HONOLULU
LA JOLLA
MONTEREY
TIBURON

SOUTHWEST FISHERIES CENTER

REPORT OF ACTIVITIES May-June 1986

NOAA/NMFS

SOUTHWEST FISHERIES CENTER

CENTER ADMINISTRATION — La Jolla, California

Center Director	*Izadore Barrett*
Deputy Director	*John F. Carr*
Planning Officer	*David J. Mackett*
Data Systems Manager	*Vacant*
Executive Officer	*Benjamin F. Remington*

LABORATORIES & DIVISIONS

Coastal Fisheries Resources Division, Chief La Jolla, California	*Reuben Lasker*
Fishery-Marine Mammal Interactions Division, Chief La Jolla, California	*Vacant*
Honolulu Laboratory, Director Honolulu, Hawaii	*Richard S. Shomura*
Pelagic Fisheries Resources Division, Chief La Jolla, California	*Gary T. Sakagawa*
Pacific Fisheries Environmental Group, Chief Monterey, California	*Andrew Bakun*
Tiburon Laboratory, Director Tiburon, California	*Norman J. Abramson*

The Report of Activities of the Southwest Fisheries Center is compiled by the Technical Writing/Editing Group at La Jolla from material submitted by the Center's staff. To change the delivery address of the Report of Activities, or to cancel your subscription, please notify Jean Michalski, Editor, at P.O.Box 271, La Jolla, CA 92038. Telephone:(619)453-2820, Extension 280.

TO OUR READERS:

The former Oceanic Fisheries Resources Division has been organized into two new Divisions: the Pelagic Fisheries Resources Division and the Fishery-Marine Mammal Interactions Division. The reorganization has been approved by Assistant Administrator for Fisheries William Gordon and Deputy Assistant Administrator for Science and Technology Joseph Angelovic and was effective June 4,1986.

Changed tuna and marine mammal responsibility for the Center, the need to devote renewed and strengthened emphasis to our Pacific tuna studies, the changes in the international tuna fleets and industry structure, and the change from the early days (when the Oceanic Fisheries Resources Division was established) in the character of the tuna fishery-dolphin mortality issues, among other reasons, provided an opportune time to make some alterations in our organizational structure.

Under the new organization, the Pelagic Fisheries Resources Division has a staff of 25 scientists, technicians, and supporting staff who are responsible for providing basic fishery analysis and management information on tunas, billfishes, and other large pelagic fish species of interest to the United States government.

The staff of the newly-established Fishery-Marine Mammal Interactions Division consists of about 30 scientists and supporting staff. This Division is responsible for monitoring population trends of dolphins in the eastern tropical Pacific and of certain coastal marine mammals of California.

Dr. Gary Sakagawa, Fishery Biologist and formerly head of the Oceanic Fisheries Resources Division, has been named Chief of the Pelagic Fisheries Resources Division. Actions to recruit a Chief of the Fishery-Marine Mammal Interactions Division are underway.

Izadore Barrett
Center Director

July 30, 1986

COASTAL FISHERIES RESOURCES DIVISION
La Jolla, California

COASTAL EASTERN PACIFIC POPULATION BIOLOGY OF FISHES

Analysis of Water Content in Dover Sole Assessed

Assessment of the water content of Dover sole is included as a routine element of the Coastal Division's biomass assessment work on Dover sole. The market for larger sole is limited because at times the flesh of the fish has a jellied consistency (high water content) which reduces its desirability as a fillet.

Biological Technician Eric Lynn has completed estimation of the water content of Dover sole which had been caught between December 1985 and May 1986 in the Morro Bay-Monterey area. Preliminary analysis of these data indicates that the water content of both white and red muscle increases with fish size. Mean water content of white muscle increases from 82% (SD = 0.4) in 150 mm sole to 90% (SD 2%) in 500 mm fish. The red muscle (responsible for head movement) also increases with size but at a slower rate with size and never contains the high water content found in the white muscle (average water content of red muscle in 500 mm fish was 85%, SD = 2%). These data indicate that the red muscle is conserved--that is, it experiences less protein resorption than white muscle. The red muscle may be conserved because it plays a major role in controlling head movements during feeding.

Water content of the muscles is correlated not only with fish size, but with depth as well. Fish from deep water have a higher water content than those living at shallower depths. However, the correlation of water content with depth may be only a result of the fact that larger fish occur more frequently in deep water.

The color of the red muscle also changed with size, with larger fish having darker red muscle indicating a higher myoglobin content. The change in water content of both muscle systems, change in color of the red muscle, onset of sexual maturity, and a movement into deep water (depth > 350 fathoms) of low oxygen content (oxygen < 0.5 ml/L) all appear to occur over the same length interval (300-400 mm total length). This indicates that these events may all be part of a general life history pattern involving an ontogenetic movement into deep water for reproduction. (J. Hunter, FTS 893-6220)

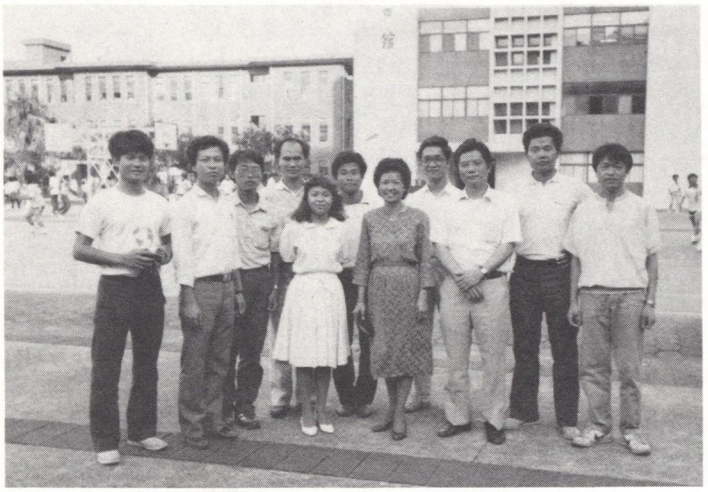
SWFC Statistician Returns from a 3-Month Stay in Taiwan

Dr. Nancy Lo, Statistician, recently returned from a 3-month stay in Taiwan, from February 21 to May 25, 1986, where she taught a fishery statistics course at the National Taiwan College of Marine Science and Technology. Her trip was sponsored by the Institute of Statistics, Academia Sinica, and the National Taiwan College, and funded by the National Science Council of Taiwan, Republic of China.

During the graduate course, Lo taught basic statistical techniques for solving fishery problems, CalCOFI sea survey techniques and procedures, and procedures for estimating biological parameters of the early life stages of northern anchovy.

Lo also presented seven seminars to various groups of scientists and fishermen on a variety of topics: "Growth models for marine fish," "Egg production methods applied to northern anchovy," "Porpoise and tuna problems," "Satellite information and marine fisheries," and "Research on marine resources conducted at the Southwest Fisheries Center."

The courses and seminars were well received, according to Lo who believes that her trip has helped to improve communication between U.S. and Chinese fishery researchers and between biologists and statisticians in Taiwan. (N. Lo, FTS 893-6218)



Nancy Lo (center) and Chuan-Hung Ho (third from the right), Chairman of the Department of Fishery and Graduate School of Fishery, National Taiwan College of Marine Science and Technology, with graduate students.

Water Mass Characteristics Accompanying Climatic Shift of Pelagic Communities Identified

Oceanographer Larry Eber, with Drs. H. Geoffrey Moser and Paul E. Smith, has identifed water mass characteristics which accompany the climatic shift of pelagic communities off the California coast. Even though the transition zone and the California Current are mixtures of adjacent water masses, the temperature-salinity (t-s) curve may indicate whether the northern complex or the southern complex of species is spawning in an area. In an exploratory effort, four species typical of the two complexes were evaluated for associations with varying t-s configurations. As expected, when species from the northern complex were present in the intermediate zone, conditions were cooler and less saline than when they were absent (Figure 1). Similarly, when species from the southern complex were found in the intermediate zone, conditions were warmer and more saline than when they were absent (Figure 2).

For northern lampfish (Stenobrachius leucopsarus) and blue lanternfish (Tarletonbeania crenularis) of the northern complex and Panama lightfish (Vinciguerria lucetia) of the southern complex, all the deviations were in the upper water column (above 9°C). For Diogenes lanternfish (Diogenichthys laternatus), deviations were observable throughout the water column analyzed (to ca. 500 meters). Eber, Moser, and Smith have not yet conducted the survey of the species to see how many react in this way to climatic change and changes in the boundaries within the California Current. (L. Eber, FTS 893-6282)

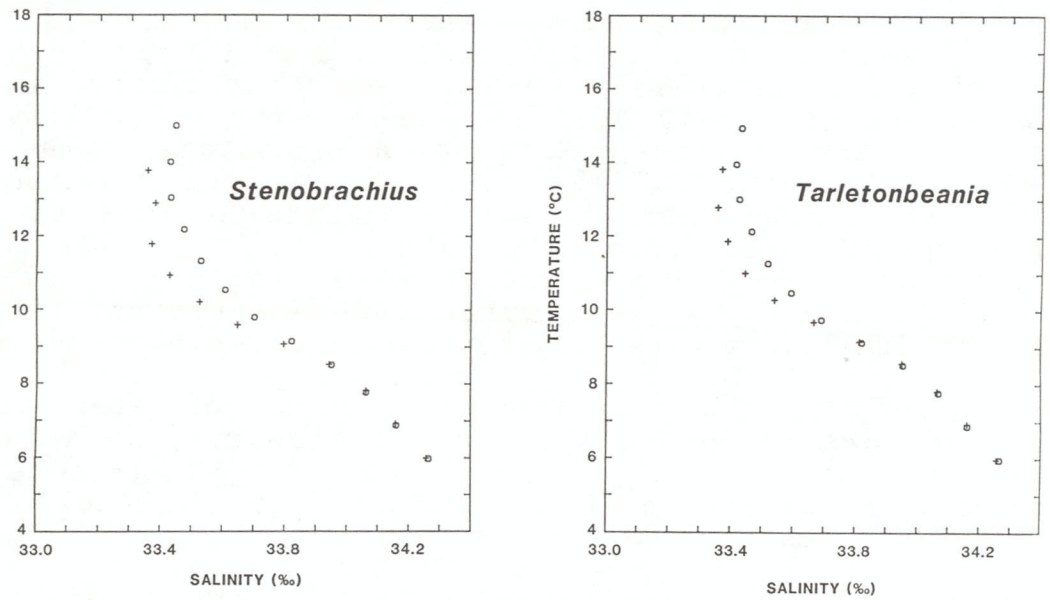


Figure 1. Average t-s curves in the central zone associated with the presence (+) or absence (o) of two representative species from the northern complex in net tow samples.

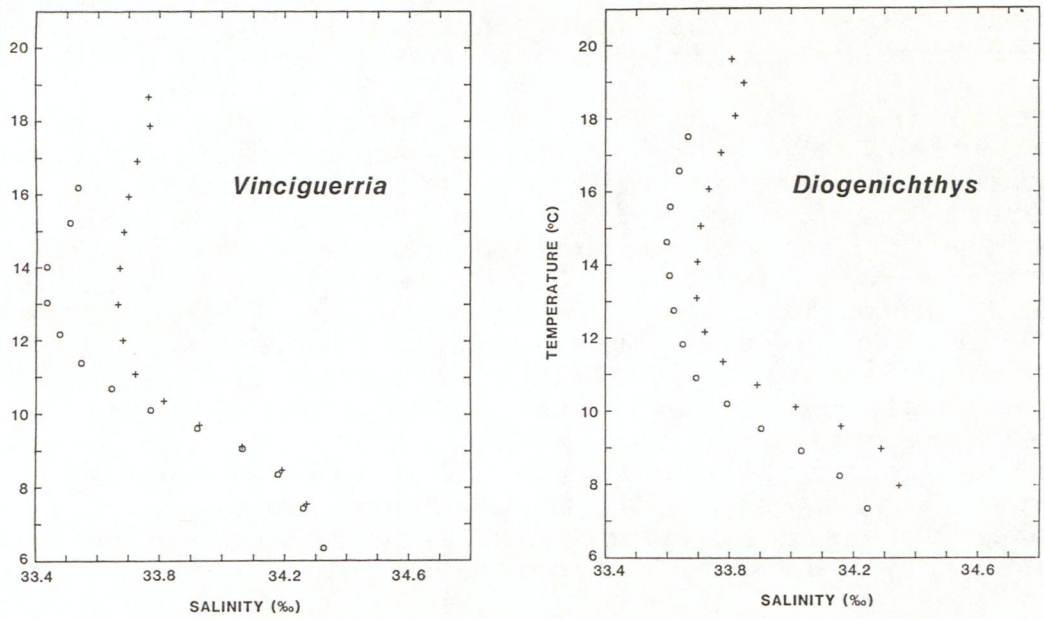


Figure 2. Average t-s curves in the central zone associated with the presence (+) or absence (o) of two representative species from the southern complex in net tow samples.

Relationship of Volume of Water Filtered to Species Diversity in Plankton Tows Studied

Fishery Biologist Paul E. Smith, with Fishery Biologist H. Geoffrey Moser and Oceanographer Lawrence Eber, have been studying the relationship between taxonomic diversity of larval fishes and volume of water filtered in CalCOFI plankton tows taken during the period 1954-1960. The number of taxa sampled depends on the diversity of adult fishes in the locality, the timing of the tow with respect to spawning seasons of the adult taxa and the duration of the tow. The latter parameter is related to the tendency for the number of taxa to increase as the sampling area increases in ecological surveys. This relationship is defined by a species-area curve in ecological literature. There are many uses for this curve when describing diversity within a community and detecting boundaries between communities.

Smith refers to the relationship of volume of water filtered in plankton tows to apparent taxonomic diversity as a "micro-species-area curve." The purpose of the study is to determine how long a plankton tow should be conducted to adequately sample larval fish species in a variety of habitats.

The size of the observation in CalCOFI standard oblique tows is controlled by the actual amount of water filtered from each unit depth and the size of the aliquot which is sorted. The amount of water filtered can be estimated from the standard haul factor. Usually, 100% of the sample is sorted but occasionally a

sample must be divided to save sorting time. About 16% of the samples were divided 1 to 4 times, resulting in 50% to 6.25% of the samples being sorted.

About 6% of the samples taken during the 1958 El Niño event have standard haul factors which were outside of currently acceptable bounds. Three percent were longer tows than usual and would be expected to average more taxa per tow while 3% were shorter than usual and would be expected to average fewer taxa per tow.

Smith, Moser, and Eber defined two micro-species area curves for the taxa in the CalCOFI 1-meter bridled ring net tows. Figure 3 illustrates the results of the analysis of the degree to which species are added when the tows are long. It also indicates the expectations for which taxa are missing when the tows are short or when the sample is subdivided. The relationship in both cases is well described by a Weibull equation which permits prediction of the number of taxa in a sample from the amount of water filtered from a unit depth or the fraction of the sample sorted.

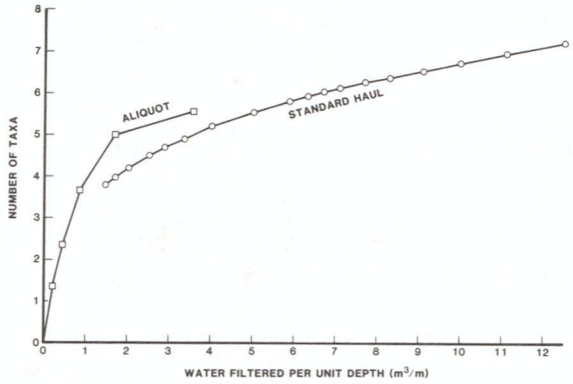


Figure 3. Two micro-species area curves. The curve with square symbols represents the effect of sorting sample aliquots (6-1/4%, 12-1/2%, 25%, and 50%). The curve with circle symbols represents the effect of filtering too little or too much water per unit depth relative to the standard haul.

	K	Sigma	Tau
Water filtered	1.786	82.0100	0.354
Aliquot sorted	5.591	0.7606	1.003

The equation has two variables. The independent variable is the volume of water filtered for each meter of depth expressed in cubic meters per meter of depth. The dependent variable is the number of taxa per observation. The error of prediction is of order 1 taxon for the water-filtered case and a minute fraction for the aliquot-sorted case. The joint effects of water filtered and aliquot sorted interactions have not been studied nor have the effects of interaction with location and season. It is preferable to study these interactions with designed studies rather than use data with post-hoc results gathered for other purposes.

The end result for these data is that the average number of taxa per observation is 5. For each split of the sample, one species is lost. If the oblique tow is so steep as to reduce the volume of water filtered per unit depth from 3 to 2 cubic meters per meter of depth, one taxon will be lost. If the angle of the oblique tow is so slight that 8 cubic meters are filtered per meter of depth, one taxon will be gained as compared to a 'standard' tow. A second taxon would be added at 12 cubic meters and a third taxon would be added at 20 cubic meters according to this empirical relationship. (P. Smith, FTS 893-6346)

COMMERCIAL AND RECREATIONAL FISHERIES RESEARCH FOR MANAGEMENT

Report on Status of Tuna Fishery for 1985 Completed

Sam Herrick, Industry Economist, and Steve Koplin, Fishery Reporting Specialist at the Southwest Region, have completed an analysis of harvesting and processing activity within the U.S. tuna industry during 1985.

For the U.S. tuna industry, 1985 appeared to be a year of relative calm following three years of turmoil during which four canneries in California and Hawaii were closed and U.S. tuna harvesting capacity was significantly reduced. Although 1985 was not as tumultuous as 1984, recent trends continued into 1985, including the further attrition of the U.S. tuna fleet, decreased cannery deliveries of domestically-caught tuna, a decline in U.S. cannery production, and increased imports of canned tuna.

With the number of vessels making up the U.S. tropical tuna fleet decreasing 15% during 1985, and the reduction in domestic processing capacity that occurred during 1984, U.S. cannery receipts of imported and domestically-caught albacore (white meat) and tropical (light meat) tunas (skipjack, yellowfin, blackfin, bluefin, and bigeye tuna) fell sharply in 1985. The total volume was 468,956 short tons (tons), a decrease of 11% in total volume from 1984 and 15% below the 1980-1984 average volume of annual cannery receipts. Cannery deliveries by domestic vessels amounted to 213,808 tons in 1985, 16% below deliveries for 1984 and 14% below the 1980-84 (5-year) average. Raw tuna imports made up the 255,145 ton balance in total cannery supplies for 1985, a 5% decrease in imports from 1984 and 16% below the 1980-1984 annual average for imports. Direct exports of domestically-caught tuna totaled 34,797 tons in 1985, up 7% from 1984 and 324% greater than the 5-year average. Total U.S. deliveries--exports of domestically-caught raw tuna plus deliveries of domestically-caught tuna to U.S. canneries amounted to 248,605 tons for 1985, 13% less than the corresponding amount for 1984 and 4% less than the 5-year average.

The western Pacific Ocean was the predominant production area for the U.S. fleet in 1985, providing 129,431 tons or 52% of the domestically-caught cannery receipts and direct exports for the year. Total domestically-caught deliveries from this area decreased 31% from 1984, and as a share of total domestically-caught deliveries by oceanic area decreased 21% from 1984. The western Pacific was also the area from which most of the raw tuna imports originated in 1985--74,356 tons, or 29% of total imports by oceanic area.

The decrease in fishing activity in the western Pacific by the U.S. fleet during 1985 can be largely attributed to prevailing economic conditions. A resurgence of U.S. fishing in the eastern Pacific Ocean during 1985 occurred as a result of the lowest ex-vessel prices in five years, particularly for skipjack tuna, and exceptionally good fishing for yellowfin tuna -- the light meat species that commands the highest ex-vessel price in both domestic and foreign markets. A record catch of yellowfin tuna (218,920 tons) was reported from the Inter-American Tropical Tuna Commission's yellowfin regulatory area. The U.S. fleet accounted for almost 39% of the eastern Pacific yellowfin tuna catch in 1985, which represented the largest contribution to tuna cannery receipts of domestically-caught light meat by oceanic area for the year.

The loss of west coast and Hawaii canning capacity and overwhelming imports of foreign packed tuna contributed to a decrease of 11% in overall U.S. canned tuna production (27.9 million standard cases) from 1984. The total addition to U.S. canned supplies--canned imports combined with U.S. production--in 1985 was 38.9 million standard cases which was a 2% decline from that in 1984. Canned imports set a new record in 1985, reaching 11.0 million standard cases, a 32% increase from 1984, and an increase of 237% since 1980. Imports were dominated by tuna packed in water which is subject to a much lower import duty than tuna packed in oil.

The retail composite canned tuna price, which decreased 3% during 1984, fell an additional 2% through mid-1985. The downward price trend contributed to corresponding growth in overall apparent consumption which increased at a projected annual rate of 0.7% in 1985, following a 2% increase for all of 1984. Sales of water-packed products--except water-packed products in the health/diet category--had increased 8% by mid-year. Since water-packed products account for more than 60% of total sales, this increase helped offset reduced sales of tuna in oil and of health/diet canned tuna products. (S. Herrick, FTS 893-6206)

Report Prepared on Status of Coastal Pelagic Fishery

Cynthia Thomson, Industry Economist, Cheryl Scannell, Biologist with the California Department of Fish and Game, and Bill Craig, Fishery Biologist at the Southwest Region, completed an Administrative Report entitled "Status of the California Coastal Pelagic Fisheries in 1985" (LJ-86-18). The report describes management programs, recreational fishing activity, and commercial harvesting and processing activity with respect to the coastal pelagic species.

Thomson, Scannell, and Craig report that total statewide landings of the coastal pelagics (northern anchovy, Pacific mackerel, jack mackerel, Pacific bonito, market squid and Pacific sardine) remained fairly constant in amount and value between 1984 and 1985. There were, however, changes in the composition of catch, with the 1650% increase in squid landings offset by decreases in the landings of other species. Approximately 85% of statewide landings were made in Southern California.

Anchovy reduction landings totalled 1,371 metric tons in 1985/86. This was the second lowest harvest in the history of the reduction fishery (the record low having been reached the previous season). The fishmeal market price, continuing the downward slide exhibited since 1977, was largely responsible for the poor showing this season.

In January 1986 the California Department of Fish and Game replaced the moratorium on Pacific sardine with a very limited directed fishery. By late June the 1000 short ton quota set for 1986 was close to being exhausted.(C. Thomson, FTS 893-6225)

Progress Continues on Socio-Economics Contract Studies

Dr. Daniel Huppert, Industry Economist, is currently reviewing the final draft report written under contract to NMFS by Natural Resources Consultants (NRC) on "Economic Evaluation of Mesh Size Regulation in the Pacific Coast Groundfish Trawl Fishery." The contractor has developed and implemented a micro-computer model to calculate the economic returns to commercial trawlers using various mesh sizes. Increasing mesh size from 3.5 inches to 5.5 inches, for example, causes a change in size distribution of fish captured by trawl nets. This change reflects a reduced proportion of smaller fish captured--termed an increased net "selectivity" for large fish. The model incorporates selectivity curves developed for four principal groundfish species groups.

Natural Resources Consultants were able to construct a model for analyzing the fishery based largely upon existing information. They borrowed extensively from Swartzman et al., "Adaptive environmental assessment and management of the Pacific

Coast Sebastes fishery." (NMFS NWAFC Processed Report 85-09) and Huppert and Squires, 1986, "Potential economic benefits of limited access in the Pacific Coast trawl fishery: a linear programming approach" (SWFC Admin. Rep. LJ-86-01). After review, copies will be distributed to NMFS, industry and the Pacific Fishery Management Council. (D. Huppert, FTS 893-6261)

Anchovy Spawning Biomass Estimated

Fishery Biologist Richard Methot has re-estimated historical biomasses, recruitments, and mortality for northern anchovy. Methot's technique, the Stock Synthesis Model, takes advantage of all available data including spawning biomass measured by the egg production method (EPM, the standard method of biomass estimation), biomass indices from historical egg abundance and acoustic surveys, and age composition from surveys, the U.S. fishery and the Mexican fishery. The model distributes measurement error among all types of data and produces the time series of abundance that is most likely given the available data. Incorporated in the model are three new relationships. First, the proportion of age 1 fish that are mature is dependent on temperature and ranges from about 10% to 100%. Thus in cold years with good recruitment, the spawning biomass is only about 50% of the total biomass. Second, natural mortality of anchovy depends on the abundance of Pacific mackerel and ranges from 0.5 with no mackerel to about 0.9 with current mackerel abundance. Third, major temperature changes (e.g. El Niño) are known to shift the anchovy population along the coast and determine patterns of age-specific availability to various types of age composition samples.

The new estimate of the spawning biomass time series and the estimate developed in 1982 for the Anchovy Fishery Management Plan are shown in Figure 4. It now seems that biomass peaks in the early 1960s and early 1970s were overestimated in the previous analysis which did not include the above three relationships and did not use a maximum

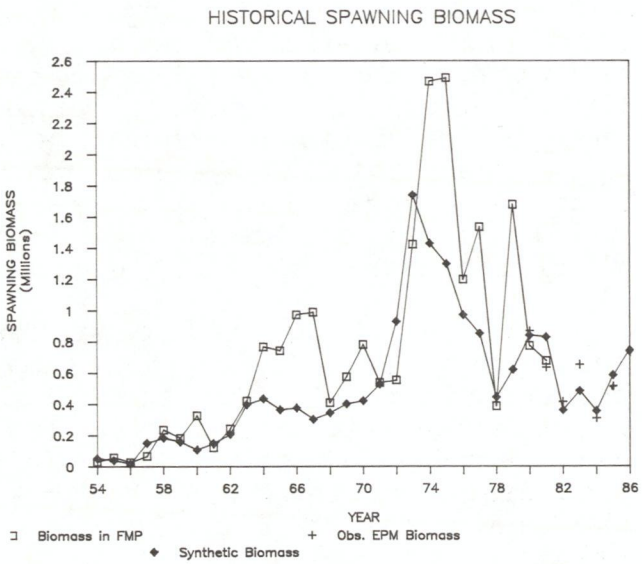


Figure 4. Time series of anchovy spawning biomass. Observations made by the egg production method are indicated by (+). The previous time series used in the anchovy FMP (open squares) and the new synthetic series (solid diamonds) are presented.

likelihood procedure to determine the best parameter estimates. The Stock Synthesis Model and the previous analysis were calibrated with spawning biomass observations made by the EPM since 1980. The average deviations between the EPM observations and the model's estimates are nearly identical to the 15-20% coefficients of variation estimated for the EPM observations. This is a satisfying result which suggests that changes in biomass indicated by EPM observations are basically consistent with changes inferred from age composition data, and that inclusion of the age composition and EPM data in a comprehensive model allows measurement error to be filtered from the input EPM observations.

No EPM observation was made in 1986. Instead, the spawning biomass was estimated by the Stock Synthesis Model using age composition data available through February 1986. The spawning biomass in 1986 is estimated to be 777,000 metric tons and is composed of 397,000 metric tons from the 1984 and older year classes and 380,000 metric tons from the recruiting 1985 year class. This estimate is nearly 50% larger than last year's EPM estimate. (R. Methot, FTS 893-6221)

Anchovy Abundance Index Calculated from Aerial Fish Spotter Logbooks

Statistician Andrew Bindman calculated an index of anchovy abundance based on aerial fish spotter logbooks collected since 1968. Large and consistent variability among spotter pilots' reported tonnages required that these differences be accounted for in the analysis. Also, because different pilots typically survey different areas, and the list of active pilots changes from year to year, there is an added complication arising from pilot-time-area interactions; that is, does a pilot give high abundance estimates because overall abundance is high, or because he only flies in times and areas where abundance tends to be high? This uncertainty (and potential for misleading results) was avoided by calibrating all of the pilots against each other, using only those schools which were observed in the same location and time. Once all of the observations had been calibrated to the standard, the anchovy abundance index was calculated by an analysis of variance (ANOVA), wherein observations are explained by a combination of area factors and time (i.e. abundance) factors. Note that pilot factors are not estimated, as the calibration has been done beforehand. As the model is multiplicative, the ANOVA used log-transformed data.

The antilogged time factors constitute a time series of quarterly abundance indexes (these values were smoothed to produce Figure 5). The time series appears to be faithful to the fluctuations in overall anchovy abundance from 1968 to 1978 estimated by Richard Methot's stock synthesis model (see preceding article). However, the level of abundance suggested by the index values from 1979 to 1982 appear to be too high in relation to the earlier values (see Figure 1 in preceding

article). It is very unlikely that the anchovy resource repeated the extraordinary abundances of the mid-1970s. The southern California purse seine fishery shifted from anchovies to Pacific mackerel during this period, so the spotters' search patterns may have changed. There is presently no way to correct the aerial index for these presumed changes in spotters' target species; as in more traditional fishery logbook analysis, multispecies effort remains an unsolved problem. The very low index value for 1983 is probably due to El Niño, when anchovy schools avoided the warm surface waters of southern California. (A. MacCall, FTS 893-6209).

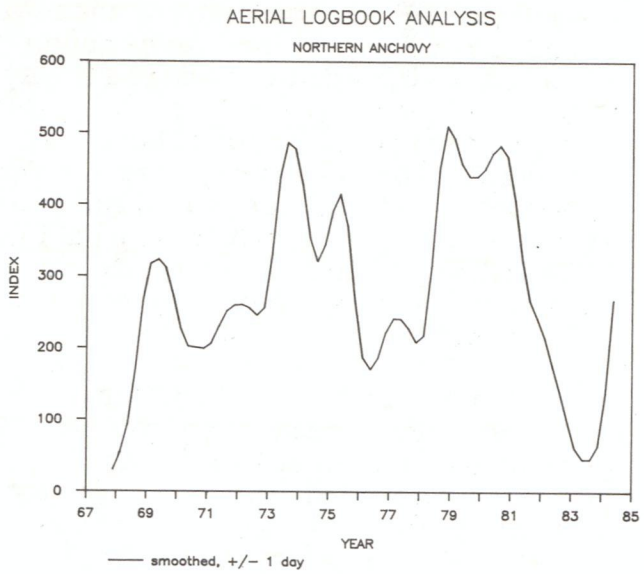


Figure 5. Index of anchovy abundance based on aerial fish spotter logbooks (scale is arbitrary).

New Definition of Pacific Mackerel Spawning Biomass Formulated

An accurate definition of spawning biomass is very important in understanding stock-recruitment relationships. An inaccurate definition introduces noise into the apparent relationship, and is likely to introduce spurious cycles of apparent spawning success as strong and weak year classes advance through the age composition. This problem becomes especially important in relating recruitment variability to environmental conditions or to fluctuations in pollution levels.

The California Department of Fish and Game monitored gonad condition of Pacific mackerel landed in southern California from 1958 through 1969 (original data were supplied by Eric Knaggs and Richard Klingbeil, CDF&G) The female gonads were classified into three categories, "I" for immature fish, "g" if eggs were present, and "G" if large translucent eggs were present. The previous definition of spawning biomass interpreted these samples based on the incidence of "g" and "G" combined, as indicators of the fraction of the fish which are capable of spawning; a proper measure of per capita egg production should moreover include the rate and duration of egg production for each age group.

Recent histological work by Beverly Macewicz, Biological Technician, and Terri Dickerson, Fishery Biologist with the CDF&G (reported by John Hunter in the Report of Activities for March-April 1986) provides an improved basis for interpreting these historical gonad observations. It is now known that the "G" category indicates hydrated eggs, which are present for only a few

hours prior to spawning, whereas "g" is the normal state of active gonads. Macewicz and Dickerson found that Pacific mackerel spawned at a rate of about every 12 days during the spawning season, but that fish were capable of spawning approximately once every 1.3 days at maximum production. In the historical fishery samples, the "G" condition was very rare in the landings of young fish, but was frequent (at times as high as 50%) for old fish in some years. Thus it appears that the old fish may have entered a condition of "maximum production" much more often than young fish. Also, the duration of the spawning season, as evidenced by presence of "g" or "G" conditions, is shorter for younger ages.

A new index of per capita egg production was calculated as follows: For each age group, monthly proportions of "g" and "G" gonads were converted to an index of spawning activity according to the two assumed rates of spawning, $I_{month} = (g/12) + (G/1.3)$. An annual index of age specific spawn production was obtained by summing these monthly indexes over the year. Analysis of variance allowed the variability in the annual indexes to be separated into multiplicative year- and age-specific factors. The coefficient of variation of year effects was about 50%, indicating substantial year to year variability in per capita egg production. The age factors provide a new set of age specific coefficients for an index of population egg production which replaces the old concept of spawning biomass. Factors for ages 3, 4 and 5+ were nearly the same, so these were defined as 1.0 and the remaining values were scaled accordingly. Unlike the previous coefficients, no density dependence was apparent for the age 1 fish. The new definition of population egg production shows that average reproduction by Pacific mackerel occurs about one year later in a fish's life than was previously thought. (A. MacCall, FTS 893-6209)

Age	1	2	3	4	5+
Old coefficients of "spawning biomass"	0 to 0.54	0.77	0.88	1.0	1.0
New coefficients of "population egg production"	0.062	0.514	1.0	1.0	1.0

Pacific Mackerel Biomass Estimates from 1929-1965 Revised

Dr. Michael Prager, Operations Research Analyst, and Dr. Alec MacCall, Fishery Biologist, have calculated a new set of biomass estimates for the Pacific mackerel stock (Figure 6). These estimates are a distinct improvement over existing estimates in several ways.

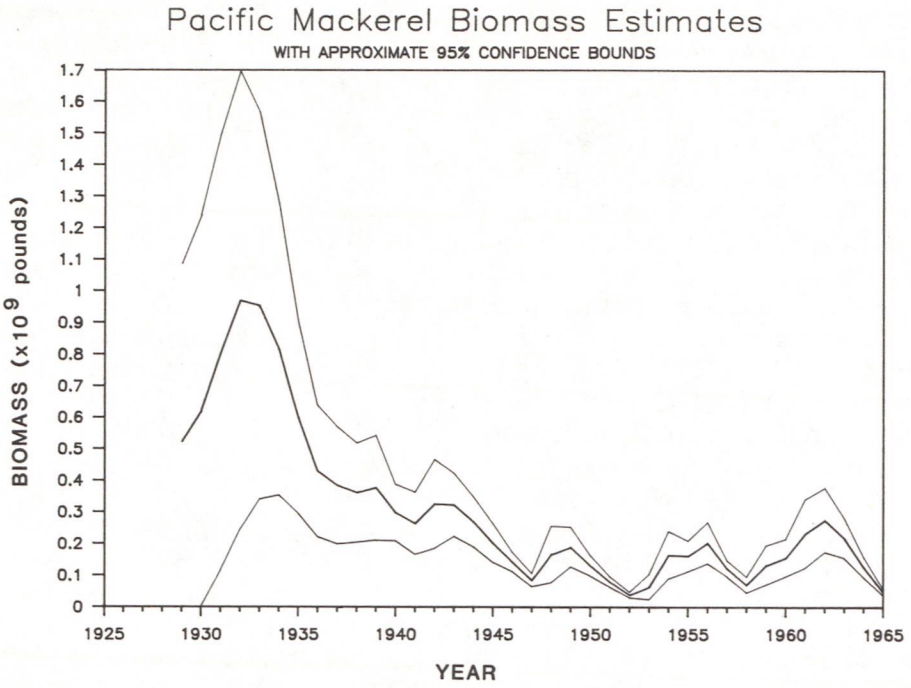


Figure 6.

First, the weights at age before 1940 have been reconstructed using regression analysis on population size and the weight at the previous age. Although density-dependent growth is evident from the data, former studies have used constant weights in the absence of measurements prior to 1939.

Second, the accuracy of the estimates was improved by using coefficients derived from a monthly cohort analysis algorithm. Such an algorithm takes into account the seasonal distribution of the catch--and not just its annual magnitude. This correction increased the biomass estimates by about 5%.

Most importantly, Prager and MacCall used the delta method to estimate the variance of each year's biomass estimate. These variance estimates are incorporated into Figure 1 in the form of an approximate 95% (± 2 standard error) confidence interval for each year. The estimated coefficient of variation (CV) is highest in 1929 at approximately 54%, declines steadily to 22% in 1938, and remains between 10% and 22% (with a few exceptions) through 1965. The high CV's in the early years are due to poorer knowledge of the age structures of the catches at that time; ages were determined by length frequency analysis, rather than actual ageing of fish. Also, since the early weights at age are reconstructions, they have higher variances.

Figure 7 shows the average composition of the variance estimates, 1939-1965. (Note that the earliest, high-variance years are omitted here.) Most of the variance comes from the natural mortality, M, and the weights at age. Other contributors are the catches at age, the total catch, and the F transfer coefficient. This last is specific to the cohort analysis algorithm used, which, by linking cohorts, requires only one a priori estimate of F. The contribution of this value, F_{1969}, to the mean variance was negligible.

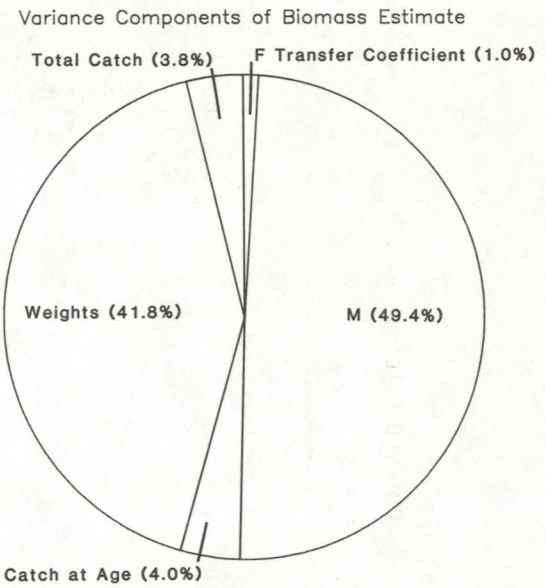


Figure 7.

The significance of this work is threefold. First, it gives an improved picture of the stock's population dynamics. Second, it provides a foundation for the recruitment modeling to form the next part of the Effects of Contaminants study now in progress, which is being funded by Ocean Assessments Division of National Ocean Service. Such modeling would be difficult, if not impossible, without the new variance estimates. Third, it demonstrates a practical algorithm for examination of the variances of cohort analysis estimates, an examination often overlooked in practice. (M. Prager, FTS 893-6272)

FISHERY-MARINE MAMMAL INTERACTIONS DIVISION
La Jolla, California

Handbook for Dolphin Sampling Completed

Dr. Al Myrick, Wildlife Biologist, has just put the finishing touches on a 69-page booklet for tuna-boat observers entitled "Procedures for sampling dolphins: A handbook for shipboard observers." The handbook discusses the proper use of sampling equipment, explains in detail the procedures for taking, preserving, and storing the biological samples, and describes the features and locations of anatomical sites from which samples are taken. Descriptions of data and specimen collection are amply supported by the handbook's 22 figures and an extensive index provides ready reference to key-word topics.

The handbook is more than just a "how-to" manual. To help make the job easier and more relevant to the shipboard observer, the handbook includes explanations of why particular procedures are required and how various samples are used in biological studies. Myrick's booklet is intended primarily as a presentation of sampling guidelines for the observer in training. However, it also contains information that the more experienced field scientist may find useful. It will soon be available as a SWFC Technical Memorandum. (A. Myrick, FTS 893-6335)

New Study Investigates Changes in Life History Parameters That Correlate with Fishing Effort

The Biological Systems Investigations Program of the Fishery-Marine Mammal Interactions Division almost exclusively uses data and samples taken from dolphins by observers on board U.S. tuna vessels for investigations into stock discrimination and identification, reproductive and growth rates, and age distributions. These investigations, in turn, support ongoing population studies. Of immediate relevance for estimating trends in the population sizes of ETP dolphin stocks is a new study by Fishery Biologists Aleta Hohn and Susan Chivers investigating changes in life history parameters that correlate with fishing effort.

Preliminary results for a sample of 1787 spotted dolphin calves show that the ratio of female (f)-to-male (m) calves (smaller than 130 cm or approximately 1 year of age and younger) increases with cumulative fishing effort. For low effort areas, the ratio is near parity. For medium effort areas, the ratio is about 2 (f) to 1 (m), for high effort areas, the ratio is about 3.5 (f)-4.0 to 1 (m). In contrast, the sex ratio of a sample of 1850 fetuses is slightly in favor of males, approximately 0.8 (f) to 1 (m).

Although fishing effort cannot be related to dolphin density in a given area, comparisons with other populations are instructive. Skewed sex ratios of young have been observed in terrestrial animals at different population levels and is thought to be a compensating response to changing population density.

Current and future efforts will examine the changes in calf and fetal sex ratios in detail, as well as investigate, among other life history traits, age at sexual maturation and changes in length at birth to determine whether these life history parameters may be useful as indicators of trends in population size. (A. Hohn, FTS 893-6202)

Ship and Helicopter Survey Conducted on How to Estimate Abundance of Harbor Porpoise

An experimental ship and helicopter survey for harbor porpoise, Phocoena phocoena, in central California was conducted from April 24 to May 5 by researchers at the Southwest Fisheries Center. Dr. Jay Barlow, Operations Research Analyst, directed the surveys, which were designed to investigate factors which may affect how porpoise abundance is estimated from previous data on ship and aerial transects. The surveys were concentrated in the area of the mouth of the Russian River and on Monterey Bay, two areas with high porpoise abundance. The experiments were designed to gather data on three questions that are relevant to abundance estimation: 1) Are harbor porpoise missed by ship-based observers because they avoid ships? 2) Of the porpoise that are visible at the surface, what fraction is missed by the observer teams on ship surveys, which are usually made up of 5 persons.

A chartered helicopter (Hughes model 500D) was used in conjunction with the NOAA Ship David Starr Jordan to investigate the first two questions. The helicopter team was led by Charles Oliver, Wildlife Biologist, and included Rennie Holt, Operations Research Analyst; and Barbara Taylor, Wildlife Biologist at the National Marine Mammal Laboratory, Seattle. The helicopter team scouted the waters approximately 3-5 miles ahead of the ship, while the Jordan followed along transect lines that corresponded to either the 10- or 25-fathom isobath. When a group of porpoise was spotted from the helicopter, the ship was directed to pass in the vicinity of the group. Meanwhile, the helicopter team made observations on porpoise behavior, including diving patterns, the fraction of time the animals were visible from the air, and any changes in behavior as the ship approached. During this time, the positions of the ship and helicopter were regularly recorded from LORAN systems on both platforms. In addition, the relative position of the helicopter was monitored from the ship by taking radar bearings.

During the joint helicopter and ship study, 32 sightings were made of porpoise groups from the helicopter. Weather conditions were adverse, however, and of these 32 sightings, only 10 groups provided useful information on surfacing interval and 6 groups yielded data on vessel avoidance. Only on one pass of the ship were distinct avoidance behaviors noted. In that case, the group of porpoise moved very rapidly out of the path of the ship and then parallel to (but in the opposite direction of) the ship. This particular group of porpoise was also spotted by observers on the ship. Although sample sizes are too small to form generalizations from these results, it appears that porpoise avoidance of surveys ships is likely to occur only when the ship has approached to within 1 km and (even when it occurs) may not prevent the porpoise from being spotted by the ship-board observers.

The other major aspect of the helicopter study was to determine the fraction of time that porpoise are visible from the air. This is relevant to the problem of estimating porpoise abundance from aerial surveys. Previous aerial surveys have, however, used fixed-winged aircraft. Observers on such aircraft only see the animals that are near the surface during the few moments that the plane is passing over a spot. Based on the 10 groups that were observed in detail from the helicopter, these animals spent only 24.4% of their time near enough to the surface to be seen from the helicopter. This result will have a major impact on interpreting previous aerial surveys because it means that density estimates must be approximately four times greater than the estimates based just on those groups that were seen.

In addition to work with the helicopter, teams of observers on the research vessel conducted surveys of porpoise abundance in central California. Observers included Peter Boveng, Randy Rasmussen, and Stephanie Sexton from the Fishery-Marine Mammal Interactions Division; Sallie Beavers, California Department of Fish and Game; Sara Heimlich-Boran and Vince Dollarhide, Moss Landing Marine Laboratory; Izzy Szczepaniak, California Academy of Science; Marc Webber, Oceanic Society; and Kate Wynne, University of Maine. A total of 200 groups of harbor porpoise was seen from the research ship. When not working with the helicopter, two independent teams of observers searched simultaneously from the ship: the principal team of 5 searched from on top of the pilot house and a "monitor" team of 3 searched from one deck below. This arrangement of observers was used to address the third question of how many porpoise groups may be missed by the usual team of 5 observers. A total of 103 groups of porpoise was seen during periods when the two teams were making independent sightings. Of these, 85 were sighted only by the 5 principal observers, 6 were sighted only by the 3 monitor observers, and 12 were sighted by both groups. These data will be used to estimate the probability that a group of porpoise that are visible at the surface will be missed by observers on ship surveys. (J. Barlow, FTS 893-6263)

HONOLULU LABORATORY
Honolulu, Hawaii

FISHERY MANAGEMENT RESEARCH PROGRAM

Skipjack Tuna Workshop Held in Honolulu

The Honolulu Laboratory hosted a workshop on "Forces of Change in Hawaii's Aku (Skipjack Tuna) Industry" from April 30 to May 1. The workshop was held to review the status of Hawaii's aku fishery and to discuss current research on the fishery. The 60 participants attending the workshop included fishing vessel owners, fresh fish marketers, state and federal personnel, and University of Hawaii researchers. The presentations, which covered biological, environmental, and economic aspects of the fishery, will be summarized in a Southwest Fisheries Center Administrative Report; the available papers will also be released as administrative reports. In addition to the 10 scientific presentations, background information was introduced in preparation for a strategic planning meeting of industry representatives which will be held at a later date.

The workshop was co-sponsored by the Hawaii Division of Aquatic Resources, the Tuna Boatowners Cooperative Inc., the United Fishing Agency, the University of Hawaii Sea Grant College Program, and the Western Pacific Regional Fishery Management Council. (S. Pooley (808) 943-1221)

American Samoa Inshore Expansion System Redesigned

David C. Hamm, Computer Systems Analyst, and Todd Kassman, Computer Programmer, completed the redesign and programming of the American Samoa Inshore Expansion System. The system will process creel survey data collected by the Office of Marine and Wildlife Resources and produce estimates of catch, effort, catch per unit effort, and species composition by fishing method for the main island of Tutuila.

The data editing, quality control, and processing system for the United Fishing Agency data were completed, and processing of the 1985 data (54,000 records) was completed. The system contains 10 programs and performs functions from data transfer to data summarization and report generation. (D. C. Hamm (808) 943-1221)

PELAGIC RESOURCES INVESTIGATION

Honolulu Laboratory Scientists Present Papers at Tuna Conference

The 37th Annual Tuna Conference was held May 18-21, 1986, at th University of California Conference Center at Lake Arrowhead, California. Dr. Richard Brill, Leader of the Tuna Behavior and Physiology Program, chaired the conference, which he organized to explore recent changes in the tuna industry and recent developments in tuna research from a variety of perspectives, including population biology, computer models, economic studies and physiological-behavioral research. The diversity of topics was also reflected in the participants, which included industry representatives, government officials, oceanographers, experimental physiologists, biochemists, and fishery biologists.

Nine presentations at the conference were based entirely or in part on work conducted at the Kewalo Research Facility in association with the Tuna Behavior and Physiology Program. These were: "Ventilation volume and cardiac output measured in free swimming tuna," presented by William K. Milsom (for David Jones, University of British Columbia); "Swimming depth/time distribution of yellowfin and bigeye tuna as determined by ultrasonic telemetry," presented by Kim N. Holland, Hawaii Institute of Marine Biology, University of Hawaii; "Cardiovascular and respiratory responses of skipjack and yellowfin tuna exposed to brief periods of low ambient oxygen," presented by Peter Bushnell, Fishery Biologist; "Characteristics of oxygen-sensitive receptors in the gills of yellowfin tuna," presented by William K. Milsom, University of British Columbia; "Tuna, tora, tuna: A metabolic biochemist's views on tuna burn," presented by Peter Hochachka, University of British Columbia; "Skipjack tuna as an elite athlete of the sea," presented by J.-M. Weber, University of British Columbia; "Strategies for elevating brain and eye temperature in tunas, sharks, and billfish," presented by Barbara Block, Duke University; "The standard metabolic rate of tunas: Why is it so high?" presented by Richard W. Brill; "The dorsal aorta parasite of yellowfin tuna: Effect on growth rate and measures of physiological condition," presented by Research Assistant Robert E. Bourke. (R. Brill (808) 943-1221)

Paper on Lactate and Glucose Turnover in Tuna Published

"Mammalian metabolic flux rates in a teleost: lactate and glucose turnover in tuna" by J.-M. Weber, R. W. Brill and P. Hochachka, was recently published in the American Journal of Physiology (250:R452-458, 1986).

In this study, radioactive lactate and glucose were injected into cannulated and lightly restrained skipjack tuna, Katsuwonus

pelamis. The goals of the study were to: (1) find out whether the high rates of lactate clearance reported during recovery from burst swimming in tuna could be accounted for by high blood lactate fluxes; (2) to extend the observed correlation between lactate turnover and lactate concentration in mammals to nonmammalian systems, and (3) to assess the importance of lactate and glucose as metabolic fuels in tuna and to compare their flux rates with values reported for mammals. When corrected for body mass and temperature, skipjack tuna had as high or even higher lactate turnover rates than those recorded for mammals. Glucose turnover rates in tuna were found to be similar to those of mammals and therefore also much higher than those rates found in other teleosts. However, even the highest lactate turnover rates measured in skipjack tuna cannot fully account for the rate of blood lactate clearance observed during recovery, suggesting that some of the lactate produced in the skeletal muscle must be metabolized in situ.

Brill also was coauthor of "Oxygen sensitive afferent information arising from the first gill arch of yellowfin tuna" by W. K. Milsom and R. W. Brill, which was accepted for publication by Respiration Physiology.

In this study, single nerve fiber discharge was recorded from oxygen sensitive receptors located in the first gill arch of yellowfin tuna, Thunnus albacares. The technique involved removing the first gill arch, perfusing it, and then isolating single nerve fibers from the vagus nerve that innervate oxygen receptors. These oxygen sensitive receptors increased their discharge rates in response to decreasing the perfusion rate, decreasing the oxygen level in the perfusion fluid, or decreasing the oxygen in the bath surrounding the isolated gill arch. Fibres that responded to lowered external oxygen exhibited an exponential increase in discharge with a sensitivity similar to that exhibited by the well-studied carotid oxygen receptors in cats. Other data collected during this study suggested that the oxygen receptors in tuna gills are located near the gill vasculature and are more sensitive to changes in arterial blood oxygen changes in water oxygen levels. The responses recorded in these isolated fibers of the vagus nerve strongly implicate them as the afferent limb in the sensitive cardio-respiratory responses exhibited by tuna to slightly lowered environmental oxygen levels. (R. Brill (808) 943-1221)

PACIFIC FISHERIES ENVIRONMENTAL GROUP
Monterey, California

Ocean Indicator Systems under Development

Andrew Bakun, Chief of the Pacific Fisheries Environmental Group (PFEG) recently produced a set of time series of estimates of atmosphere-ocean energy and the momentum of exchange processes in the environment of the Peruvian anchoveta. These estimates were based entirely on maritime weather observations which had been reported routinely and will be part of an international cooperative study of this largest of all recorded fish stocks. Bakun's contribution to the study which has been undertaken jointly by the Instituto del Mar del Peru (IMARPE) and the International Center for Living Aquatic Resources Management (ICLARM) is a part of PFEG's research project on "Comparative Studies of Eastern Boundary Current Systems."

According to Bakun, the area off Peru presents a particular challenge since it is subject to drastic and abrupt perturbations in the natural environment for which there are only scattered observations. In Figure 1, Bakun presents filtered time series of some of the index series. He noted that all series have been observed to undergo interrelated, nonseasonal variations at multiyear periods. Episodes of El Niño, in addition to the anomalously high temperatures, are also apparently characterized

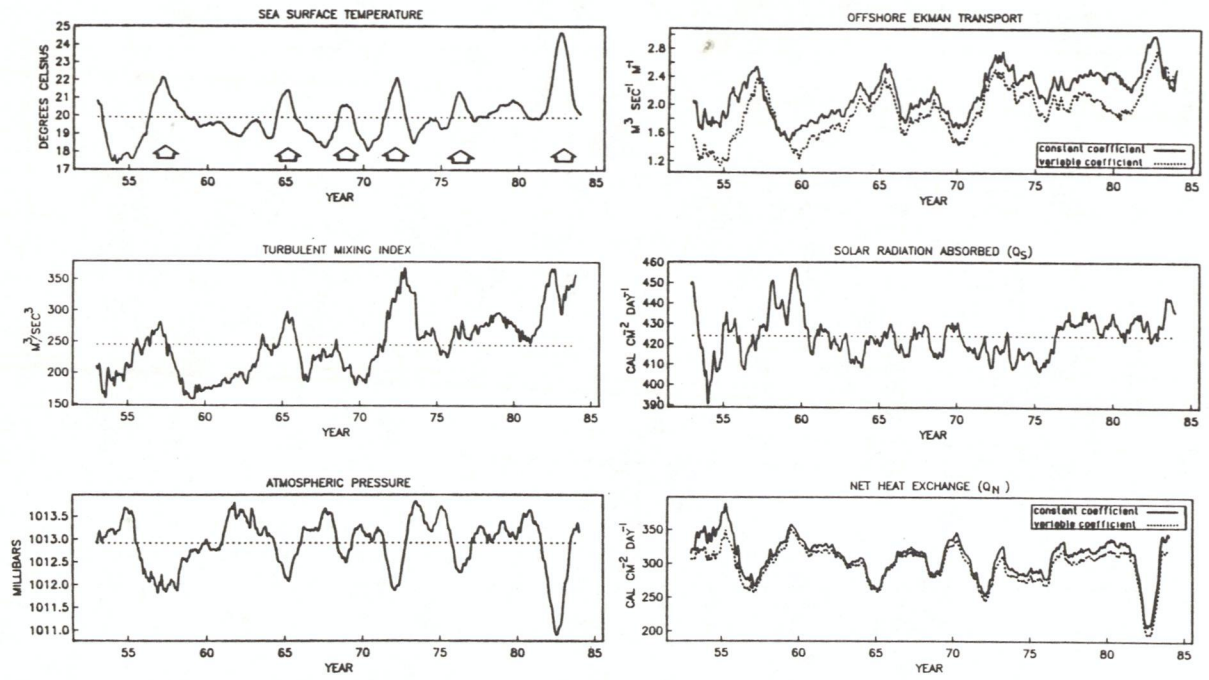


Figure 1. Low frequency non-seasonal variations. 12-month running means of monthly time series values. Major El Niño events are indicated by arrows below the temperature plot.

by intense turbulent mixing of the ocean by the wind, by intense offshore-directed surface Ekman transport, and by anomalously low heat gain to the ocean through the sea surface.

The population of Peruvian anchoveta collapsed in conjunction with the 1972 El Niño event. These results tend to corroborate the findings of Dr. Reuben Lasker and other scientists in the Coastal Fisheries Resources Division that turbulent mixing may be detrimental to larval survival of clupeoid fishes. It also appears to corroborate the results of comparative studies conducted by PFEG scientists which indicate that the reproductive strategies of anchovies and sardines permit avoidance of turbulent mixing and of strong offshore transport.

Hancock Seamount Oceanographic Data Analysis Suggests Taylor Column Effects

Oceanographer Russell Brainard, of the NOAA Corps posted to PFEG, has completed an analysis of oceanographic data taken during the SWFC Honolulu Laboratory's Insular Resources Investigation's cruises to Hancock Seamount during summer, 1984, and winter, 1985. Both cases show indications of cold doming over the seamount, and an increasing anticyclonic (i.e., clockwise, in the northern hemisphere) tendency in the flow pattern with increasing depth, relative to the surface flow (Figure 2); these indications are consistent with tendencies

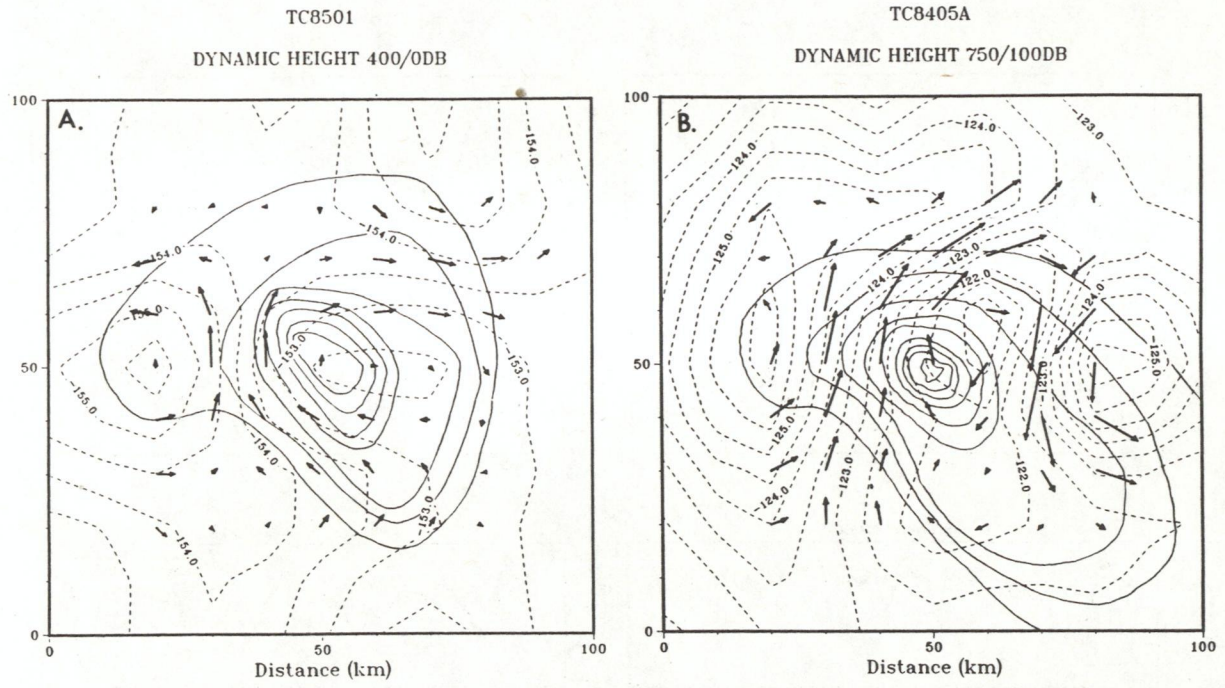


Figure 2. Geostrophic flow at depth relative to flow near the surface. Solid lines indicate Southeast Hancock Seamount bathymetry. Dashed lines indicate dynamic height contours. Vector symbols indicate geostrophic velocities. (A) Winter cruise, TC8501. (B) Summer cruise, TC8405.

expected from the presence of a Taylor column which is hydrodynamically trapped by the seamount topography.

Taylor columns are an expression of the inherent resistance to "vortex stretching" in quasi-geostrophic flow within a rotating fluid (such as is represented by the ocean on the rotating earth). Ocean water flowing over a seamount structure must experience vortex stretching due to the varying depth of the lower boundary of its motion. The result is that when the incident current is sufficiently slow and sufficiently steady, water overlying the seamount is prevented from being transported away, with the incident flow deflected around the trapped water parcel.

Retention of reproductive products and planktonic food chain components in such trapped stuctures may provide part of the explanation of how seamount ecosystems are able to generate and support surprisingly large fish biomasses. In addition, the Taylor column mechanism includes the likelihood of continual local enrichment of the area over the seamount by upwelling which is driven by frictional retardation of the anticyclonic circulation pattern. Temporal variability in the integrity of such Taylor column structures could therefore provide an explanation for a cause of variability in fish population size and resilience to exploitation.

Brainard's results suggest that if Taylor columns are indeed at the root of the observed distributions, then the one which may have been present during the winter cruise was of the "non-stratified" type, where the trapped water parcel and associated closed circulation extends upward to the surface of the ocean. Those observed during the summer cruises may have been of the "stratified" type where the Taylor column effects are trapped near the seamount surface and do not reach the ocean surface layers.

Recent measurements taken by Brainard over a deep seamount located in the California Current off central California have indicated similar thermal doming to that observed over Hancock Seamount. Thus it appears that the Taylor column phenomenon may affect ecosystems in regions of research interest to the mission of the SWFC other than Northwest Hawaiian Ridge Seamounts. (A. Bakun (408) 646-3311)

'Driver' Software Written for Graphic Displays Output on PFEG Laser Printer

Operations Research Analyst Roy Mendelssohn has recently written special software routines to permit computer-generated maps, contour plots, and other graphic displays to be printed directly on the laser printers in use at PFEG. This allows coupling of graphics and word processor-produced text on the same page, printed on the same equipment. This also provides a very fast and convenient alternative to computer graphics production

on PFEG's multi-color 'ink pen' graphics plotter. The expanded capability further enhances the versatility and power of PFEG's multi-user scientific computing facility, which has developed into an exemplary system under the management of Mendelssohn and Oceanographer David Husby. (R. Mendelssohn (408) 646-3311)

PELAGIC FISHERIES RESOURCES DIVISION
La Jolla, California

Meeting Held to Coordinate NMFS Tuna Research

Representatives of the Southeast Fisheries Center (SEFC) and the Southwest Fisheries Center (SWFC) involved in tuna research met in La Jolla, California, on May 22, 1986, to discuss current tuna research at the two centers and the rationale for future research. Gary Sakagawa, Chief of the Pelagic Fisheries Resources Division (PFRD), convened the meeting, and Wes Parks, Fishery Biologist, served as rapporteur. The meeting was the first in what may become a series of annual SEFC/SWFC meetings.

Izadore Barrett, Director, welcomed meeting participants. He explained the recent re-organization of research on tuna, and noted that since the organization is new, research plans are not yet firm. Gary Sakagawa is the coordinator of SWFC's tuna research and a strategic plan for tuna research will be developed soon.

Barrett stated that in FY87 the SWFC will add a new focus to tuna research: gathering fisheries data and related information, keeping aware of worldwide matters relating to tuna fisheries and processing and trade in processed tuna, and distributing the information to researchers, fishery managers and constituents. This information gathering, evaluating and distributing is a need identified by persons in the U.S. tuna industry. For tuna in general, Barrett noted that stock assessments and research on improving assessment methods should be high on the list of activities.

Sakagawa reviewed research activities in the Division in 1986, and indicated that the staff of PFRD will be working on data management and stock assessment. Reuben Lasker, Chief of the Coastal Fisheries Resources Division, described research on tuna in the Coastal Division, noting that activities underway are in economics of tuna fisheries and in albacore/oceanography.

Fishery Biologist Chris Boggs of the Honolulu Laboratory summarized recent tuna research at Honolulu and described future tuna research, which will focus less on the global tuna situation, now the purview of the PFRD, and more on local Hawaiian pelagic fisheries (and those in other Fishery Conservation Zones in the central and western Pacific).

Ray Conser of the SEFC's Oceanic Fisheries Division (OFRD), discussed tuna research at the Miami Laboratory, which has also recently been reorganized. Activities on tuna and other pelagic species are now organized so that one person is responsible for basic information on one or more species. Activities currently are concentrated on collecting basic fishery data, maintaining data bases and tracking developments in the fisheries. All

assessments using the data are done in intensive, short-term workshops involving in-house as well as invited experts. This has the advantage of pooling scarce assessment expertise to address particular problems of interest to the Pacific and Atlantic Fishery Management Councils and the International Commission for the Conservation of Atlantic Tunas. Most activities involve swordfish, bluefin tuna, blue marlin and mako shark.

Operations Research Analyst Roy Mendlessohn discussed tuna research at PFEG, which is centered around cooperation with researchers in other SWFC labs to develop the albacore fishery simulation model and efforts to develop an objective, fine spatial-scale forecasting model to forecast the probability of fishing success in one-degree squares of ocean 2 weeks in advance using data on the state-of-the-environment in these areas.

Sakagawa introduced a discussion of the rationale and objectives for future tuna research in the National Marine Fisheries Service (NMFS). He stated that the rationale for NMFS research on tuna and tuna-like species is in two categories. First, as the lead U.S. marine fisheries agency, NMFS should monitor U.S. fisheries and gather data to assess the condition of the stocks. Information on the status of the stocks is used by regional management bodies and NMFS officials to manage fisheries, as directed by U.S. law, and to develop and evaluate tuna fishing policies. Second, as lead U.S. agency, NMFS should monitor development in world tuna fisheries and evaluate events that affect the supply of tuna to the U.S. market. Information generated is used by government officials to develop and evaluate U.S. tuna fishing policies that affect our role as the major world market for canned tuna and a major world tuna fishing nation. (W. Parks, FTS 893-6208)

The Role of Natural Mortality in Tuna Models Studied

The role of natural mortality in tuna stock assessment models was the subject of a recent study conducted by Fishery Biologist Earl Weber. Natural mortality in tunas is a difficult subject to study for several reasons. First, from the numerical standpoint, the great number of individuals in tuna stocks and the vast geographical ranges they occupy makes traditional natural mortality estimation procedures problematic. Determining the causes of natural mortality and at what life stage these causes manifest themselves is difficult also. Because dead tunas are heavier than sea water and therefore sink, necropsies which can be conducted on mammals, birds or other fish are impossible. Also since tunas hydrate (assimilate water) when faced with starvation to maintain their hydrodynamic form, traditional condition factors are meaningless as indicators of health. Acknowledging these problems, this study was intended to examine the various ways in which natural mortality is estimated and enters into the modeling process. This information will

ultimately be used to assess the sensitivity of fishery models to simulated changes in natural mortality.

The model chosen for this study was a cohort model because it is widely used in fishery biology and because its output is used as a basis for other population models. Two sets of simulations were conducted. In the first set natural mortality was assumed to be constant but a different value was used in each simulation. In the second set several vectors of age-specific natural mortality were used. All simulations were conducted with the same catch at age data, the average from the North Pacific albacore fishery for the years 1965 through 1982, and the resulting populations predicted in the simulations were recorded.

The results of the cohort simulations in which natural mortality was assumed constant indicate that the population sizes predicted through cohort analyses were greatly affected by the value of natural mortality even though the model was constrained in such a way that total mortality was equal to the value observed from fishery data in all simulations. Natural mortality was analagous to an interest rate in that high values of natural mortality inflate the population size at each age predicted by the cohort model. The second set of simulations, conducted with age-specific values of natural mortality, indicated the predicted population size by age group was more sensitive to the values of natural mortality for younger age groups that are well represented in the fishery than the values of natural mortality in the older age groups with fewer individuals in the catch subjected to any given level of inflation. In brief, predicted population levels were affected by the value of natural mortality when assumed to be constant, as well as by the shape of the vector when assumed to be variable. Errors in the output of a cohort model would also, of course, affect other fisheries models based on this output.

Weber presented the results of this study at the 37th Annual Tuna Conference held at Lake Arrowhead, California, in May 1986. His presentation was an introduction to the estimation of natural mortality and the problems associated with errors in the estimation procedures. Succeeding presentations by Center scientists involved methods for improving estimates of natural mortality. (E. Weber, FTS 893-6214)

Summary of the 1985 North Pacific Albacore Fishery Data Sent to Fishermen

Anthony P. Majors, Fishery Biologist, and Forrest R. Miller, Meteorologist with the Inter-American Tropical Tuna Commission, completed and sent to over 350 participating fishermen a copy of "Summary of the 1985 North Pacific Albacore Fishery Data" (Administrative Report LJ-86-10). Another 350 of these summary reports were sent to state fisheries agencies for distribution by samplers during the 1986 albacore fishing season. The report is a compilation of data taken from the logbooks of

albacore fishermen. The fishermen, who participated voluntarily in the program, recorded daily fishing effort, numbers of fish caught, types of gear used, and real-time environmental data. Majors and Miller then summarized the data and compiled the results in the "Summary."

The report shows that during the 1985 season, an estimated 7,931 mt of albacore were landed by commercial fishing vessels in ports throughout California, Oregon, Washington, and Hawaii. Approximately 82.0% of the U.S. North Pacific albacore catch was landed in California, 7.0% in Hawaii, 9.0% in Oregon, and 2.0% in Washington. About 61.0% of the catch was sampled for catch and effort and 3.0% for length-frequency. The average length of albacore measured for 1985 was 69.0 centimeters in length. Estimated annual catch-per-unit-effort for a standard vessel (45-foot) was 82.0 fish per day.

The report covers 7,728 days of sampled fishing effort. Most of this effort was concentrated in inshore areas (areas between 140°W longitude and the U.S. coastline) where coastal upwelling maintained good temperature edges from mid-July to September. The inshore fishery was strongest along the western edge of an upwelling which occurred along the coast from Point Conception to Cape Blanco. Although more than 80.0% of the total catch was taken in inshore areas, the largest number of 1-degree squares with CPUEs greater than 200 were located offshore (areas west of 140°W longitude) in areas south of 40°N latitude. Stronger than normal subtropical ocean fronts in this area from April to June may have contributed to the success of this offshore fishery early in the season.

The 1985 summary is the 12th successive year that state and federal agencies have worked together to collect information on the U.S. North Pacific albacore fishery. Those agencies participating in the program are the California Department of Fish and Game, Oregon Department of Fish and Wildlife, Washington Department of Fisheries, Pacific Marine Fisheries Commission, Western Fishboat Owners Association, and the Honolulu Laboratory. (A. Majors, FTS 893-6286)

TIBURON LABORATORY
Tiburon, California

GROUNDFISH PHYSIOLOGICAL ECOLOGY INVESTIGATION

Studies Continue of Reproductive Biology of Yellowtail Rockfish

One of the important objectives of the staff of the Physiological Ecology of Pacific Coast Groundfishes Task is to determine the reproductive capacity of rockfishes relative to their physiological conditions. Part of this study includes measurements of age- and size-specific fecundities and the examination of fertilized eggs for normal development. During the 1985-86 reproductive season, monthly field collections and laboratory studies were conducted on yellowtail rockfish (Sebastes flavidus) from the Cordell Bank area, northwest of San Francisco, California. Yellowtail rockfish were selected for study because of their coastwide sport and commercial importance and their suitability for laboratory experimentation.

Fecundity estimates were made on adult yellowtail rockfish by Maxwell Eldridge and Brian Jarvis. The eggs of the rockfish were staged at late vitellogenesis or postfertilization. Within this group, 36% had fertilized eggs. Sizes of females ranged from 325-440 mm SL (361-492 mm FL) and ages spanned 9-31 years.

When compared with yellowtail rockfish from waters off Washington state (Gunderson et al. 1980, Mar. Fish. Rev. 42(3-4):74-79), California fish had more eggs per size despite the fact that California fish were generally smaller than Washington fish.

A potentially important finding was the presence of abnormal development in a high proportion (20%) of fertilized yellowtail rockfish eggs. Fresh embryos were examined under dissecting microscopes 16-24 hours after capture. The malformation ranged from approximately 5 to 100% of all eggs sampled. In vitro incubation of these embryos in physiological saline proved them to be inviable within short periods of time.

Although causes for this condition are unknown, pathological examinations of the females revealed a fungus (Icthyophonus sp.) infestation in spleens, head kidneys, and some livers and hearts. This suggests a potential problem of reduced individual and population fecundities. Expanded studies are scheduled for the next reproductive season to determine the possible causes and to delimit the extent of the condition.

In December 1985, 26 sexually mature yellowtail rockfish were collected at Cordell Bank and returned to the Tiburon Laboratory's experimental facility at the University of

California Bodega Marine Laboratory. After acclimation, the fish were allowed to develop for the remainder of the reproductive season. Only four females progressed to full maturity and gave birth to larvae. On April 8, fish were examined for gonadal maturation state and were found to be resting or sexually inactive. This situation poses relevant questions relating to the reproductive adaptive capacity of the rockfish. Were eggs resorbed or aborted in the nonspawners? Was gonadogenesis reversed? Perhaps spawning does not take place annually. If so, what factors determine the frequency of spawning? Field and laboratory studies presently underway are designed to answer some of these questions. (M. Eldridge, FTS 556-0565)

GROUNDFISH COMMUNITIES INVESTIGATION

Young-of-the-Year Rockfishes Less Numerous in Nearshore Habitats This Year

Young-of-the-year rockfishes, Sebastes spp., continue to be fewer and are developing later than last year. This finding, based on midwater trawl collections in April and presented in the SWFC Report of Activities for March-April, has since been corroborated by direct observations of these fish arriving in nearshore habitats along the Sonoma and Mendocino coasts in June. However, this nearshore work by Investigation leader Dr. Ted Hobson, with Fishery Biologists Tony Chess and Dan Howard, has found that, while the total number of Sebastes spp. has been lower, at least one species--the black rockfish, S. melanops--has been arriving in greater numbers this year (Table 1).

Table 1.--Juvenile Sebastes spp. at one Mendocino station, 19 June 1985 and 24 June 1986.

Species	Mean no. counted/min 6/19/85 n = 22	6/24/86 n = 37
S. flavidus	130.8	21.1
S. mystinus	50.6	9.3
S. melanops	4.2	16.4

Another apparent difference from last year is in the relative numbers of various species at different places along the coast. During 1985, the three major species nearshore--S. flavidus, S. melanops, and S. mystinus--occurred in about the same relative numbers in both Mendocino and Sonoma counties. This June, however, their relative numbers have differed between

the two regions (Table 2). The occurrence of fewer S. flavidus in Sonoma may relate to the association of this species with beds of the bull kelp (Nereocystis). These beds are developing rapidly in both areas at this time of year, and were less developed in Sonoma when counts were made there on 12 June, than when counts were made in Mendocino two weeks later. (E. Hobson, FTS 556-0565)

Table 2.--Juvenile Sebastes spp. at four stations in Sonoma on 12 June 1986, and at one station in Mendocino on 24 June 1986.

Species	Mean no. counted/min Sonoma n = 79	Mendocino n = 37
S. flavidus	2.1	21.1
S. melanops	3.1	16.4
S. mystinus	19.9	9.3

GROUNDFISH ANALYSIS INVESTIGATION

The staff of the Groundfish Analysis Investigation is studying the abundance and distribution of young-of-the-year (juvenile) rockfishes (species Sebastes) off the coast of central California. The major goal of the study is to estimate year-class strength of important species of rockfish prior to recruitment to fisheries.

The Investigation's fourth annual midwater trawl survey for juvenile rockfish, led by Fisheries Technician Sharon Moreland and Fishery Biologist Joseph Hightower, was completed in June. It surveyed the area between Monterey Bay and Point Reyes from nearshore to 36 miles offshore. The cruise lasted 21 days during which 102 midwater trawls were completed. (The sample design called for sampling a group of stations three times in order to study the timing of abundance of juveniles. Because time was lost due to weather and gear problems, only 2.5 station groups were completed.) More than 10,000 juvenile rockfish were caught, considerably more than in previous cruises. Over 9,000 were shortbelly rockfish (S. jordani), with brown rockfish (S. auriculatus), bocaccio (S. paucispinis), widow rockfish (S. entomelas), and canary rockfish (S. pinniger) the next most abundant species. The juveniles were small on the average, 10-30 mm total length, compared to previous years when they averaged 30-60 mm total length, and appeared to be late in arriving in the study area. Catches were considerably higher in the second and third legs than in the first leg.

Identification of the specimens should be completed in July and the results will be incorporated in an annual report of juvenile rockfish studies by the Tiburon Laboratory. (T. Wyllie Echeverria, FTS 556-0565)

FISHERIES INFORMATION SYSTEMS & ADP
La Jolla, California

Word Processing Units Converted to 10 Pitch Typing Element

To comply with directives in the new Department of Commerce Correspondence Handbook, the word processing units at the La Jolla Laboratory have been converted from the 12 pitch to the 10 pitch typing element. The conversion to the 10 character per inch and 65 character margin was effective June 27. Dorothy Roll, Systems Analyst, issued a general memo requesting that the scientific and technical staff conform to this format when submitting text files to the secretarial staff. (D. Roll, FTS 893-6250)

Committee Discusses Computerized Shipboard Data Collection System

The shipboard committee members Ron Lynn and Rich Charter of the Coastal Fisheries Resources Division, Wes Parks and Al Coan of the Pelagic Fisheries Resources Division, Jack Brown, Susan Jacobson, and Dorothy Roll met in mid-May to review the status of the software for the shipboard data collection system. They also discussed Charter's observations of the CAMAC/Molecular 15-8 interface during the CalCOFI cruise in early May, and specified the collection requirements for the sensors. The sensors tapped are wind direction, fluorometer, wind speed, water temperature, salinity, SAT NAV, and Loran C. For each of the sensors, the committee defined the collection intervals, the averaging intervals, and the acceptable range limits. They specified Greenwich Mean Time as the date tag for all records. By default, the Molecular 15-8's time of day is local time. The committee asked Jack Brown to write a program to reset automatically the 15-8 clock to Greenwich Mean Time whenever the unit is re-started after a down time. (D. Roll, FTS 893-6250)

MISCELLANEOUS

Public Affairs

La Jolla Laboratory

Honor Student Wins NOAA Marine Science Grant

Lena S. Shiroma, valedictorian of her class at Mar Vista High School in Imperial Beach, California, with a perfect 4.0 scholastic record, is the latest recipient of the 1986 National Oceanic and Atmospheric Administration (NOAA) Junior Fellowship Award.

Each summer since 1972, one or more outstanding graduating high school students have been selected to work at one of the Center's laboratories in La Jolla, Monterey, and Tiburon, California and Honolulu, Hawaii where they gain valuable practical experience in marine sciences research, working directly with staff scientists. Each summer, and during extended holiday breaks throughout their college years, the NOAA Junior Fellows return to the Center's laboratories. Upon their graduation from college, they are eligible for positions with NOAA without further Civil Service competition.

According to her teachers and counselors, Shiroma, who was born in Japan, is destined for success based on her outstanding high school record. Listed in Who's Who Among American High School Students for the past 3 years, winner of the Academic All-American Award in 1985, recipient of the Harvard Club of San Diego Certificate of Merit, recipient of an award in 1985 from the American Chemical Society, President of the California Scholarship Federation, recipient of the American Legion Citizenship Medal for Life Saving, Shiroma appears to be every parent's ideal teenager. With all her many activities, Shiroma still found time to visit elderly residents of a convalescent home on a regular basis, distribute campaign material and voting surveys, take leading roles in high school plays, and join clubs to improve interracial relationships. Shiroma, who will enter Pomona College in the fall of 1986, plans to major in the field of marine and aquatic biology.

At the Center, Shiroma will be assigned to work with Dr. William Perrin and his staff who conduct research studies on the systematics and ecology of tropical dolphins.

Nominations for the NOAA Junior Fellowship program are requested from local area high schools during March and April of each year. To be considered for the program, candidates must be in the upper 10% of the graduating class in an accredited public or private high school and need earnings from employment to help meet college expenses.

June 25 - Paul Smith gave a talk at the La Jolla Country Club on the subject of "Ocean Variables" to a group of 40 retired corporation executives, military officers and educators comprising the Twelve-Thirty Club.

Pacific Fisheries Environmental Group

May 24-25 - Members of the PFEG staff manned a NOAA/NMFS exhibit at the Monterey Squid festival. Paul Sund was coordinator.

June 12 - Members of the PFEG staff attended the dedication for Fleet Numerical and Naval Environmental Research and Prediction Facility Administration and Research building. This new building will make offices available in Building 4 where PFEG will move during the second week in July.

Tiburon Laboratory

May 1 - Mickey Eldridge presented a talk on the physiological ecology of the early life stages of fishes to a graduate class in fish physiology at the University of California, Davis.

15 - Edmund Hobson and Mickey Eldridge met with a fishery biology class from the College of Marin, Kentfield, California, and presented slides and a discussion on the coastal fisheries programs of the Tiburon Laboratory.

NEWS RELEASES

Honolulu Laboratory

May 2 - Rehabilitated Monk Seals to Be Released.

28 - Abandoned Monk Seal Pups Rescued.

June 2 - Kaiser High School Senior Selected for Junior Fellowship Program.

- NOAA Ship Completes Deepwater Shrimp Research Cruise.

20 - Many Cooperate to Rescue Injured Sea Turtle.

La Jolla Laboratory

June 19 - Fisheries Service Administrator Honored as Employee of the Year.

26 - Honor Student Wins NOAA Marine Science Grant.

SEMINARS

Honolulu Laboratory

May 2 - Harold Hirth of the University of Utah spoke on "Reproductive Strategies of Sea Turtles."

9 - Grant Bartlett, Laboratory for Comparative Biochemistry, San Diego, California, spoke on "Marine Turtle Nesting Along the West Coast of Mexico, and Fishing in the Amazon."

30 - David A. Somerton spoke on "Pearl Harbor Nehu: Recruitment Processes."

June 20 - Michael Hall, Hallprint Pty., Ltd., Australia, spoke on "New Developments in Fish Tags."

La Jolla Laboratory

May 22 - Dr. Ray Hilborn, South Pacific Commission, Noumea, New Caledonia, presented "Appropriate Questions for Fisheries Stock Assessment."

June 3 - Dr. Ivar Strand, Department of Agricultural and Resource Economics, University of Maryland, College Park, Maryland, spoke on "Inter-Modal Substitution in Southern California Sport Fishing."

16 - Jean Michalski, Technical Writer/Editor, gave a seminar on "Writing and Correct Grammar."

Tiburon Laboratory

May 21 - James Clegg, Director of the Bodega Marine Laboratory, University of California, spoke on "Adaptations to water loss in Artemia embryos" as part of the Tiburon Seminar Series, a cooperative effort of the Paul F. Romberg Tiburon Center for Environmental Studies (San Francisco State University) and the Tiburon Laboratory.

June 13 - Robert Cooper, Chief of Fishery Management, New Zealand Ministry of Agriculture and Fisheries, spoke on "Structure of fisheries management in New Zealand" as part of the Tiburon Seminar Series, a cooperative effort of the Paul F. Romberg Tiburon Center for Environmental Studies (San Francisco State University) and the Tiburon Laboratory.

HONORS AND AWARDS

Pacific Fisheries Environmental Group

Fisheries Service Administrator Honored as Employee of the Year

Rosemary Troian, Administrative Officer for the Pacific Fisheries Environmental Group (PFEG) in Monterey, California, was named NMFS Employee of the Year for 1985.

Functioning as a one-woman administrative office for a staff of 12 oceanographers, mathematicians, and fishery biologists, Troian is responsible for procurement, travel, personnel and budget, as well as many other related duties. According to Oceanographer Andrew Bakun, Chief of PFEG, Troian was selected for the award because of her outstanding performance in all her areas of responsibilities. He cited her willingness to take on tasks beyond her regular duties and to work with the scientific staff in helping them meet deadlines. Bakun noted that Troian's contributions have raised the productivity and effectiveness of the entire unit.

Troian began work for PFEG in 1983. She graduated from Wisconsin State University at Whitewater with a Bachelors of Education degree in 1963, and has worked for the U.S. Naval Postgraduate School and Monterey Peninsula College.

The NMFS Employee of the Year is selected by a Manpower Committee in the Fisheries Service on the basis of nominations solicited within the organization nationwide. Troian, who won her award in the category for administrative, technical, clerical, and support service, was recognized for her exceptional and sustained efforts toward accomplishing the NMFS mission to "assist in the development, use, and protection of living resources in the sea." She will receive a plaque and a cash award from NMFS.

VISITORS

Honolulu Laboratory

May 2 - Center Director Izadore Barrett spent the day at the Honolulu Laboratory.

- Gary T. Sakagawa, Chief, Pelagic Fisheries Resources Division, La Jolla, met with Richard Shomura, Sam Pooley, George Boehlert, Jerry Wetherall, Richard Brill, and Robert Skillman to discuss future tuna research at the Southwest Fisheries Center.

5 - University of Hawaii student Warren Izke met with Richard Shomura to discuss a paper he prepared on the skipjack tuna workshop.

7 - Henry Sakuda, Al Katekaru, and June Shimana of the Hawaii Division of Aquatic Resources met with Richard Shomura, David Hamm, and Fletcher V. Riggs to discuss WPACFIN.

- Omer Darr, a visitor from Tahiti, gathered information at the Honolulu Laboratory in connection with a possible acquisition of a purse seiner by the French government in Tahiti.

8 - J. R. Spradley, Special Assistant to Dr. Calio, visited Richard Shomura.

14 - Paul J. Struhsaker visited several staff members.

29 - Richard Brill met with John DeBeer, Van Camp Seafood Division, Ralston Purina Company, to discuss practical applications of research to determine short-term tuna movements using

ultrasonic telemetry (i.e., results of the tracking project).

30 - Marsh Youngbluth, Harbor Branch Foundation, Florida, visited George Boehlert to discuss seamount research and submersible programs.

- G. David Johnson, Smithsonian Institution, Washington, D.C., visited George Boehlert and Bruce C. Mundy.

June 9 - Michael Gawel, Chief, Marine Resources, Federated States of Micronesia, Kolonia, Pohnpei, visited David Hamm.

13 - Chung-Hai Kwoh, Taipei, Taiwan, Republic of China, visited Richard Shomura.

23 - Tim Davis, Commonwealth Scientific and Industrial Research Organization, Australia, visited the Honolulu Laboratory.

24-26 - Center Director Barrett, Deputy Director John Carr, and David Mackett, Center Planning Officer, conducted the annual Honolulu Laboratory program review.

La Jolla Laboratory

20 - J. Curtis Mack II, Deputy Administrator, NOAA, Washington D.C., met with Center Director Izadore Barrett and toured the Center.

J. Curtis Mack II

May 19-20 - Alex Duncan, Assistant Manager - Economics, New Zealand Fishing Industry Board, visited economists in the Commercial and Recreational Fisheries Research program, seeking information on data collection and analysis methods used in NMFS.

22 - Three representatives from the Office of the Inspector General, Department of Commerce, began a 6-week stay at the Center.

June 2- 5 - Ivar Strand, Professor of Agricultural Economics at the University of Maryland, visited the La Jolla Laboratory, providing computer software and instructions for computing maximum likelihood estimates of multiple discrete choice models.

4 - Mr. Hansen, Office of the Inspector General, Department of Commerce, visited the Center.

17-20 - Robert Pedrick and Mary Gessner, Office of Resource Investigation, NMFS, Washington, D.C. came to the Center to participate in the Coastal Fisheries Resouces Division and Albacore Task Review.

24 - Representatives from the Office of Personnel Management were at the Center for an Installation Assessment visit.

30 - Phil Meyer, Meyer Resources, Inc. conferred with Dan Huppert on economic analysis for the Sacramento chinook salmon habitat study.

Pacific Fisheries Environmental Group

May 16 - Robin Muench, Science Applications Inc., Bellevue, Washington, visited with Dave Husby to discuss Antarctic CTD data.

June 2- 3 - Izadore Barrett, John Carr and Bob Wolf came to PFEG for the annual program review.

Tiburon Laboratory

May 13 - David Yee-Ting, Assistant Secretary, Office of the President, Republic of Kiribati, met with Norman Abramson and Sus Kato to discuss methods of fishery management and regulation.

29 - Ken Sasaki of Nippon Suisan Co. (Japan) and Great Land Seafood (a joint venture firm in Redmond, Washington, and Alaska) visited Sus Kato to discuss surimi and its applications in the U.S. Sasaki was

on temporary assignment as a quality control expert at the surimi plant in Dutch Harbor.

June 10 - Jerry Rosenthal visited Sus Kato to discuss development of markets for underutilized species of fishes.

MEETINGS AND TRAVEL

Honolulu Laboratory

May 2 - Sam Pooley represented Richard Shomura at the Hawaii Fisheries Coordinating Council meeting at the Hawaii Department of Land and Natural Resources board room.

5 - Robert A. Skillman, Leader, Fishery Management Research Program, departed for a 4-month rotational assignment in Washington, D.C.

13 - Laboratory Director Richard S. Shomura attended a luncheon for Ambassador Edward E. Wolfe, Deputy Assistant Secretary for Oceans and Fisheries Affairs, Department of State. Ambassador Wolfe was in Honolulu to participate in tuna negotiations.

14-21 - Richard Shomura traveled to California to attend the tuna conference at Lake Arrowhead.

17-24 - George W. Boehlert traveled to Miami, Florida, to attend the 10th Annual Larval Fish Conference, where he presented a paper and chaired a session.

18-21 - Richard Brill, Peter Bushnell, and Robert Bourke traveled to Lake Arrowhead, California, to attend the 37th Annual Tuna Conference.

19-20 - Richard Shomura traveled to La Jolla to participate in the albacore program review.

25 - Richard Shomura traveled to the South Pacific to attend a meeting as a delegate of the State Department in Noumea, New Caledonia, and the South Pacific albacore workshop in Auckland, New Zealand.

27 - George Boehlert and Sam Pooley attended a meeting of the Council's Bottomfish Planning Team to discuss access management schemes.

29 - George Boehlert, Jerry A. Wetherall, and Jeffrey J. Polovina and Sam Pooley attended the 53rd meeting of the Council.

30 - Dorothy D. Powell attended the Federal Executive Board luncheon meeting at the Hale Koa Hotel.

La Jolla Laboratory

May 1- 3 - Director Barrett traveled to Honolulu, Hawaii, to attend a Tropical Tuna Research Planning meeting.

2 - Dan Huppert gave a lecture to Dave Farris's fisheries course at San Diego State University.

2- 5 - William Flerx, Eric Lynn and Ron Dotson traveled to Santa Cruz, California, to meet the NOAA Ship David Starr Jordan.

7-14 - Mark Lowry went to San Miguel Island to recover time depth recorders attached to adult female elephant seals and to conduct the elephant seal stomach lavage/food habits study with Marine Mammal Laboratory personnel.

14-15 - Director Barrett went to Washington, D.C. to brief House and Senate staffers on the SWFC dolphin monitoring cruises.

14-21 - Steve Reilly and Rennie Holt traveled to Woods Hole, Massachusetts, to participate in a workshop on Right Whale Assessment and to Washington, D.C. to visit NMFS Headquarters.

15-16 - Charles Oliver went to San Miguel Island to conduct studies on Northern elephant seals.

16-22 - Paul Smith attended the 10th Annual American Fisheries Society Larval Fish Conference in Miami, Florida. At the Conference, Smith gave a presentation and organized a symposium.

18-19 - Izadore Barrett and Norm Bartoo attended the 37th Annual Tuna Conference at Lake Arrowhead, California.

18-21 - Andrew Dizon met with staff of the Marine Mammal Commission in Washington, D.C.

- Attending the 37th Annual Tuna Conference at Lake Arrowhead, California, were John Carr, Al Coan, Pierre Kleiber, Michael Laurs, Wes Parks, Gary Sakagawa, David Holts, Elizabeth Vetter, Earl Weber, and Jean Michalski. Laurs, Kleiber, Weber, and Vetter gave presentations.

18-23 - Gail Theilacker traveled to Miami, Florida, to present an invited paper at the Larval Fish Conference.

May 18 - Geoffrey Moser went to Miami, Florida, to attend
June 8 the Larval Fish Conference and to Boston to work on larval fish collections at the Museum of Comparative Zoology at Harvard University. He also went to Gloucester Pt., Virginia, to work on a larval fish paper at the Virginia Institute of Marine Science.

June 1- 4 - Alec MacCall traveled to Providence, Rhode Island, to present a paper on research needed for management of large marine ecosystems.

2- 4 - Alec MacCall presented a paper titled "Rethinking research for fishery and ecosystem management" at the 10th Annual Symposium of the Center for Ocean Management Studies, University of Rhode Island.

2- 5 - Izadore Barrett, John Carr, and David Mackett went to the SWFC laboratories at Tiburon and Monterey to conduct FY 1986 Task Reviews.

6-14 - Reuben Lasker traveled to La Coruña, Spain, to attend a Symposium on Oceanography and Marine Science.

9-13 - A Marine Recreational Fisheries Planning Workshop was held at the Center.

11-15 - Michael Prager attended meeting of the Resource Modeling Association in Newport, Oregon. He presented a paper (written with Alec MacCall), entitled "VPA estimates of Pacific mackerel spawning biomass: Calculating the variances."

13 - Izadore Barrett, Dan Huppert, Alec MacCall and Rick Methot attended a meeting of the Pacific Fishery Management Council Anchovy Advisory Subpanel in Terminal Island, California.

16-22 - John Butler attended a meeting of the American Society of Ichthyologists and Herpetologists in Victoria, British Columbia, Canada. He also went to Nanaimo, B.C., to visit the Pacific Biological Station, Nanaimo Laboratory, for training in break and burn technique for reading groundfish otoliths.

17-19 - Cynthia Thomson participated in the Marine Recreational Fisheries Statistics Survey Workshop in Portland, Oregon.

May 18 - June 9 - Pierre Kleiber traveled to Noumea, New Caledonia to investigate and document contents of tagging data bases of the Tuna and Billfish Programme, South Pacific Commission.

23-27 - Izadore Barrett, John Carr, and David Mackett went to Honolulu, Hawaii, to conduct 1986 Task Reviews at the Honolulu Laboratory.

25-27 - Gail Theilacker and Marlene Johnson boarded the NOAA Ship David Starr Jordan in San Francisco to collect live euphausiids.

May 29 - June 3 - Izadore Barrett and Gary Sakagawa traveled to Vancouver, British Columbia, Canada, to attend a University of Washington, Institute for Marine Studies workshop on world tuna management.

Constituents Meet to Formulate Plan for California Marine Recreational Fisheries

A constituents workshop on long-range planning for the California marine recreational fisheries was held in La Jolla at the Southwest Fisheries Center from June 9 to 11, 1986.

Dr. Christakis works with constituents of the California marine recreational fishery.

This workshop was the third in a series of three workshops, which were sponsored by the National Marine Fisheries Service and the California Department of Fish and Game (CFG) and held to prepare a long-range, strategic plan for the California marine recreational fishery. This meeting was focused on constituents' goals and objectives (see Report of Activities for March-April, 1986). Fourteen constituents from northern and southern California participated in the workshop, which was facilitated by Dr. Aleco Christakis and Hillary Austen of the Center for

Interactive Management, George Mason University, and David Mackett, Planning Officer for the Southwest Fisheries Center. During the workshop, participants generated goals for the future of the California marine recreational fishery and provided options for initiatives and activities for achieving them. Mark Helvey, Recreational Fisheries Coordinator for the Southwest Regional Office, and Don Schultze of the CFG were co-leaders of the technical task force supporting the planning effort.

Pacific Fisheries Environmental Group

May 5 - Jerry Norton met with David Vantresca of California Department of Fish and Game to confer on environmental parameters for the last 10 years.

6 - Rusty Brainard returned from a 12 day cruise on the ship DeSteiger with the Navy. Brainard did hydrographic surveys of Taney Seamounts.

19-22 - Roy Mendelssohn traveled to the Tuna Conference at Lake Arrowhead. He gave a talk entitled "Forecasting albacore catch: some preliminary results." On May 22 Mendelssohn attended a tuna planning meeting at SWFC.

June 19-20 - Dick Parrish traveled to La Jolla to attend the albacore budget review meeting.

Tiburon Laboratory

May 1 - Sus Kato traveled to Morro Bay, California, to discuss alternative fishing methods for California halibut with Bud Laurent (California Department of Fish and Game), John Richards and Karen Worcester of Sea Grant, and several Morro Bay fishermen's representatives.

20-21 - Sus Kato and Bill Leet traveled to Red Bluff, California, to set up fish traps and collect samples of Sacramento squawfish, a major predator on juvenile salmon.

23 - Sus Kato traveled to Monterey, California, to set up an informational display for the Monterey Squid Festival. Paul Sund of the Pacific Fisheries Environmental Group helped set up the NMFS Southwest Fisheries Center display, and other employees of PFEG manned the booth during the Festival.

June 2 - Norman Abramson and Bill Lenarz travelled to Sacramento, California, for a CalFIN meeting with

representatives of the California Department of Fish and Game and the NMFS Southwest Region.

9-13 - Sue Smith travelled to La Jolla to participate in the Marine Recreational Fisheries Meetings held at the Southwest Fisheries Center.

16-19 - Norman Abramson participated in a meeting of the Technical Subcommittee of the Canada-U.S. Groundfish Committee in Ashland, Oregon.

PERSONNEL ACTIONS

Honolulu Laboratory

May 5 - John J. Czyz, Computer Clerk - Excepted Appointment (SIS).

- Jerry L. Fuqua, Computer Programmer - Full-Time Temporary Appointment.

6 - Barry K. Choy, Biological Aid- Excepted Appointment (SIS).

11 - Doris J. Alcorn, Wildlife Biologist - Conversion to Career-Conditional Appointment (On-Call).

- Joseph W. Schulz, Library Aid - Conversion to Appointment.

27 - Jed Hirota, Fishery Biologist - Faculty Fellowship Appointment.

June 2 - Joel S. Lenox, Biological Science Student Trainee - Jr. Fellow Appointment.

- Frank A. Parrish, Biological Aid - Part-time Temporary Appointment.

10 - Todd T. Kassman, Computer Programmer - Extension of Temporary Appointment.

13 - Paul L. Jokiel, Fishery Biologist - Termination of Appointment.

14 - John A. Loux, Biological Aid - Extension of Temporary Appointment.

- Theresa L. M. Villanueva, Biological Science Student Trainee - Leave Without Pay Status (Jr. Fellow).

La Jolla Laboratory

May 1 - Frank Ralston, Computer Specialist - Entered on Duty.

8 - Dennis Gruber, Biological Technician - Resignation.

9 - Raymond Young, Computer Clerk - Resignation.

11 - Shirley Gray, Secretary - Entered on Duty.

26 - Bradley Earhart, Biological Aid - Entered on Duty.

27 - John Kevin George, Biological Technician - Entered on Duty.

30 - Larry Zins, Computer Programmer - Resignation.

June 5 - Andrew Bindman, Statistician - Resignation.

- Gretchen Tripp, Biological Aid - Expiration of Appointment.

22 - Douglas DeMaster, Wildlife Biologist - Entered on Duty.

30 - John Graves, Oceanographer - Expiration of Appointment.

Pacific Fisheries Environmental Group

May 23 - Rosemary Troian was named the 1985 Outstanding NMFS Employee of the Year in the Administrative /Technical /Clerical /Support Services Category.

29 - Doris Small, Biological Aid resigned from PFEG to take a job with the State of Washington.

June 20 - NOAA Corps officer Rusty Brainard graduated from the Naval Postgraduate School with a Master of Science in Oceanography.

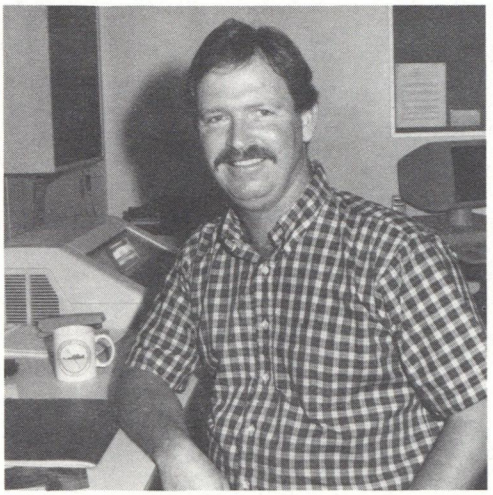
Tiburon Laboratory

May 11 - Jacqueline Toa Hing Chan, Biological Aid - Temporary Appointment.

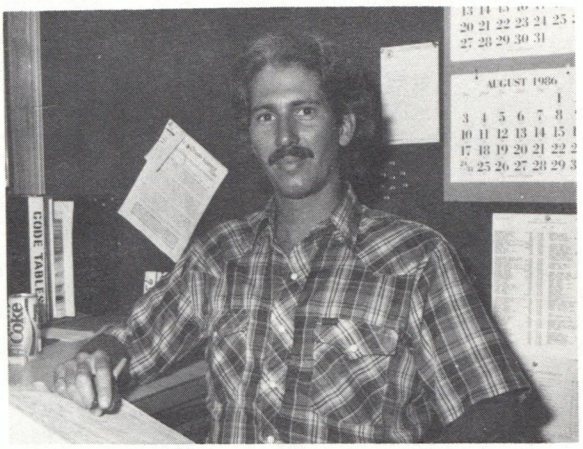
June 21 - Sharon L. Moreland, Biological Technician (Fisheries) - Transfer to the U.S. Army Corps of Engineers.

23 - Kelly R. Silberberg, Biological Aid - Temporary Appointment.

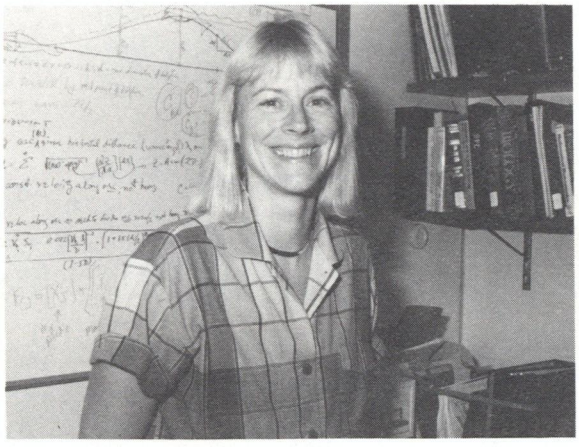
New Permanent Employees at the La Jolla Laboratory



Frank Ralston, Computer Specialist, Automatic Data Processing.



Peter La Civita, Fisheries Biological Technician, Pelagic Fisheries Resources Division.



Elizabeth Vetter (Ph.D.), Operations Research Analyst, Marine Mammal Interactions Division.

Stephanie Sexton, Operations Research Analyst, Fishery-Marine Mammal Interactions Division.

TRAINING

Tiburon Laboratory

June 17 - Susan Smith, Fishery Biologist - Power Communications Skills, Career Track Seminar

STATUS OF PUBLICATIONS

Published

Balazs, G. H. 1986. Ontogenetic changes in the plastron pigmentation of hatchling Hawaiian green turtles. J. Herpetol. 20(2):280-282. [Note.]

Johnson, D. F., L. W. Botsford, R. D. Methot, Jr. and T. C. Wainwright. 1986. Wind stress and cycles in Dungeness crab (Cancer magister) catch off California, Oregon, and Washington. Can. J. Fis. Aquat. Sci. 43:838-845.

Dungeness crab (Cancer magister) catch records along the coasts of northern California, Oregon, and Washington covary in a cyclic pattern with a period of 9-10 yr. Both environmental forcing and density-dependent recruitment have been proposed as the mechanisms causing these cycles. Spring wind stress in a southward direction is correlated with crab catch along this coast at typical lags of 4 and 5 yr. This time lag corresponds to the time required for growth from the larval phase to the size caught in the fishery. Also, computed auto-correlations show that wind stress is itself cyclic. Since crab larvae appear to be transported offshore and northward during the early larval phase, the observed correlation may result from a dependence of subsequent successful settlement on wind-driven southward, onshore transport during the late larval phase in the spring. However, the exact mechanisms are not known. The computed correlations indicate that wind stress may contribute to the observed cycles.

Mundy, B. C. 1986. Fishery resources surveyed with deep-sea camera. Hawaii Fishing News 11(5):30.

Suzuki, T., S. Yamamoto, K. Ishii, and W. M. Matsumoto. 1986. On the flying squid Stenoteuthis oualaniensis (Lesson) in Hawaiian waters. Bull. Fac. Fish. Hokkaido Univ. 37(2):111-123.

Theilacker, Gail H., Amy S. Kimball and James S. Trimmer. 1986. Use of an ELISPOT immunoassay to detect euphausiid predation on larval anchovy. Mar. Ecol. Prog. Ser. 30:127-131.

The ELISPOT immunoassay, where samples are spotted onto 0.45 μm pore-size nitrocellulose and incubations are based on a BLOTTO/Tween system, proved satisfactory for detecting northern anchovy Engraulis mordax yolk in euphausiid Euphausia pacifica guts. Polyclonal antiserum to anchovy yolk was developed in male New Zealand rabbits. The system detected 30 nannograms purified yolk protein with 1:5000

diluted antiserum and positively identified 75% of experimentally-fed and frozen euphausiids.

Weber, J. M., R. W. Brill, and P. W. Hochachka. 1986. Mammalian metabolite flux rates in a teleost: lactate and glucose turnover in tuna. Am. J. Physiol. 250 (Regulatory Integrative Comp. Physiol. 19):R452-R458.

Lactate and glucose turnover rates were measured by bolus injection of [U-^{14}C] lactate and [6-^{3}H] glucose in cannulated lightly anesthetized skipjack tuna, Katsuwonus pelamis. Our goals were 1) to find out whether the high rates of lactate clearance reported during recovery from burst swimming in tuna could be accounted for by high blood lactate fluxes; 2) to extend the observed correlation between lactate turnover and lactate concentration in mammals to a nonmammalian system, and 3) to assess the importance of lactate and glucose as metabolic fuels in tuna and to compare their flux rates with values reported for mammals. Measured lactate turnover rates ranged from 112 to 431 $\mu mol \cdot min^{-1} \cdot kg^{-1}$ and were correlated with blood lactate concentration. Glucose turnover rate averaged 15.3 $\mu mol \cdot min^{-1} \cdot kg^{-1}$. When correcting for body mass and temperature, skipjack tuna has at least as high or even higher lactate turnover rates than those recorded for mammals. Tuna glucose turnover rate is similar to that of mammals but much higher than levels found in other teleosts. Even the highest lactate turnover rate measured in tuna cannot fully account for the rate of blood lactate clearance observed during recovery, suggesting that some of the lactate produced in skeletal muscle must be metabolized in situ. After injection of [U-^{14}C] lactate, <5% of the total blood activity was recovered in glucose, suggesting that the Cori cycle is not an important pathway of lactate metabolism in tuna.

Yoshida, H. O. 1986. Marine debris: A growing concern. World Record Game Fishes. Int. Game Fish Assoc., p. 89-96.

Approved by Center Director

Boehlert, G. W. An approach to recruitment research in insular ecosystems. TRODERP Workshop held in Ciudad del Carmen, Campeche, Mexico, 21-25 April 1986.

Bourke, Robert E., James Brock and Robert M. Nakamura. A study of delayed capture mortality syndrome in skipjack tuna, Katsuwonus pelamis. For consideration for publication in the Journal of Fish Diseases.

Cooke, W. J., and G. H. Balazs. First occurrence of the caprellid amphipod Caprella andreae Mayer, 1890 in Hawaii, on the olive ridley sea turtle, Lepidochelys olivacea.

For consideration for publication in Fishery Bulletin, U.S. (Note).

Hochachka, P. W., and R. W. Brill. A new analysis of the tuna burn problem. For consideration for publication in the Journal of Food Science.

Huppert, Daniel D. and Dale Squires. Potential economic benefits and optimum fleet size in the Pacific coast trawl fleet. For consideration for publication in Marine Resource Economics.

MacCall, Alec D. Rethinking research for fishery and ecosystem management. In: Rethinking fishery management. 10th Annual Symposium, Center for Ocean Management Studies, University of Rhode Island.

Perrin, W. F., E. D. Mitchell, J. G. Mead, D. K. Caldwell, M. C. Caldwell, P. J. H. van Bree and W. H. Dawbin. Revision of the spotted dolphins, Stenella spp. For consideration for publication in Marine Mammal Science.

Polovina, J. J. Pacific island fisheries: The deep slope resources. For consideration for publication in the Pacific Islands Monthly.

Polovina, J. J., and S. Ralston. The biology and fishery management of snappers and groupers in the tropics. Westview Press.

UNITED STATES
DEPARTMENT OF COMMERCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE
SOUTHWEST FISHERIES CENTER
8604 LA JOLLA SHORES DRIVE
P.O. BOX 271
LA JOLLA, CALIFORNIA 92038

OFFICIAL BUSINESS

PENALTY FOR PRIVATE USE, $300

AN EQUAL OPPORTUNITY EMPLOYER

POSTAGE AND FEES PAID
DEPARTMENT OF COMMERCE
210

THIRD CLASS