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Pelagic Fisheries Research Program

Volume 4, Number 1 January–March 1999

Workshop Consensus: International Project on Bigeye Tuna Needed

Bigeye tuna is the mainstay of longline fisheries throughout the Pacific Basin. It is the principal target species of the Japanese distant-water longline fleet and a critical component of smaller-scale longline fisheries in Hawai'i, French Polynesia and Australia. The landed value of bigeye tuna caught in the Pacific has been estimated to be approximately US$1.5 billion. The total landings of bigeye tuna have been relatively constant for the last 10 years at around 175,000 mt per year (Figure 1). Most of these landings are by longline vessels, but the proportion harvested by purse seine has been steadily increasing. Purse-seine landings are composed of largely immature fish, and there are preliminary indications that these harvests may be having a detrimental impact on some longline fisheries. Unfortunately, bigeye tuna is the least understood of the major tropical species, and in spite of its economic importance, less than 0.1% of its landed value is expended by the various research organizations around the Pacific on studies of this species. The lack of critical information on mortality rates and movement rates prevent scientists from making definitive evaluations of the status of the bigeye tuna population in the Pacific.

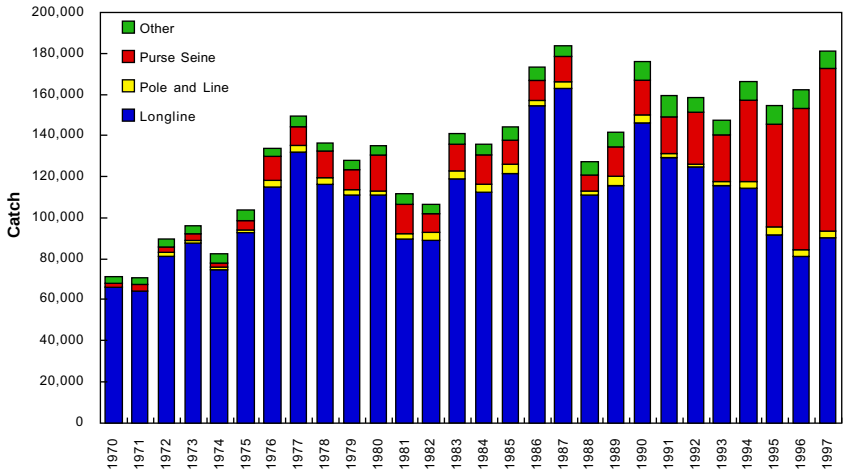

Figure 1. Total catch in metric tons of bigeye tuna in the Pacific Ocean by various gear types. (Source: "Report of the eleventh meeting of the standing committee on tuna and billfish," 28 May–6 June 1998, Honolulu)

In November 1998, the PFRP coordinated a workshop attended by tuna scientists from all major research institutions in the Pacific. The workshop participants discussed current and planned research on bigeye tuna in their part of the world and identified research priorities and approaches for future work. The participants concluded that a well-designed, coordinated, large-scale, international tagging project is necessary to address the critical information gaps. The project they envisaged would utilize a variety of different tagging methods including simple dart tags, acoustic tracking devices, data logging archival tags and pop-up tags that transmit data to satellites. The choice of methods would depend on local circumstances, such as availability of bigeye tuna for tagging, probability of recapture and scientific hypothesis to be addressed.

The workshop participants also concluded that a dedicated tagging vessel is necessary for long-term monitoring of tuna populations in the Pacific. This vessel would be a scientific asset to be utilized throughout the Pacific on a rotating basis to provide up-to-date information on changes in movement, mortality and levels of exploitation. Participants were optimistic that the consensus they achieved will improve the prospects for increasing the general level of funding for research on this important but neglected natural resource. The workshop report is available on the PFRP World Wide Web site (www.soest.hawaii.edu/PFRP).

PFRP

CONTENTS

Creating the Big Picture for Pacific Bigeye Tuna

A Pelagic Fisheries Research Program (PFRP) workshop on Pacific bigeye tuna, Nov. 9–10, 1998, in Honolulu, addressed the spotty nature of current regional research on the species. PFRP Director John Sibert, coordinator and chairman of the workshop, noted that some regions are well advanced in the planning or implementation of field research while others are very much in a conceptual or planning phase. Workshop participants reported on proposed and ongoing fieldwork in their regions. The projects are summarized below.

Australian Coral Sea

In an area where fishing effort has increased significantly in recent years, tagging results raise questions about assumed growth rates and longevity of bigeye tuna. In the early 1990s, the South Pacific Commission (SPC, now the Secretariat of the Pacific Community) conducted the Regional Tuna Tagging Project (RTTP). As part of the project, approximately 3,800 medium-sized bigeye tuna were tagged in the northwestern Coral Sea. More than 200 of these individuals have been recaptured. Continuing recaptures of medium-large bigeye tuna in the same area of release suggest that bigeye tuna may live longer and grow slower than commonly thought.

The SPC's Oceanic Fisheries Program (OFP) in conjunction with the Australian research organization CSIRO (Hobart) is augmenting research on bigeye tuna in the northwestern Coral Sea with a small-scale archival tagging project. John Hampton of SPC OFP explained that the project would deploy 80 data-logging tags manufactured by Wildlife Computers on medium-sized (80–100 cm) bigeye tuna during December 1998. Australian flag longline vessels would longline and handline bigeye tuna found on lanternfish (*Myctophidae*) feeding aggregations that normally occur in the area during this time of year. Fishing vessel owners have made their vessels, crews and fish available at no cost to the project. A return rate of 10% is expected. The CSIRO plans to match the SPC-funded 1998 tagging with 100 additional archival tags during the 1999 season.

Western Equatorial Pacific

During the RTTP (see above), a total of 6,800 bigeye tuna were tagged, of which 35% were released in the Western Equatorial Pacific (WEP) and a further 3,500 in the Philippines. Overall return rates were 8% and 25%, respectively. Tony Lewis of SPC OFP said the experiments provided useful information on movements, age and growth and estimates of natural mortality of various sized bigeye tuna. The OFP currently has no plans to undertake further conventional tagging of bigeye tuna. Opportunities to routinely tag-and-release large numbers of bigeye are generally quite limited, Lewis said. However, a recent increase in the use of drifting FADs in the WEP fishery may offer some potential for tagging of small- to medium-sized bigeye tuna in this area, provided technical and handling problems could be overcome.

Deployment of archival tags in the region is also a possibility. A proposal has been lodged with the United States Tuna Foundation for 300 archival tags to be deployed in as yet undetermined areas, but likely to include areas adjacent to the main longlining fisheries grounds in the central Pacific.

OFP continues to be involved in other areas relevant to bigeye research, such as age and growth studies, investigation of environmental determinants of tuna production, and observer and port sampling work.

Western North Pacific

Field research on tropical tuna conducted by Japan's National Research Institute of Far Seas Fisheries—traditionally carried out on dedicated research cruises and during some observer trips on commercial tuna vessels—will soon be augmented by operations aboard a longline research vessel. A medium-sized vessel has been chartered for a three-year period, and Western Pacific operations concentrating on swordfish and albacore, bigeye and yellowfin tuna research are to begin September 1999, reported Naozumi Miyabe.

In addition, prefectural longline training vessels that will be operating near Hawaiian waters during late 1998 and 1999 provide the possibility for collaborative research, Miyabe noted.

Another potential source for future research on bigeye tuna is a large and well-equipped government research vessel that will become available for pelagic research in the Pacific during 1999. Equipped with a full array of sophisticated marine electronics, RV *Shoyo Maru* will be capable of longline and gillnet operations and acoustic tagging of large fish.

Hawai'i

In Hawai'i, bigeye tuna is one of the two highest dollar-value pelagic resources landed by locally based fishermen. It is no wonder then that research on the species is booming.

A particularly ambitious project is the Hawai'i Tuna Tagging Project (HTTP), which will tag yellowfin and bigeye tuna throughout Hawai'i's exclusive economic zone (EEZ) for a two-year period. Kim Holland and David Itano explained that the PFRP project, which began releasing tags in March 1998, is an expansion of a small-scale tagging project at Cross Seamount, which was designed to address interaction and aggregation issues of bigeye and yellowfin tuna. HTTP uses commercial and sport vessels as tagging platforms at Cross Seamount, near Midway Atoll and around the main and Northwestern Hawaiian Islands. Aggregation points—such as seamounts, isolated islands and anchored fish aggregation devices (FADs)—are targeted to maximize releases of bigeye tuna. The total number of releases to date for both projects exceeds 11,000, of which 58% are bigeye tuna. Domestic fishing vessels have recaptured 1,100 individuals, with recapture rates for bigeye and yellowfin tuna at 8.7% and 13.6%, respectively. Most of the releases and recaptures have been made at Cross Seamount and inshore FADs. An ancillary State of Hawai'i tagging project, which targets small yellowfin and bigeye tuna

(20–35 cm) found in association with state-anchored FADs, began in November 1998 and is an integral part of HTTP.

Additional bigeye tuna studies in Hawaiian waters are being conducted by Honolulu Laboratory. Michael Laurs said the National Marine Fisheries Service (NMFS) laboratory has, under a PFRP-sponsored project, committed 80 archival tags to bigeye tuna, with 24 deployments and one capture recorded to date (see 'Archival Tags—A Worthy Reward,' *PFRP Newsletter,* July 1998). Meanwhile, conventional tagging of longline-caught bigeye continues on an opportunistic basis from the NMFS RV *Townsend Cromwell*, which also conducts in situ fisheries oceanography in the Hawai'i EEZ and adjacent seas.

A major initiative of Honolulu Lab in recent years is the study of pelagic fish habitat and ecology in relation to offshore fisheries through direct fieldwork, remote sensing and validation, habitat studies and large-scale ecosystem research and modeling. Jeffrey Polovina, who leads these efforts, said use of satellite altimetry data to detect current eddies, seamounts and vertical temperature structure, such as shoaling of the thermocline, is encouraging.

Several research proposals involving bigeye tuna have been submitted to PFRP and are currently under scientific review.

Eastern Pacific Ocean

In the Eastern Pacific Ocean (EPO), a FAD-based purse-seine fishery has recently developed. It takes significant quantities of juvenile bigeye tuna in an area where a longline fishery targets large, high-valued individuals. The ensuing interaction issues are of dominant concern in the area. The Inter-American Tropical Tuna Commission (IATTC) has imposed a limit of 45,000 mt of bigeye tuna from the EPO surface fishery, which if exceeded would shut down purse-seining on floating objects. Robin Allen explained the importance of obtaining better age-specific estimates of natural mortality, as yield assessments and interaction estimates rely significantly upon these parameters.

The IATTC intends to mount a large-scale tagging project, focused on conventional tagging of bigeye tuna found in aggregation with floating objects, but no firm plans are currently in place pending the identification of a funding source. However, there is a distinct possibility of conducting a pilot tagging project in early 1999 to tag bigeye, yellowfin and skipjack tuna in the EPO purse-seine fishing grounds. The objectives of this project are to estimate movements, interaction between surface and subsurface fisheries, and rates of natural mortality in bigeye, but the opportunity would be used to gain a better understanding of the relationship between southern (south of 5°N) and northern groups of yellowfin in the EPO. There is also an interest to deploy archival tags in the southern region in conjunction with conventional tags. The intention of the IATTC is to realize an ongoing tagging project for bigeye tuna in the EPO region over the next several years.

Kurt Schaefer outlined plans for the IATTC to begin life history research on EPO bigeye tuna, which will include studies on the age, growth and reproductive biology of the species in different geographic regions of IATTC jurisdiction. Otoliths and vertebrae will be sampled from tagged bigeye tuna of 30–180 cm fork length that have been chemically marked for age validation purposes. Size and age-specific reproductive characteristics from surface and subsurface fisheries will be determined using histological analyses of gonad material. Spatio-temporal distributions in spawning, length at maturity, spawning frequency, batch fecundity and sex ratios will be determined.

French Polynesia

In an area strategically located for basin-wide bigeye tuna research, French researchers are winding down on the ECOTAP program—two years of fieldwork investigating the pelagic resources of the French Polynesian zone (see 'Tuna Telemetry in Tahiti,' *PFRP Newsletter,* October 1997). Stephen Yen and Laurent Dagorn described the results of the study, which involved pelagic longlining, echo sounding, sonic tracking of tuna and pelagic trolling. Utilizing the RV *Alis*, researchers investigated behavior and habitat of bigeye tuna and longline characteristics in relation to catch rates. ECOTAP will conclude in the summer of 1999, leaving the future of this type of research in question. However, cooperation between researchers and local fisheries has been excellent, and results of direct relevance to local fishermen have been obtained. The legacy of ECOTAP, Yen said, includes a willingness and interest of local commercial vessels to work with researchers and the mechanisms and staff to facilitate this type of collaboration.

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PFRP Technical Reports

For a copy of these recent or other PFRP technical reports, please contact

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Sociology of Hawaii Charter Boat Fishing, by Julie Walker, SOEST 97-02, JIMAR 97-309.

Design of Tag-Recapture Experiments for Estimating Yellowfin Tuna Stock Dynamics, Mortality, and Fishery Interactions, by Peter Bills and John Sibert, SOEST 97-05, JIMAR 97-313.

Cost-Earnings Study of Hawaii's Small Boat Fishery, 1995–1996, by Marcia Hamilton and Stephen Huffman, SOEST 97-06, JIMAR 97-314.

An Assessment of Bigeye (Thunnus obesus) *Population Structure in the Pacific Ocean, Based on Mitochondrial DNA and DNA Microsatellite Analysis,* by Peter M. Grewe and John Hampton, SOEST 98-05, JIMAR 98-320.

New Data Fuels Old Debate on Bluefin Tuna

New findings suggest the distribution of spawning-size giant Atlantic bluefin tuna (*Thunnus thynnus*) is much broader than previously considered. These findings, reported by Molly Lutcavage, a research scientist at the New England Aquarium, add to the intense debate over the population of a species that is very valuable (with individual fish worth $10,000 each) yet whose harvest is strictly regulated.

Information obtained by Lutcavage and her colleagues highlights the possibility that bluefin tuna that travel through New England waters spawn, or lay eggs, between Bermuda and the Azores. Since bluefin tuna are managed under the theory that there are two different stocks or groups (western and eastern Atlantic), these findings argue for reconsideration of current assumptions about migration, spawning habitats and stock structure.

In September and October 1997, researchers tagged 20 bluefin tuna of reproductive size, 75–115 inches long (estimated ages 8–18 years), off the New England coast using tags that detach from the fish and transmit data to a satellite. The tags were pre-programmed to release or "pop-up" monthly from March to July 1998. The tags are about the size of a cigar, with a 5-inch long antenna. Once released, the tags not only transmit location but also reveal historical data about water temperature during the tuna's travels.

Seventeen out of 20 tags reported after being on the bluefin tuna for as long as 9 1/2 months, a span of time that is unprecedented with pop-up tags (Figure 1). Five of the tags popped up on the eastern side of the western Atlantic management line at 45˚W longitude, the international fisheries management boundary established by the International Commission for the Conservation of the Atlantic Tuna (ICCAT).

"Tuna clearly have a very complex and broad migration pattern," Lutcavage says. "Since the 1980s, scientists concluded that there were two, separate bluefin tuna stocks. Now it looks as though the same tuna that travel through New England waters also swim near the Azores. We now have an opportunity to quickly gain a better understanding of bluefin migration and potential spawning areas, and pop-up tag technology is proving to be a very effective research tool to gather data."

A giant bluefin tuna is brought alongside the FV *Cookie Too* for application of a pop-up tag. Recent research results from these tags have rekindled debates on the management of the species.

Giant Atlantic bluefin tuna are the largest living species of tuna, reaching up to 10 feet in length and weighing more than 1,400 pounds. Bluefin tuna are at the center of a heated debate because they are commercially valuable (fetching up to $120/lb) and believed by many to be depleted in the eastern Atlantic. Fishery regulators have been recommending increasingly stricter quotas, while fishermen claim they see more bluefin tuna in a week than regulators say exist in the entire North Atlantic all year. In fact, the last two stock assessments for the western Atlantic zone reveal that the population of bluefin tuna is on the rise. Currently, bluefin tuna are managed by fishing area quotas, size limits and spawning area protection measures. However, compliance with these regulations occurs only in the western Atlantic fishing grounds and surrounding seas off the coasts of the United States and Canada.

Understandably, New England fishermen are eager to take part in the scientific research of bluefin tuna to learn whether or not adhering to restrictions in the western Atlantic is worthless because of the lack of management compliance in the eastern Atlantic. In another first, Lutcavage and colleagues have undertaken an international collaboration with Canadian Department of Fisheries and Oceans researcher Julie Porter and Canadian bluefin tuna fishermen. The new partnership targeted both New England and Canadian giant Atlantic bluefin tuna during the 1998 season. In late August, the first of five Canadian bluefin tuna was tagged with pop-up technology. The tags are scheduled to pop up in 9 1/2 months.

The 1998 tagging study was funded by the East Coast Tuna Association and through donations by cooperating fishermen. "Ongoing collaborations with fishermen contribute priceless information about bluefin tuna, a source of knowledge that has until now been untapped as a research resource," said Rich Ruais,

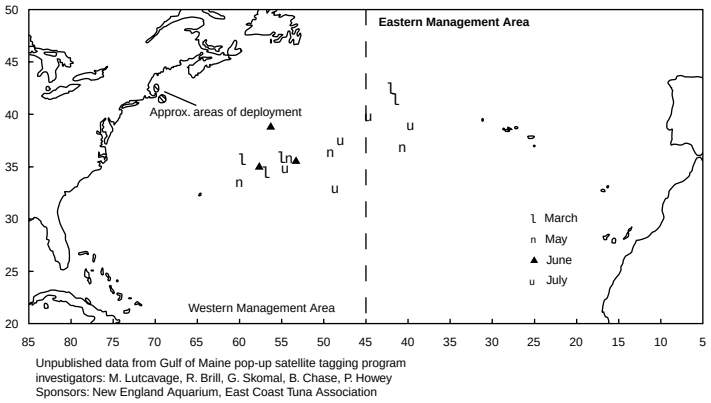

Figure 1. Release locations for pop-up satellite tags deployed on giant bluefin tuna in the Gulf of Maine, 24 Sept.–6 Oct. 1997.

executive director, East Coast Tuna Association. "Through this joint research with the New England Aquarium, some light will be shed on critically important questions which might allow future development of a fair and efficient long-term, Atlantic Ocean–wide conservation program for Atlantic bluefin tuna."

Regulators need to have better information on exactly where bluefin tuna spend their time and where they reproduce to ensure that tuna stocks are properly managed and not overfished. A highly migratory and fast-swimming species, bluefin tuna spend much of their time foraging off the continental shelf and then probably disperse to spawning areas to lay eggs. It has been assumed that bluefin tuna spawn primarily in the Mediterranean and in the Gulf of Mexico. Before these recent results from pop-up tagging research, there was little reason to question these assumptions. Despite the intense interest in bluefin tuna, their travels and behaviors are not well understood or documented, and their life cycles are believed to be exceedingly complex. By understanding the whole cycle of the bluefin tuna's life, fisheries managers can make informed decisions about appropriate management and conservation measures.

Augmenting these tagging efforts, New England Aquarium researchers also conduct aerial surveys and remote-sensing and hydro-acoustic tracking studies of bluefin tuna. Through a new study with Johns Hopkins Applied Physics Laboratory in Baltimore, the National Marine Fisheries Service, the National Environmental Satellite Distribution and Information Service of NOAA and Areti Associates of Tucson, Ariz., Lutcavage is testing cutting-edge LIDAR and synthetic aperture radar technology to learn more about bluefin tuna. In a process similar to radar, LIDAR emits a laser light that bounces off an object creating a three-dimensional image. In this manner, researchers hope to

(continued on page 6)

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Upcoming Events

January 15-23
Interim Scientific Committee Meeting
Honolulu, Hawai'i
(619) 546-7067
fax (619) 546-5655

February 10-19
Multilateral High-Level International Conference IV
Honolulu, Hawai'i
(808) 522-8220
fax (808) 522-8226

February 24-27
Seabird Bycatch: Trends, Roadblocks and Solutions
Blaine, Washington
(206) 543-9968
e-mail emelvin@u.washington.edu

March 16-18
International Symposium on Geographic Information Systems in Fishery Sciences
Seattle, Washington
(81) 543-36-6043
fax (81) 543-35-9642
e-mail tnishida@enyo.affrc.go.jp

June 7-11
Standing Committee on Tuna and Billfish
Tahiti
(687) 26-3818
fax (687) 26-2000

New Data Fuels Old Debate (continued from page 5)

learn how many bluefin tuna are swimming below the ocean's surface, therefore gaining a more accurate count of the total population. Synthetic aperture radar technology may be used to detect the distribution of surface-swimming bluefin tuna over a broad geographic area.

New England Aquarium Conservation Director Greg Stone is a U.S. Senate-appointed member of ICCAT, a 23-member-country organization charged with determining all legal quotas of North Atlantic bluefin tuna and other large open-ocean fish. Lutcavage serves as scientific technical adviser to the Bluefin Working Group of the Scientific Advisory Committee of ICCAT. Her colleagues on the bluefin tuna study include Richard Brill of the Pelagic Fisheries Research Program at the University of Hawai'i, Greg Skomal and Brad Chase from the Massachusetts Division of Marine Fisheries, and Paul Howey from Telemetry 2000 in Columbia, Md.

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Anthony Mendillo Jr., mate on the FV *Cookie Too,* holds the tagging applicator that he and Cookie Murray designed and constructed. Attached to the applicator is a tag that is pre-programmed to detach from a fish at a predetermined date to transmit data to a satellite.

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