only be less available for the management of marine resources over the next 25 years; funds to support basic research and to train the scientists that will replace those of us currently practicing our trade will become extremely difficult to secure. Additional funding to support graduate students will have to come from the agencies responsible for resource management or there will be a shortage of well-trained biologists in the year 2015.

Finally, by the year 2015, at least on the West Coast, the Federal government will have to actively manage fishery-marine mammal interactions under the Marine Mammal Protection Act. The states are unlikely to want the responsibility and cost of such management and the Federal government is authorized to actively manage marine mammal under the MMPA, if it so chooses. In 25 years, the population of California sea lions may well be over 200,000 animals. In addi-

tion, increasing numbers of 3,000-pound male elephant seals establishing mainland breeding territories will put the fear of God into the most robust of our county and city lifeguards. While this may seem a tad whimsical, it does point to the need for the Federal government to move towards a more active role in managing certain species of marine mammals.

In summary, by the year 2015, the management of marine resources will be predominantly based on data collected by at-sea observers which will be augmented with data collected through remote imagery and scientists aboard research vessels. Many species that are affected by the activities of U.S. fishermen and other human activities will not be studied or managed due to a lack of funding. Priorities for research funding will be based more on biological principles (and less on public opinion) than they are now. Finally, the Federal government will take a more active role in the management of marine mammal species that interact with coastal fisheries along the west coast of North America.

## Dr. Daniel D. Huppert, Industry Economist, La Jolla Laboratory

The integration of economics into the biological and physical science perspective of NMFS's research centers, which began at the SWFC in 1974, will make further strides during the next 25 years. Social and physical scientists will continue to specialize within their own fields, and will continue to have some difficulties communicating the importance and implications of their knowledge to each other. However, the common elements of the two branches of scientific research will become more apparent as we view man's use of natural resources as an essential part of the global biological system. Economists will improve their concepts and knowledge to more clearly incorporate the complexity and sensitivity of the ecological system in their prescriptive models of man's use of nature. This will probably involve models making use of the detailed data available from fishery logbooks and fishery independent surveys. Natural scientists will come to appreciate the ability of social science to understand and explain how man behaves in the presence of alternative decision environments and under different institutional systems. Economists have made significant inroads during the past 25 years by insisting that harvesting and managing resources uses up valuable resources, i.e. there are costs. This simple proposition is elaborated in a number of ways, including a variety of rather sophisticated mathematical optimizing models and some multi-objective decision models. One major result of this is a growing appreciation for management systems that encourage individuals to behave in ways that economize on resource use in a broad sense (including use of fossil fuels, minerals, and labor). The increasing use of "limited access" in commercial fisheries is the most prominent application of this knowledge. I expect continuing expansion of limited access systems; and, as social scientists become more daring, increasing sophisticaiton in the understanding and use of social mechanisms that rely on non-profit incentives. Territorial use rights, cooperative associations with resource stewardship responsibilities, and publicly owned and operated fisheries are all reasonable replacements for open access that will be considered and developed in North American fisheries.

NMFS research centers will continue to provide essential technical support for fishery management in the Exclusive Economic Zone, and will be increasingly concerned with marine sanctuaries, coastal pollution, and integration of fishery management with conservation of birds, mammals, and other noncommercial resources. Global warming may eventually have a substantial impact on fisheries, but fisheries scientists (including social scientists) will have little, if any, role to play in understanding, predicting, or controlling that trend. Evaluation of consequences, and adaptive response to the changing ecosystem will require substantial efforts by NMFS researchers.

The mythical division between political decision making and technical decision making will become an increasingly untenable intellectual partition. NMFS will come to realize that technical information (including most economics information) contains no

ethics, no human objectives, and that "technical or scientific" resource management is actually based upon specific ethical propositions that are either naively misunderstood or disingenuously masked. Resource management decisions require integration of physical and social science information concerning possibilities and consequences with a social decision making process for resolving, at least temporarily, disagreements over values and objectives. Technical information, in the sense of quantitative description and prediction of physical events, is simply incapable of directing decisions regarding resource use. Recognition of this will lead researchers and managers in NMFS to see more clearly their dual roles as seeker of knowledge and protagonist for resource-based ethics.

Economists and other social scientists may become more influential in the operation of NMFS research centers simply because they will be gaining seniority. As this happens, the economists will change to become more loyal to resource management as a practical art, and will come to appreciate the importance of social conventions and ethical propositions for directing and channeling human action. This will result in a broadening and homogenizing of the various social sciences, and a melllowing of the economists involved in fishery management.

## Dr. Pierre Kleiber, Fishery Biologist, La Jolla Laboratory

In the past 25 years, the SWFC has conducted a great deal of fundamental research that has made important contributions to our understanding of the biology and ecology of fish populations and fisheries. But in recent years, due to tightening of budgets and the pressure of politics, the trend has been to emphasize "mission oriented" research, that is, research with a direct connection to management issues. In practice this mostly means analyzing catch and effort data from fisheries usually with a suite of time-worn stock assessment models. While this kind of work could be construed to be scientifically humdrum, some interesting and important improvements in the traditional methods have been, and continue to be, pioneered by SWFC scientists. However, we should not extrapolate this trend to predict the major research activities at SWFC in the coming 25 years.

Fishery management issues are becoming more complex than simply finding an effort level to maximize sustainable harvest or a size limit to maximize yield per recruit. Management needs to be conducted in light of the ecological context of the resource and the socio-economic context of the fishery. In addition to maximizing the profit of fishing industries, our mission includes long term conservation of fish resources as well as non-commercial resources such as many of the marine mammals. These concepts are not new to fishery scientists in the SWFC or elsewhere; but the potentates who manage the fisheries service are apparently now beginning to recognize these "modern" ecological concepts and goals of fishery science, most likely because of the emergence of the environment as a popular political issue.

To address ecological issues as they apply to fisheries will require more than analysis of catch and effort data. While it is highly important to continue collecting these data, for the most part we have learned to glean all we can from them. To quote a famous fishery scientist: *"You can't make a low-rider out of a Morris Minor."* Ecological management requires understanding of processes such as recruitment, migration, and species interactions plus the influence of oceanographic and climatic parameters on all these processes. The SWFC will need to continue the kind of progress that it has been quietly making all along with studies of reproductive behavior, surveys of eggs and larvae, tracking movements of animals, gathering environmental data, investigating behavioral and physiological responses of animals to their environment, to name a few examples. To help get new and better data, we can anticipate advances in the technology of such things as data logging tags, remote sensing and satellite tracking, all of which will help us investigate important processes with animals in their natural habitat.

All this may seem at first sight to be more in the realm of fundamental research as opposed to mission oriented research, but it is

actually very much directed to our true mission, the conservation of marine resources.

## Dr. Alec MacCall, Acting Director, Tiburon Laboratory

As I gaze into my crystal ball, I see the La Jolla Laboratory perched precariously atop an eroding cliff in the year 2014. Work at the laboratory is strongly influenced by global climate change, which has become fully apparent. Indeed, climate forecasters are no longer discussing "$2xCO_2$", as that point is no longer distant. Research is concentrating on "$4xCO_2$" with the hope that concentrations can eventually be limited to that level. Efforts to reduce carbon dioxide emissions as well as to maintain air quality have made fuel quite expensive, with effects ranging from reduced ship operations to less reliance on automobiles to get to work. In any case, few employees are willing to pay $2,500 for a UCSD parking permit.

Another effect of warming is management's inability to define OY for highly fluctuating stocks of surface fishes. Sardines are supporting a major West Coast fishery, with the biggest problem being "excessive" harvest by Canada. Groundfish have been somewhat overfished, but otherwise have been relatively unaffected by climate change. There are severe management disputes over salmon: Should we try to preserve the declining natural runs (which are being impacted by warm water and ill- timed runoff) or resign ourselves to hatchery production on which we can depend. The Sacramento Delta has been in the process of "reverse reclamation" due to breaching of levees by severe floods; however, many of the flooded fields are being converted to use for aquaculture.

Major research programs at the SWFC are rather similar to these back in 1989. There are some differences: Recreational fishing is the focus of a major multidisciplinary research effort, as gill nets were banned by passage of a ballot initiative in the 1990's. Also catches of migratory gamefish have been quite good in southern California. Multispecies trophic interactions and ecosystems dynamics are the subject of extensive field research and simulation models using massively parallel desktop personal computers. We are not closer to solving the "recruitment problem," but have been turning attention to understanding causes of longer-term changes in recruitments.

Deteriorating retirement benefits will cause many old-timers (hired during the 1970's and 1980's) to have postponed retirement. Consequently, there is now an especially high turnover of personnel and, as usual, the La Jolla Laboratory is undergoing a major restructuring of its programs.

### Figure Captions for Southwest Fisheries Center Construction and Dedication:

1. Clarence W. Pautzke, Commissioner of Fish and Wildlife Service, at podium during groundbreaking ceremonies for the Fishery-Oceanography Center, June 8, 1963.

2. Left to right: Edwin W. Pauley, Regent of the University of California and Undersecretary of the Interior James K. Carr share a shovel at the U.S. Bureau of Commercial Fisheries groundbreaking ceremony, June 8, 1963. Pautzke looks on approvingly.

3. Principals involved in planning and construction of the Fishery-Oceanography Center. From left: Robert S. Wolf of the California Current Resources Laboratory; a Robert Bittman; Gerald Howard, director of the Tuna Resources Laboratory, Donald R. Johnson, then Director, BCF California Area, a Mr. Kilpatrick, Frank Hope, head of the architectural firm that designed the building, Elbert H. Ahlstrom, Director of the California Current Resources Laboratory; Commander Jenkins of the U.S. Navy's Bureau of Yards and Docks who oversaw the building construction, a Mr. Scammell, Donald R. McKernan, Director of BCF; Dr. Richard Whitney and David Kramer of the BCF Tuna Resources and California Current Resources Laboratory, and Gordon Oliver, Hope and Associates architect who actually designed the building.

4. Donald Johnson at podium during groundbreaking ceremonies.

5. Morris Landon presents ceremonial key of Center to Captain W.A. Miller. Looking on from left are: Howard, Ahlstrom, and Pautzke.

6. View of Fishery-Oceanography Center under construction.

7. View of Center in December, 1964.

8. Aerial view of Scripps Institution of Oceanography and newly- completed Center. Note sharp curve of La Jolla Shores Drive before road was straightened.

9. Center at dusk.

## RECENT TECHNICAL MEMORANDUMS

Copies of this and other NOAA Technical Memorandums are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22167. Paper copies vary in price. Microfiche copies cost $4.50. Recent issues of NOAA Technical Memorandums from the NMFS Southwest Fisheries Center are listed below:

NOAA-TM-NMFS-SWFC- 125 Interannual variability of temperature in the upper layer of the North Pacific eastern boundary region, 1971-1987.
D.A. COLE and D.R. McLAIN
(March 1989)

126 Albacore management information document.
R.H. PARRISH, N.W. BARTOO, S.F. HERRICK JR., P. M. KLEIBER, R. MICHAEL LAURS and J.A. WETHERALL
(May 1989)

127 Oceanographic observations in the Scotia Sea marginal ice zone June-August 1988.
D.M. HUSBY, R.D. MUENCH and J.T. GUNN
(May 1989)

128 Report of a marine mammal survey of the eastern tropical Pacific aboard the research vessel *McArthur*, July 28-December 6, 1988.
S.N. SEXTON, R.S. HOLT and A. JACKSON
(June 1989)

129 Report of a marine mammal survey of the eastern tropical Pacific aboard the research vessel *David Starr Jordan*, July 28-December 6, 1988.
R.S. HOLT and S.N. SEXTON
(June 1989)

130 Catalog of the synoptic collection of marine mammal osteological specimens at the Southwest Fisheries Center.
W.F. PERRIN and J.V. KASHIWADA
(June 1989)

131 Report of ecosystem studies conducted during the 1988 eastern tropical Pacific dolphin survey on the research vessel *David Starr Jordan*.
L.J. LIERHEIMER, P.C. FIEDLER, S.B. REILLY, R.L. PITMAN, L.T. BALLANCE, G.G. THOMAS and D.W. BEHRINGER
(June 1989)

132 Report of ecosystem studies conducted during the 1988 eastern tropical Pacific dolphin survey on the research vessel *McArthur*.
L.J. LIERHEIMER, P.C. FIEDLER, S.B. REILLY, R.L. PITMAN, L.T. BALLANCE and D.W. BEHRINGER
(June 1989)

133 The 1987-88 demersal fish surveys off Central California (34°30'N to 36°30'N)
J.L. BUTLER, C.A. KIMBRELL, W.C. FLERX and R.D. METHOT
(July 1989)

134 The First 25 Years.
LILLIAN L. VLYMEN
(September 1989)