



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Fisheries Center
Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

Richard S. Shomura

A SUMMARY OF THE 1983 TUNA BAITFISH WORKSHOP

Richard S. Shomura
Southwest Fisheries Center Honolulu Laboratory
National Marine Fisheries Service, NOAA
Honolulu, Hawaii 96812

and

Henry M. Sakuda
Division of Aquatic Resources
Department of Land and Natural Resources
Honolulu, Hawaii 96813

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An informal tuna baitfish workshop, cosponsored by the Honolulu Laboratory, Southwest Fisheries Center, National Marine Fisheries Service (NMFS) and the Hawaii Division of Aquatic Resources (DAR), was held at the NMFS Kewalo Research Facility on April 14, 1983. Eight informal papers presented at the workshop addressed past and present trends and the status of the baitfish fishery, substitute bait, habitat enhancement, and economic considerations. The 71 persons attending the workshop included leaders of the tuna industry, boat owners, boat captains, interested fishermen, and scientists from NMFS, DAR, Naval Ocean Systems Center (NOSC), and the University of Hawaii's Institute of Marine Biology (HIMB).

The purposes of the workshop were to review the problem of bait shortage in the Hawaiian skipjack tuna fishery and identify possible solutions. The workshop was organized into six sections, as noted below.

The informal nature of the workshop encouraged discussion and a free exchange of ideas among the participants, who all had a common interest (1) in finding short-term solutions to the current critical bait shortages, particularly in time for the 1983 summer fishing season, and (2) to identify long-term goals and objectives to assure sustained bait production for the future well-being of the aku fishery.

1. Present status of the aku fishery

From a review of the status of the aku fishery, it was apparent that aku production declined sharply in mid-1982. The 1982 total catch was only 6,600 lb above that of 1980, the poorest year on record.

The very low catches for 1980-81 prompted appeals from the industry for assistance and relief from the problems of bait shortage and mortality that almost constantly plague the fishermen. Discussed were research projects such as nehu habitat enhancement that could provide quick relief.

The review also brought out that aku production steadily declined from 9.2 million lb in 1971 to 2.4 million lb in 1980. Catch/boat showed a similar downward trend. It was noted that during this period of declining catches, Federal, State, and academic researchers had not taken an active part in trying to solve some of the problems, particularly as they relate to bait mortality and shortages. Criticisms and past feelings aside, it was brought out that the industry and the scientific community must come together to seek possible short-term and long-term solutions to keep the industry viable.

Discussion then focused on the current Aku Catch Report form, which even when filled out properly according to instructions, left much to be desired. Modification of the presently used form was strongly recommended.

The occurrence of "red mud" (red tide) in Pearl Harbor has also been a long-time concern of the fishermen. DAR identified this phenomenon as a dinoflagellate bloom. Apparently, water from "red mud" areas pumped into aku boat baitwells has caused total mortality of nehu. A baitwell aeration device, developed through the cooperative efforts of boat captains and DAR biologists, has apparently proved helpful.

It was pointed out that catching bait in Pearl Harbor's West Loch is no longer practical because almost no bait is available in this sector. The question asked was whether this condition is merely temporary or more or less permanent.

On other species, it was questioned whether substitute cultured bait could be made available in time for the upcoming aku season and whether the species being considered for culture would be acceptable to the fishermen.

Other questions raised during the review addressed the problem of whether nehu habitat could be enhanced, and whether significant declines in nehu abundance could be reversed.

All the boat captains agreed that nehu aggregated near recently dredged areas. Preliminary tests conducted in the past indicated that bottom sediment agitation or disturbance served as a concentrating mechanism for nehu. Some workshop participants felt the concept had merit and strongly supported it as a means of providing quick relief for the aku boats. Furthermore, it was highly recommended that research should continue in finding a viable substitute bait and that research be initiated in enhancing nehu habitat.

2. Review of the nehu fishery

Discussion centered on statewide historical catches, baiting effort, and catch per effort of baitfish in 1960-81. It was noted that significant changes had occurred in bait catching practices over the 22-year period examined. The 10-year period from 1960-69 was one of rather low catches and fishing pressure compared with the 10-year period from 1970-79. Whereas the total catch in 1960-69 averaged 32,300 buckets, the 1970-79 catches averaged 21% higher or roughly 39,200 buckets. In 1980-81, the average annual catch declined to only 26,500 buckets.

The review also brought out that the practice of catching bait at night has declined steadily since 1965, and in recent years practically none of the vessels were engaged in this type of activity. As a consequence, day-bait catching effort has increased significantly.

Over the years examined, Pearl Harbor and Kaneohe Bay were, by far, the most important bait grounds, contributing 33% and 37%, respectively, to the statewide bait catches. The remaining catches were contributed by a number of other areas of minor importance such as Ala Wai Canal, Haleiwa, and the neighbor island sites.

Pearl Harbor showed rather wide fluctuations in bait catch and effort over the years 1960-81 but catch/effort has remained relatively constant with no noticeable trends. However, rather dramatic changes have occurred over the years in Kaneohe Bay. Total bait catch and effort rose significantly in 1966 and again in 1973. Also, whereas effort increased 96% from 1972 to 1977 in Kaneohe Bay, catch rose only 60% during the same period. After 1973, when catch/effort peaked in Kaneohe Bay, the index of relative abundance declined steadily. It was determined that the fishery is probably not the cause of the decline but that a decline in food supply may be responsible.

The review also dealt with nehu mortality, pointing out that before 1967, baitfish mortality fluctuated between 12% and 21%. In 1967-81, the mortality fluctuated between 20% and 30%. Mortality is usually lower during the summer and the reasons cited were that bait is used faster in summer and that summer bait may be stronger.

Nehu spawn all year long and spawning peaks in summer although this peak may shift to late winter and early spring. Nehu eggs are planktonic, and incubation is about 24 hours. Growth of larvae after hatching is rapid and metamorphosis to the adult stage occurs in 6-7 weeks. From time of hatching, 8 to 12 weeks are required before nehu are sexually mature at approximately 30 mm standard length. Very few nehu live longer than one year.

It was pointed out that there has been a gradual increase in the catch of "sardine" which reached 10% in 1977 and nearly 21% by 1981. The species is actually a herring common to waters of the Marshall Islands and not the Marquesan sardine that was originally introduced from the Marquesas Islands in the late 1950s.

The ensuing discussion indicated that the fishermen strongly believe that introductions of talapia and sardine were responsible for the decline in the nehu population. Some fishermen stated that these species fed extensively on larval, juvenile, and adult nehu. Pollution of the habitat resulting from discharge of wash water from fertilizer barges was also cited as a cause for decline in nehu abundance.

3. Review of alternative species

a. Mollies (Maui Project).--The Maui mollie culture facility at Kealia started production in 1978 to determine the feasibility of culturing a supplemental baitfish. Based on past results of HIMB experiments and sea tests conducted in American Samoa, the project concentrated on the Mexican topminnow, which exhibited most of the characteristics of a good baitfish. The facility uses brood ponds, fry collecting troughs, and rearing ponds. It was reported that mollies could be reared to bait size in three months. To enhance production, solar domes to raise temperatures and a waste recycling system was instituted, the latter based on the concept of fertilizing water with duck manure. The ponds were also stocked with silver and grass carps and mullet.

Comparison of aku catch rates using mollies and nehu demonstrated that differences were relatively small, particularly when fishing schools around fish aggregating devices. For open-sea school fishing, the aku boat ORION caught 15.28 lb of aku/lb of mollies. It was pointed out that fishing methods, particularly chumming to hold the school near the stern, have to be modified when fishing with mollies.

It was brought out that about 2,000 lb of mollies were being reared for delivery to an albacore boat for testing this summer in the Hawaiian Islands. Near-term goals were to culture as much as 3,000-4,000 lb for aku fishing and that plans are underway for construction of a large-scale facility.

b. Culture experiments in the South Pacific.--Mollies and milkfish have been the species of primary interest of some South Pacific island governments in the culture and use of bait in tuna fishing. Results from trials conducted in American Samoa, Palau, Tonga, French Polynesia, Kiribati, Cook Island, and Pitcairn Island were reviewed. At several locations, trials with mollies and talapia were discontinued due to lack of interest and lack of funds. Among the more encouraging results were those the South Pacific Commission (SPC) in French Polynesia where the HATSUTORI MARU, a vessel chartered for aku tagging, obtained a catch rate of 34.7 lb/unit of bait (UOB) using milkfish as bait. At Kiribati, the following aku catches were obtained: 38.5 lb/UOB with mollies and 55.9 lb/UOB with milkfish. In comparison, for the period 1950-72 nehu yielded a catch of 16-37 lb/UOB in Hawaii. Thus, on this basis, nehu could be termed a poor baitfish by the SPC researchers. It was also reported that many of these trials were based on small amounts of bait; however, it appears to be rather clear that milkfish is a much better baitfish than mollies.

c. Tilapia and threadfin shad.--A pilot tilapia culture plant, established in Paia, Maui, produced roughly 450 buckets of baitfish in each of the two years that the plant was in operation (1958-59).

Test fishing with bait produced at this plant yielded an average of 53 lb of aku/lb of tilapia as compared with 64 lb of aku/lb of nehu. Fishing was conducted using each bait species alternately on schools encountered. For wild schools and schools of large aku, tilapia proved to be relatively effective.

Results from this pilot study led eventually to the establishment of the State's tilapia culture station at Sand Island in 1960. This facility produced about 3,000 lb of baitsize tilapia per year; maximum production was 5,000 lb per year.

Field trials with threadfin shad on the R/V CHARLES H. GILBERT produced good results. Shad, a freshwater species found mainly in Wahiawa Reservoir on Oahu, is not easily obtained, and the capture, transport, and acclimation procedure could be expensive as well as labor-intensive. It has been estimated that from 5,000 to 10,000 buckets of shad inhabit the reservoir and that shad abundance is probably related to water level in the reservoir.

d. Mullet and milkfish culture.--Research on mullet at Oceanic Institute began in 1969 but it wasn't until 1980-82 that mass production research, funded by Pacific Tuna Development Foundation (PTDF) and the State, got underway. Mullet attain sexual maturity in three years and experimental results indicate that an average fertilization rate of 90% and an average hatching rate of 70% are expected. About 600,000 viable eggs can be obtained from an adult female.

The hatched larvae are fed cultured rotifers, which in turn were fed cultured phytoplankton. Larval survival ranged from zero to 50%. About 45 days are required for the larvae to reach the fry stage.

Current plans call for shifting from tank to pond culture which should cut down the production cost.

Research on milkfish is still ongoing at Oceanic Institute.

4. Habitat enhancement

From a review presented earlier and based on discussions that ensued, it was apparent that immediate relief was necessary to help the industry. Discussion led to agreement among the boat captains that habitat enhancement looked like an attractive near-term solution and that a project to stir up the bottom sediment at selected localities should be strongly recommended. Because of possible environmental and legal constraints in pursuing such a project, it was recommended that the US Corps of Engineers be consulted or invited to attend the Hawaii Fishery Coordinating Council (HFCC) meeting where short- and long-term solutions to the bait problem were to be recommended and discussed.

The Workshop was opened to comments from two investigators who reported on (1) water quality studies conducted at Pearl Harbor and on (2) nehu population studies in Kaneohe Bay. Sediment metabolism studies currently underway at three primary locales in Pearl Harbor will examine the effect of sewage diversion on the total ecosystem. It was indicated that although sewage diversion will reduce nitrogen and phosphorus in the ecosystem, the nutrients available to phytoplankton will not be cut off overnight or completely. Much nitrogen and phosphorus will still enter Pearl Harbor through streams that empty into the harbor. Nutrients are also expected to leach at high rates from accumulated bottom muds for at least several months.

It was noted that red tide blooms have increased significantly since Hurricane IWA, possibly in response to "Kona" winds which decrease circulation in the harbor and cause nutrient concentrations to increase.

Presently the US Navy conducts only routine environmental monitoring required by the Environmental Protection Agency (EPA). There is no intensive monitoring of overall environmental conditions going on at this time.

Pearl Harbor was described as heavily stressed and no living corals can be found in the harbor probably because of the high concentrations of heavy metals. Nehu, however, show no apparent direct effect from heavy metal pollution. It is likely, however, that heavy metals and other pollutants may affect planktonic organisms constituting the nehu's diet.

A study of the nehu population in Kaneohe Bay has produced results which indicated that the adults and large larvae migrate into shallow water to seek shelter along the coast during the day and move into deep waters of the bay at night. Eggs and newly hatched larvae are found primarily in deep water.

5. Economic considerations

In discussing economic considerations, it was noted that demand and price were the two most important considerations. The topminnow was cited as an example of a good cultured bait that can be produced rather cheaply. Based on 1980 data, it was estimated that initial start-up costs could reach \$23,000/acre of pond and annual operating costs would be about \$16,000/acre. The cost of producing topminnow was estimated to be about \$1.60/lb (10,000 lb/acre production) and \$2.70 lb (6,000 lb/acre production). The current cost of production is estimated at about \$3.00/lb with production of 8,500 lb/acre. The question is whether there is a demand for topminnow at this price.

It was added that in 1980, Japanese pole-and-line fishing boats paid \$1.70-1.80/lb for natural bait. Based on the ratio of tuna price and cost of bait, it was estimated that if topminnow cost \$3.00/lb, then the price of tuna should be \$1.04/lb or \$2,310/ton.

6. Recommendations

The participants developed recommendations for presentation to the HFCC. These recommendations were categorized into those that needed immediate attention or short-term solutions and those requiring more detailed long-term research.

Among the short-term recommendations were:

1. Enhance the natural habitat of nehu by stirring up or agitating bottom sediment. It was noted that this project, which was considered top priority, would provide quick relief by attracting nehu from surrounding areas; however, there is danger that this action may further reduce the already low abundance of the existing nehu stock.

2. Seek access to grounds where nehu are known to congregate but which are off-limits due to private or government-imposed restrictions.

3. Identify all facilities that could be put into immediate operation for culturing either tilapia or mollies. The consensus among the boat captains, however, was that mollies were preferred over tilapia.

4. Examine impact of and possibly remove restrictions, if any, on sale of tilapia and "sardine" so that the boats may be able to sell these species when they are captured in the bait seines.

5. Modify the presently existing Aku Catch Report form so that more meaningful catch and effort statistics could be collected not only for scientific analysis but also so that more feedback can be provided to industry.

Long-term recommendations included:

1. Compile and analyze available information and conduct a full investigation on the ecosystem in Pearl Harbor and Kaneohe Bay to determine how natural phenomena and man-induced activities influence or affect the nehu populations.

2. Encourage continued research on milkfish culture so that the species could be eventually produced on a large scale as baitfish.

APPENDIX 1

AGENDA

Opening statement (Richard Shomura/Henry Sakuda)

Objectives of workshop

1. Present status of the aku fishery (John Robey)
2. Review of the nehu fishery (Richard Uchida)
3. Review of alternative species
 - a. Mollies (Maui project) (Fred Matsumoto)
 - b. Culture experiments in the South Pacific (Wayne Baldwin)
 - c. Tilapia and threadfin shad (Thomas Hida)
 - d. Mullet and milkfish culture (Cheng Sheng Lee)
4. Habitat enhancement (Henry Okamoto)
5. Economic considerations (Yung C. Shang)
6. Recommendations (open discussion)

Short-term

Long-term

APPENDIX 2

LIST OF PARTICIPANTS

Louis Agard
1089-A Ala Moana Blvd.
Honolulu, Hawaii 96814

Bob Agres
Economic Department
Maui County
200 South High Street
Wailuku, Maui, Hawaii 96793

Walter Asari
Owner/Captain
F/V MARLIN
c/o P. O. Box 238
Honolulu, Hawaii 96809

Wayne Baldwin
Hawaii Institute of Marine Biology
University of Hawaii
P. O. Box 1346
Kaneohe, Hawaii 96744

Ed Bartholomew
Sea Grant Extension Svc.
Maui Community College, Bldg. 214
310 Kaahumanu Avenue
Kahului, Maui, Hawaii 96732

Paul Bartram
1145 21st Avenue
Honolulu, Hawaii 96816

Dr. Richard Brill
NMFS, Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

Dr. Richard Brock
Hawaii Institute of Marine Biology
University of Hawaii
P. O. Box 1346
Kaneohe, Hawaii 96744

Allen Cattell
AECOS, Inc.
970 N. Kalaheo Avenue
Suite A-300
Kailua, Hawaii 96734

Randy Chang
NMFS, Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

Bill Choy
1605 Piihana Street
Wailuku, Maui, Hawaii 96793

Dr. Tom Clarke
Hawaii Institute of Marine Biology
University of Hawaii
P. O. Box 1346
Kaneohe, Hawaii 96744

Alika Cooper
163 Kaiulani Street
Hilo, Hawaii 96720

John Corbin
Aquaculture Development Program
Department of Land & Natural Resources
335 Merchant Street
Honolulu, Hawaii 96813

David Crear
AECOS, Inc.
970 N. Kalaheo Avenue
Suite A-300
Kailua, Hawaii 96734

Frank Goto
Manager, United Fishing Agency
117 Ahui Street
Honolulu, Hawaii 96813

Albert Grace
Captain
F/V TRADEWIND
c/o P. O. Box 238
Honolulu, Hawaii 96809

Charles Greenwald
Aquatic Farms
49-139 Kamehameha Highway
Kaneohe, Hawaii 96744

Dr. Philip Helfrich
Hawaii Institute of Marine Biology
University of Hawaii
P. O. Box 1346
Kaneohe, Hawaii 96744

R. Scott Henderson
Naval Ocean System Center
P. O. Box 997
Kailua, Hawaii 96734

Sharon Hendrix
NMFS, Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

Tom Hida
NMFS, Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

George Higashide
Captain
F/V NEPTUNE
c/o P. O. Box 238
Honolulu, Hawaii 96809

Dr. Kim Holland
Hawaii Institute of Marine Biology
University of Hawaii
P. O. Box 1346
Kaneohe, Hawaii 96744

Bernard M. Ito
NMFS, Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

Thomas Iwai Jr.
Anuenue Fisheries
Division of Aquatic Resources
2 Sand Island Access Road
Honolulu, Hawaii 96819

Brian Kanenaka
Division of Aquatic Resources
1151 Punchbowl Street
Honolulu, Hawaii 96813

Alvin Katekaru
Division of Aquatic Resources
1151 Punchbowl Street
Honolulu, Hawaii 96813

Hon. Richard Kawakami
State Legislator
State Capitol
Honolulu, Hawaii 96813

Thomas Kazama
NMFS, Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

Jake Kennedy
F/V TRADEWIND
91-551 Kulana Place
Ewa Beach, Hawaii 96796

Richard Kinney
Owner
F/V LEHUA
Lehua Fishing Co., Inc.
117 Ahui Street
Honolulu, Hawaii 96813

Peniasi Kunatuba
Pacific Islands Development Program
Aquaculture Project
East-West Center
1777 East-West Road
Honolulu, Hawaii 96848

Rudy Kunihiha
Dole Pine
Castle & Cooke
P. O. Box 3380
Honolulu, Hawaii 96801

Dr. Cheng Sheng Lee
Oceanic Institute
Makapuu Point
Waimanalo, Hawaii 96795

Wilfred Maeda
Maeda Fish Market Ltd.
651 Ilalo Street
Honolulu, Hawaii 96813

Donald Markham
NEPTUNE Inc.
P. O. Box 238
Honolulu, Hawaii 96809

Margaret Markham
NEPTUNE Inc.
P. O. Box 238
Honolulu, Hawaii 96809

Kenneth McEnroe
1726 Hooehulu Street
Pearl City, Hawaii 96782

Peter Milone
NMFS, Western Pacific Program
Office
P. O. Box 3830
Honolulu, Hawaii 96812

Mitsu Nakamura
Captain
F/V SEA QUEEN
c/o P. O. Box 238
Honolulu, Hawaii 96809

John Naughton
NMFS, Western Pacific Program
Office
P. O. Box 3830
Honolulu, Hawaii 96812

Henry Okamoto
Division of Aquatic Resources
1151 Punchbowl Street
Honolulu, Hawaii 96813

David Onizuka
Anuenue Fisheries
Division of Aquatic Resources
2 Sand Island Access Road
Honolulu, Hawaii 96819

Martina K.K. Queenth
NMFS, Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

Ralph Rehberg
P. O. Box 175
Kailua-Kona, Hawaii 96740

Herman Reis
Captain
F/V KILOHANA
c/o 117 Ahui Street
Honolulu, Hawaii 96813

John W. Robey
President
Tuna Boat Owners' Co-Op Inc.
P. O. Box 238
Honolulu, Hawaii 96809

Justin Rutka
Western Pacific Regional
Fishery Management Council
1164 Bishop Street, Rm. 1608
Honolulu, Hawaii 96813

Matthew Saito
Captain
F/V BLUEFIN
Hawaii Aku, Inc.
P. O. Box 238
Honolulu, Hawaii 96809

Richard Saito
F/V BLUEFIN
c/o P. O. Box 238
Honolulu, Hawaii 96809

Henry M. Sakuda
Director
Division of Aquatic Resources
1151 Punchbowl Street
Honolulu, Hawaii 96813

Donald Schug
University of Hawaii
Honolulu, Hawaii 96822

Dr. Yung C. Shang
University of Hawaii
Ag. Ec. Bil 304
Honolulu, Hawaii 96822

Jack Shinsato
Owner
F/V ANELA
Angel Fishing Co.
117 Ahui Street
Honolulu, Hawaii 96813

Richard S. Shomura
Director
NMFS, Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

Howard Silva
General Manager
Hawaiian Tuna Packers
P. O. Box 238
Honolulu, Hawaii 96809

Kitty Simonds
Western Pacific Regional
Fishery Management Council
1164 Bishop Street, Rm. 1608
Honolulu, Hawaii 96813

Charles Spinney
P. O. Box 354
Kailua-Kona, Hawaii 96740

Kealoha Spinney
P. O. Box 354
Kailua-Kona, Hawaii 96740

William Streeter
2714 Kahoaloha Ln. #905
Honolulu, Hawaii 96826

Janet Swift
Pacific Tuna Development
Foundation
P. O. Box 2359
Honolulu, Hawaii 96804

Brooks A. Takenaka
United Fishing Agency
117 Ahui Street
Honolulu, Hawaii 96813

Randal Tanabe
Tuna Boat Owners' Co-Op, Inc.
P. O. Box 238
Honolulu, Hawaii 96809

Shoji Teramoto
NMFS, Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

Jon Tsukazaki
1131 1st Avenue
Honolulu, Hawaii 96816

Richard N. Uchida
NMFS, Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

Dr. Roger Uwate
Pacific Islands Development
Program
East-West Center
1777 East-West Road
Honolulu, Hawaii 96848

Dr. Jerry Wetherall
NMFS, Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

Charles Yamamoto
P. O. Box 10471
Honolulu, Hawaii 96816

Howard Yoshida
NMFS, Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812