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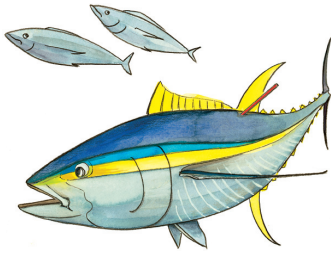

Pelagic Fisheries Research Program

university of hawai'i at mānoa

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October–December 2005

Highly Migratory Scientists Meet in Noumea

John Sibert

The first meeting of the Scientific Committee of the Commission for the Conservation and Management of Highly Migratory Fish Stocks (WCPFC) was held August 8 to 19, 2005 at the headquarters of the Secretariat of the Pacific Community (SPC) in Noumea, New Caledonia. The primary mandate of the WCPFC Scientific Commission (SC) is to provide advice to the Commission on the status of the fisheries and the stocks that support them.

The first meeting of the SC was given the additional task of evaluating 5- and 10-year projections of the stocks and fisheries under different feasible management options.

State of the Fisheries

The total catch in the WCPFC convention area in 2004 was 2,020,000 mt, a record and the highest catch since 1998 (see Figure 1). Sixty-two percent of this catch, a record 1,260,000 mt, was landed by the purse seine fleets of Japan, Korea, Taiwan, United States and several Pacific island countries. The catch by the U.S. fleet dropped to less than 100,000 mt, continuing its long-term decline.

The skipjack catch by the purse seine fleet was 1,060,000 mt or 84% of the total purse seine catch. Skipjack also comprised the majority, 68%, of the total WCPFC tuna landings (see Figure 2) followed by yellowfin (20%), bigeye (6%), and albacore (5%).

The yellowfin catch in the purse seine fishery in 2004 was the lowest since 1996 and, in the longline fishery, was the lowest since 1999. Albacore and bigeye made up the majority of the longline

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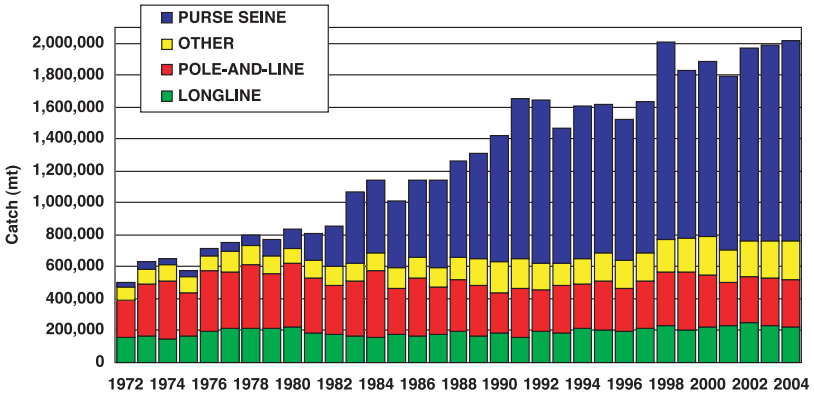

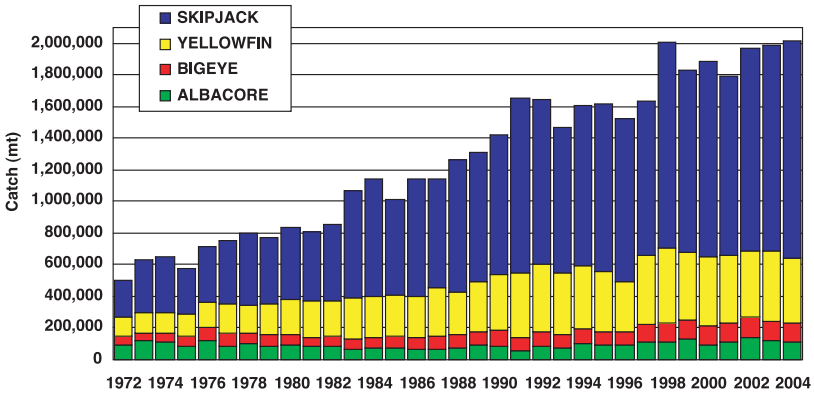

(top) Figure 1. Catch (mt) of albacore, bigeye, skipjack and yellowfin in the WCP–CA, by longline, pole-and-line, purse seine and other gear types. (bottom) Figure 2. Catch (mt) of albacore, bigeye, skipjack and yellowfin in the WCP–CA.

The first meeting of the Scientific Committee of the Commission for the Conservation and Management of Highly Migratory Fish Stocks (WCPFC) was held August 8 to 19, 2005 at the headquarters of the Secretariat of the Pacific Community (SPC) in Noumea, New Caledonia.

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catch, with albacore being the mainstay of growing Pacific island longline fleets.

Status of Stocks

The WCPFC assessment methods utilize all available data from the 1950s through the most recent year available. The data include total catch and fishing effort by gear type and region, size composition of the catch (in both length and weight), and tag release and recapture data.

The analysis explicitly incorporates spatial heterogeneity of both the population and the fisheries. The analyses are fully integrated, linking all data in a single consistent statistical estimation procedure; they provide estimates of uncertainty around all estimates, and indicate where data may be inconsistent with model structure. Once the parameters of the model are estimated from fisheries data, the same model is used to predict population trajectories under different conditions, for example, to compute the biomass trajectory that might have occurred in the absence of fishing.

Reference Points	Species				
	Bigeye	Yellowfin	Southern Albacore	Skipjack	Northern Albacore*
$B_{current}/B_0$	0.46	0.49	0.73	1.18	0.38
$S_{current}/S_0$	0.22	0.37	0.81	1.15	NA
$B_{current}/B_{current,F=0}$	0.33	0.40	0.91	0.86	NA
$B_{current}/B_{MSY}$	1.25	1.32	1.69	3.01	0.67
$F_{current}/F_{MSY}$	1.23	1.22	0.05	0.17	1.43

**The stock assessment for Northern Albacore employed a different method, and the results are not strictly comparable to those for the other species. The reference points for Northern Albacore in the table were computed from information presented in "Report of the Nineteenth North Pacific Albacore Workshop," M. Stocker (editor) assuming that F 40% is equivalent to FMSY, a precautionary assumption.*

Biological reference points are indicators of stock status derived from the results of the stock assessments. Several alternative reference points were presented to the SC for the four principle target tuna species. $B_{current}/B_0$ is the ratio of the current biomass to the equilibrium biomass at the beginning of the time series; this ratio expresses the change in population size ignoring fluctuations in the environment. $S_{current}/S_0$ is the ratio of the current spawning biomass to the biomass at the beginning of the time series. It expresses the change in the biomass of reproductively mature adults ignoring changes in the environment. $B_{current}/B_{current,F=0}$ is the ratio of the current biomass to the biomass that would be predicted to have occurred in the absence of fishing; this ratio is a direct measure of the impact of fishing and takes into account fluctuation in the environment that may have altered the productivity of the stock. $B_{current}/B_{MSY}$ is the ratio of the current biomass to the biomass if the fishery were harvesting the "maximum sustainable yield" (see box); $F_{current}/F_{MSY}$ is the ratio of the current fishing mortality to the fishing mortality required to produce MSY. For the purposes of computing these reference points "current" is defined as the average over the period 2001-2003.

These reference points indicate that the spawning stocks of WCPO yellowfin and bigeye have declined to about 20% of their unfished state and that the current populations are less than half the size they might have attained in the absence of fishing. Such low population sizes are consistent with the MSY-based reference points which indicate that fishing mortality is greater than the fishing mortality at MSY, but populations have not declined to the size they would attain when fished at MSY.

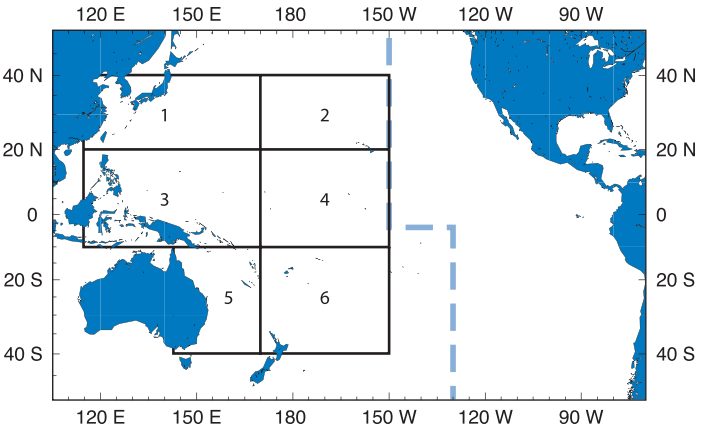
In the jargon of United States fishery management practice, overfishing is occurring in yellowfin and bigeye stocks, but the stocks are not in an overfished state. South Pacific albacore and skipjack stocks appear to have been only lightly impacted by the fisheries, and the skipjack population has actually grown.

North Pacific albacore stock assessments use methods which are not comparable to those used for the other four species and that do not directly estimate MSY. The figures in the table were calculated from the stock assessment document by making the precautionary assumption that F 40% is equivalent to F_{MSY}. Catches of Northern Albacore were higher in the 1950s than current catches, suggesting that Northern Albacore has been heavily exploited since the end of World War II.

The stock assessments are structured to estimate the impact of the fisheries in each of the regions in the accompanying map. Most of the yellowfin and bigeye catch comes from equatorial fisheries, and as might be expected, the fishery impacts are estimated to be highest in regions 3 and 4. The fishery has reduced the bigeye population in region 3 by 80% compared to a 30% reduction in region 2. Similarly, the fishery has also reduced the region 3 yellowfin population by 80%, but by only 6% in region 2. Such regional disparities in fishery impact imply that management policies should be tailored to the specific conditions in each region.

Prior to the 1980s, yellowfin and bigeye were almost exclusively caught by longline fisheries, which select the largest fish. Since then, the rapidly growing purse seine fishery has caught increasingly large volumes of both species. Large yellowfin are the principle catch of one segment of the purse seine fleet which targets "free" or "unassociated" tuna schools. Small individuals of both bigeye and yellowfin are caught in large numbers by the segment of the purse seine fleet that depends on floating objects to attract mixed schools of skipjack, yellowfin and bigeye. Small bigeye and yellowfin have thus become "bycatch" of the purse seine skipjack fishery.

The net effect of this change in the overall fishery has been to extend exploitation over the whole life history of these two species. The situation was raised as a matter of concern by the fourteenth meeting of the Standing Committee on Tuna and Billfish, held in Noumea five years ago in August 2001. The participants in SCTB14 "recommended that there be no increase in fishing mortality in surface fisheries" on these two species "until uncertainties in the current assessments have been resolved." The uncertainties have not been resolved completely, but the assessment results have been consistent for the last five years.



The eastern boundary of the WCPFC treaty area is shown as the heavy dashed line. The numbered boxes in the WCPO indicate the regions used in the stock assessments for yellowfin and bigeye.

Management Options

In 2001, there was no management organization that could respond effectively to recommendations of the SCTB. At its first meeting, the WCPFC charged the SC to estimate sustainable catch and effort levels for bigeye, yellowfin and South Pacific albacore and the potential consequences of alternative management options for bigeye and yellowfin tuna based on projections of the population models.

Scientists at the SPC Oceanic Fisheries Programme evaluated a large number of different management options. A substantial number of these options predict an increase in the stocks of yellowfin and bigeye, and a few even predict an increase in the total yield. Specifically certain constraints on the purse seine fishery, such as closed periods or transfer of effort away from floating objects to schools, might actually increase the total yield to the fishery. Of course, these options would forgo a significant skipjack catch. The Commission will consider these options at its second meeting in December 2005.

John Sibert is the manager of the Pelagic Fisheries Research Program, University of Hawai'i.

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Maximum Sustainable Yield

The yield in weight from a cohort of fish is generally higher at higher fishing effort. At some level of effort, the increase in yield for a given increase in effort becomes zero. Further increases in effort actually result in lower yield. The point where the change in yield becomes zero is called Maximum Sustainable Yield or MSY. Computing MSY for stocks that span an ocean basin and are exploited over wide range of age classes by multiple fishing gears is a challenging task. It requires assumptions about reproductive success at low stock levels and what the general level of productivity might be. In the case of WCPO tuna fisheries, such low stock levels have never occurred, and it is known that the general level of productivity of the stocks has long-term trends. Computing MSY requires assumptions about how the gear might be deployed to produce high mortality levels. In the WCPO, analysts generally assume that age-specific fishing mortality is unchanged at higher levels of effort. Fisheries theory tells us that the biomass of a stock fished at MSY is approximately 30-40% of the unexploited biomass. If all fish stocks were to be harvested at MSY, there would probably be severe perturbations in the ecosystem. MSY is difficult to measure accurately, and its use as a reference point promotes reduction in stocks to rather low levels.

Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean

The WCPFC was created when the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean entered into force on 19 June 2004. The signing of this convention in Honolulu on 5 September 2000 was the culmination of four years of negotiation between the coastal States of the Western and Central Pacific and States fishing in that region. The Convention is one of the first regional fisheries agreements to be adopted since the conclusion in 1995 of the UN Fish Stocks Agreement and explicitly embraces the precautionary approach, the ecosystem approach and other modern principles of fishery management. The Convention has been signed by 25 of the parties to the negotiations, and the Commission held its first meeting at Pohnpei in December 2004. The Commission has authority to regulate fisheries for highly migratory fish stocks (i.e., tunas, marlins, swordfish, sharks) throughout the convention area (see accompanying map), including the high-seas. The Commission is also obligated to adopt measures to minimize the impact of fisheries on protected and endangered species such as turtles and marine mammals.

The Commission is committed to base management measures on the best available scientific evidence. In support of this mission, the Commission includes a Scientific Committee. At its first meeting, the Commission adopted the organizational structure used by the Standing Committee on Tuna and Billfish. The SCTB was the de facto source of scientific information on highly migratory fish stocks in the Western and Central Pacific Ocean for 17 years until its final meeting in Majuro in August 2004.

More information about the WCPFC and the Convention can be found on the World Wide Web at http://wcpfc.org/.

Deploying Satellite Tags on Swordfish Using the California Harpoon Fleet

Heidi Dewar and Jeff Polovina

Recent improvements in satellite and archival tagging technology have rapidly advanced studies of the biology of diverse pelagic species, including seabirds, mammals, and fish. The promise of collecting previously unobtainable biological data on animal movements and behaviors has resulted in a rush to use this new technology with the number of studies having dramatically increased over the last five years.

The tool that has been most widely used on pelagic fish, for which there is a low chance for tag recovery, is the pop-up satellite archival (PAT) tag. While these tags have provided impressive data on a broad range of species, studies conducted to date with swordfish have returned disappointing results.

In the first three studies, swordfish were captured for tagging using longlines. Problems encountered in these studies included non-reporting by the satellite tag, when the tag is deployed but never transmits; fish mortality, when it can be demonstrated using depth data that the fish died shortly after release; and premature release, when the satellite tag releases from the fish prior to the programmed date. Premature release and non-reporting can both result from mortality.

Sedberry and Loefer (2001) report that 52% of the tags deployed either released early or failed to report. In the study conducted by Brill, the non-reporting rates ranged from 50 to 70%.

Dewar found that while the eight tags deployed from a longliner all reported, five out of the eight swordfish tagged died shortly following release. It is without doubt the time on the longline and handling that result in high mortality rates and contribute to the low success rates for PAT tags deployed on swordfish. A different approach is necessary if the potential of PAT tags is to be realized in studies of swordfish.

One potential alternative to capturing the swordfish for tagging on longlines is to use a harpoon to tag free swimming animals. There is an established harpoon fleet for swordfish off Southern California. Harpooning swordfish diminishes the stress associated with tagging by eliminating the requirement to catch and handle the fish.

During the harpooning event, the swordfish are at the surface and often swimming slowly, which allows for tagging to be relatively controlled. An experienced harpooner can target a small area on the fish for implanting the dart that secures the tag to the fish. The location of dart attachment is critical for successful tag deployments.

In 2002 and 2003, as a part of a separate study, seven satellite tags were secured to swordfish for short-term deployments using a harpoon (Dewar unpublished data). Over these deployments there were no mortalities associated with the tagging effort. While this study indicated the potential for using the California harpoon fleet to deploy satellite tags on swordfish, the sample size was small and tags were deployed only for short durations of less than two months.

Additional efforts are required to determine whether the harpoon fleet provides a viable option for long-term deployment of satellite tags on swordfish. This includes developing the tools and methods to maximize deployment durations and minimize premature release, such as identifying the most appropriate darts for tag attachment.

It is also necessary to determine if the use of the RD 1800, instead of the RD 1500, will reduce the incidence of premature release due to the swordfish traveling below the devices release depth (1,800 versus 1,500 m, respectively). In the previous study by Dewar, two tags on apparently healthy fish released and transmitted early when the fish swam below 1,500 m. As well as developing methods for tag deployments, this research will provide the opportunity to collect critical biological information on swordfish movements and behaviors.

Beginning in 2004 and over the course of three years, we plan to deploy a total of 30 PAT tags on swordfish off the California coast in collaboration with the California harpoon fleet. Wildlife Computers PAT 4 and PAT 5 tags are being used in this study.

Of the 30 PAT tags to be deployed, 15 tags each will be secured with one of two dart types to compare the retention time. These tags are being programmed to release after periods of six and 10 months and will be deployed at the beginning of the season in June and July, and toward the end of the season in October and November when possible.

The PAT tags are being deployed by two fishermen who between them have over 50 years of experience on the water. Working with only two fishermen provides some consistency across deployments. When deploying tags, the fishermen use the same harpoon that they use to capture fish. A special adaptor is used to secure the applicator tip for the dart to the harpoon lily iron. The harpoon is thrown such that the dart is inserted at the base of the second dorsal fin with the dart penetrating across the midline. Fish greater than 200 lbs. are targeted for deployments. The fishermen are paid for each tag deployed to reimburse them for the value of the fish.

This study began in the fall of 2004 when six tags provided by the Tagging of Pacific Pelagics program (a pilot project of the Census of Marine Life) were deployed off California on fish ranging in size from 160 to 300 lbs. (estimated size). Two of these fish were recaptured shortly after their release by the local driftnet fleet and one of these tags was recovered by the fleet providing a minute by minute record of temp, depth and light for 25 days (Figure 1).

Two other tags released and transmitted data to satellite, the first after four months and the second after six months. Of the two tags that popped up and transmitted to satellite, the first fish traveled southeast 1,770 km and is the first fish satellite tagged off California to travel in this direction.

The second swordfish traveled 2,480 km southwest, which is the same direction traveled by other fish tagged off California. The two remaining tags failed to transmit data to satellite. Fortunately, one of these tags was recently recovered from a beach in Cuyucos, California, and is currently at the manufacturer (Wildlife Computers) for data retrieval. The archived data recovered from this tag will hopefully provide insight into why the tag failed to transmit data to satellite.

The analysis of the data obtained for the three fish from which data was recovered is still in the very early stages and preliminary at this point but some insights into swordfish biology can be gained. The tag recovered by the driftnet fleet provides a valuable opportunity to examine more detailed information on vertical movements and behaviors than the summarized information that is transmitted through the Argos satellites.

Four days in the life of the swordfish are shown in Figure 1. The most obvious pattern is the diurnal shift in depth distribution from deep waters during the day to shallow mixed layer at night. This pattern was consistent across the record and all other records, although there was some variation in the day and night time depths.

For the fish that remained close to the California Coast, the median nighttime depth was 4 m (maximum 39 m) and the average daytime depth was 284 $\pm$ 67 (range 36-489). This depth distribution is similar to that for the fish whose tag popped up after four months to the southeast. For this swordfish, maximum daytime depths ranged from 24 to 428 m (average 264 $\pm$92), although daytime depth decreased toward the end of the record. At night, most time was spent in the top 5 m.

For the second fish whose tag released after six months toward the southwest far off shore, maximum daytime depth increased as the track progressed from an average of 405 m ($\pm$51 m) over the first month to 620 m ($\pm$107 m) for the last month when the maximum

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UPCOMING EVENTS

World Pelagics 2005 Outlook for Global Pelagic Market and Fisheries Management
October 24-25, Arabella Sheraton Grand Hotel, Cape Town, South Africa
Contact: conferences@agra-net.com
Online information: http://www.agra-net.com/pelagics05

NPAFC-PICES Joint Symposium on the Status of Pacific Salmon and their Role in North Pacific Marine Ecosystems
October 30–November 1, 2005, Lotte Hotel Jeju, Jeju Island, Republic of Korea
Contact: Skip McKinnell, Deputy Executive, Institute of Ocean Sciences at mckinnell@pices.int
Online information: http://www.pices.int

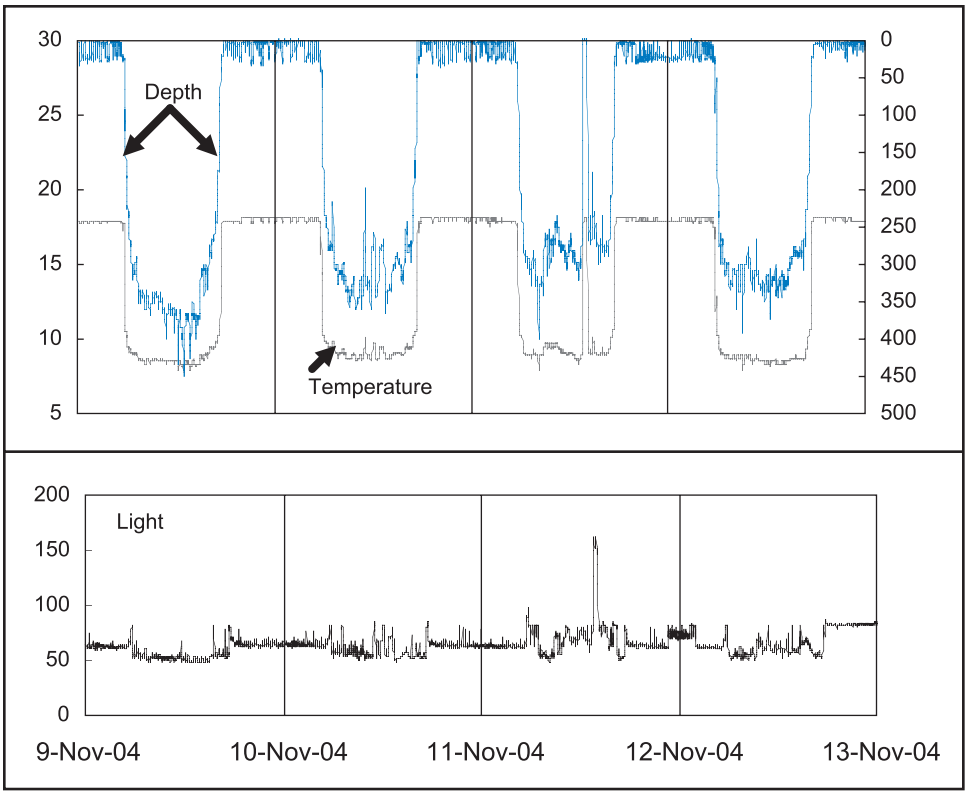
Pelagic Fisheries Research Program Principal Investigators Workshop
November 14-15, 2005, Imin Conference Center, East-West Center, Honolulu, Hawaii
Contact: John Sibert, PFRP manager, sibert@hawaii.edu
Online information: http://www.soest.hawaii.edu/PFRP

Research Priorities Workshop
November 16-18, 2005, Imin Conference Center, East-West Center, Honolulu, Hawaii
Contact: John Sibert, PFRP manager, sibert@hawaii.edu
Online information: http://www.soest.hawaii.edu/PFRP

Western and Central Pacific Fisheries Commission Technical and Compliance Committee, 1st Regular Session
December 5-9, 2005, Pohnpei, Federated States of Micronesia
Regular Sessions of the Commission, 2nd Regular Session
December 12-16, 2005, Pohnpei, Federated States of Micronesia
Contact: contact@wcpfc.org
Online information: http://www.wcpfc.org

PICES/GLOBEC Symposium on Climate Variability and Ecosystem Impacts on the North Pacific: A Basin-Scale Synthesis
April 19-21, 2006, Imin Conference Center, East-West Center, Honolulu, Hawaii
Contact: PICES Secretariat at secretariat@PICES.int
Online information: http://www.pices.int

Scientific Committee of the Commission for the Conservation and Management of Highly Migratory Fish Stocks (WCPFC)
August 7-18, 2006, Manila, Philippines
Contact: contact@wcpfc.org
Online information: http://www.wcpfc.org



(top) Figure 1. The depth (blue) and temperature (gray) data are shown over four days for a PAT tag recovered from a swordfish. (bottom) The light data for the same fish over the same time period is also shown. Note the lack of an obvious day/night signal in the light data.

depth exceeded the 980 m limit of the depth sensor on two occasions. The increase in depth in off-shore waters is likely due to the increased penetration of light and associated increase in the depth of the deep scattering layer where the swordfish feed.

The swordfish demonstrates an impressive tolerance for both cold temperatures and rapid and extreme temperature variations. At deeper depths the swordfish experiences waters down to 4°C. Unlike many other pelagic fish which make short forays into cold water, the swordfish can spend up to eight hours at temperatures between 4 and 6°C.

During either basking events or the vertical movements associated with sunrise or sunset, the swordfish can experience temperature changes of over 20°C in only a few hours. This tolerance has interesting physiological implications especially for systems, such as the heart, not served by heater tissue or counter-current heat exchangers.

One exception to the consistent diurnal pattern is the apparent basking events which can be best examined in the archival record. Over the 24-day record this fish traveled to the surface on six separate occasions sometime between 9 a.m. and 1:30 p.m. where it spent periods from seven to 168 minutes.

Basking events do not occur each day as one might expect if they are strictly thermoregulatory, but on only 25% of the days with no obvious pattern. These apparent basking events may be influenced by successful foraging as feeding will add to the thermal stress and physiological requirements. Interestingly, swordfish that are caught by the harpooners while basking at the surface almost always have a full stomach.

While light level records on PAT tags can be used to estimate geolocation for many species, this is not the case for swordfish. Note the light levels shown in the lower panel of Figure 1. As a result of diving behavior, there is no light signal associated with sunrise and sunset; identifying the time of sunrise and sunset is critical to estimating longitude and latitude. It may be possible, however, to use the behavior of the animal to document sunrise and sunset.

The time that the swordfish initiated their morning dive and returned to the surface at night was very consistent. In the morning, the fish dived below 40 m on average seven minutes ($\pm$ 4 min) before the beginning of civil twilight. In the evening the swordfish returned to within 40 m of the surface on average 13 minutes ($\pm$2.3 min) after the end of civil twilight. A four-minute error translates to one degree in longitude. Thus using the dive signal alone, it should be possible to obtain a rough estimate of longitude.

The error in latitude estimates will be greater whether using day length or SST and will depend on a number of external factors, such as time of year or regional stratification in SST. Other factors which will introduce error are cloud cover and moon phase.

However, at a minimum, when detailed dive records can be obtained it should be possible to determine basic scale movements. Obtaining a signal associated with diving from data transmitted through the satellite will require some modifications to the PAT tag software.

While the results are preliminary, data collected to date indicate the potential for using PAT tags to collect data on movements and behaviors of swordfish at least over a period of up to six months. The results obtained from the remaining deployments will indicate the potential for longer-term movements and help us to identify the best methods for tag attachment.

Heidi Dewar is a marine biologist at Hopkins Marine Station, Stanford University. Jeff Polovina is a researcher at NOAA-National Marine Fisheries Service.

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Longline Fishers Announce 12-Point Plan to Conserve World's Tuna Resources

Eighty commercial longline fishermen outlined a 12-point plan for ensuring the sustainability of the world's tuna resources at the International Fishers Forum and International Conference on Responsible Tuna Fisheries, July 25-29, in Yokohama, Japan. The fishermen represented thousands of commercial fishermen in North and South America, Asia, Australia, New Zealand and Oceania.

Among the key points of their "Declaration on Responsible Fisheries" to which the fishermen have committed are the following:

- To facilitate rules to manage tuna fishing capacity based on the principle that any introduction of new fishing capacity should be accompanied with removal of equivalent capacity
- To improve techniques for using fish aggregation devices (FADs) with the aim of reducing the impact of purse-seine operations on bigeye tuna, especially juveniles
- To refrain from reflagging vessels in order to circumvent conservation and management measures
- To support the Joint Meeting of Tuna Regional Fishery Management Organizations (RFMOs) to be held in Japan in early 2007
- To ensure conservation and management of shark stocks
- To reduce incidental catch of sea turtles and seabirds
- To promote proven techniques for reducing sea turtle incidental catch and improving the survival rates of sea turtles that are caught and released
- To promote proven techniques for reducing seabird incidental catch
- To promote responsible tuna fishing, trade, marketing and consumption
- To reaffirm that the UN Food and Agriculture Organization (FAO) and RFMOs have primary responsibility for addressing international tuna issues
- To challenge biased and unscientific accusations that attack environmentally responsible tuna fisheries
- To ask the United Nations and national governments, including Japan and the United States, to support the points outlined in the Declaration

Approximately 250 fishermen, researchers, government officials and members of environmental non-government organizations from 26 countries attended the joint Conference and Forum hosted by the Tokyo-based Organization for Responsible Tuna Fisheries (OPRT) and the Honolulu-based Western Pacific Fishery Management Council. For more information, visit www.wpcouncil.org.

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Shaffer, S.A., Y. Tremblay, J.A. Awkerman, R.W. Henry, S.L.H. Teo, D.J. Anderson, D.A. Croll, B.A. Block, and D.P. Costa. 2005. Comparison of light- and SST-based geolocation with satellite telemetry in free-ranging albatrosses. *Marine Biology* 147: 833-843, 2005.

The following Scientific Committee documents can be found online at http://www.wcpfc.org)

Hampton, J., P. Kleiber, A. Langley, Y. Takeuchi, and M. Ichinokawa. Stock assessment of yellowfin tuna in the western and central Pacific Ocean. Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia. NOAA Fisheries, Honolulu, Hawai'i. National Research Institute of Far Seas Fisheries. Shimizu, Japan. WCPFC-SC1-SA WP–1.

Hampton, J., P. Kleiber, A. Langley, Y. Takeuchi, and M. Ichinokawa. Stock assessment of bigeye tuna in the western and central Pacific Ocean. Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia. NOAA Fisheries, Honolulu, Hawai'i. National Research Institute of Far Seas Fisheries. Shimizu, Japan.WCPFC-SC1-SA WP–2.

Hampton, J., A. Langley, S. Harley, P. Kleiber, Y. Takeuchi, and M. Ichinokawa. Estimates of sustainable catch and effort levels for target species and the impacts on stocks of potential management measures. Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia. Ministry of Fisheries, New Zealand. NOAA Fisheries, Honolulu, Hawai'i. National Research Institute of Far Seas Fisheries. Shimizu, Japan.WCPFC-SC1-SA WP–10.

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(continued on page 8)

Publications of Note (continued from page 7)

Langley, A., J. Hampton, and M. Ogura. Stock assessment of skipjack tuna in the western and central Pacific Ocean. Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia. National Research Institute of Far Seas-Fisheries. Shimizu, Japan. WCPFC SC1-SA WP–4.

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In Memoriam

Pacific fisheries lost a great friend with the passing of ʻAkauʻola on October 6 in Nukuʻalofa. ʻAkauʻola, born ʻInoke Fotu Faletau, served his country as High Commissioner to Great Britain. Later he took up the post of Director of the Commonwealth Foundation. After returning to Tonga he became the Deputy Secretary of the Prime Minister's office, was appointed Secretary for Fisheries, represented Tonga and international fisheries meetings and served as Chair of the Standing Committee on Tuna and Billfish. He was a commanding speaker and statesman and was dedicated to the sustainable management of the fishery resources of the Pacific.

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