

September 23, 1993 F/SWC2: CHB: FLF
CR9305-3. CHB

CRUISE REPORT

VESSEL: *Townsend Cromwell*, Cruise TC-93-05 (TC-183)

CRUISE PERIOD: Leg I: 9-23 July 1993
Leg III: 13-27 August 1993

AREA OF OPERATION: Within a radius of 300 miles of the Island of Hawaii (Figs. 1, 2)

TYPE OF OPERATION: Longline fishing operations were conducted using monofilament longline gear in conjunction with hook timers and time-depth recorders (TDRs) to study the habitat utilization, hooked longevity, and vulnerability to fishing gear of blue marlin (*Makaira mazara*), yellowfin tuna (*Thunnus albacares*), and associated species. Physical oceanography was monitored with expendable bathythermographs (XBTs), conductivity-temperature depth (CTD) casts with Niskin bottles for dissolved oxygen (DO) measurements and comparative salinity determinations, and with the acoustic Doppler current profiler (ACDP).

ITINERARY: LEG I

9 July The longline shooter was removed and repaired in the morning. Embarked scientists and departed Snug Harbor at 1230. Conducted a short longline set south of Oahu to test the gear and familiarize all personnel with fishing operations.

10-22 July Conducted longline operations each day within a 150-nmi radius of the Island of Hawaii. A CTD and Niskin bottle cast were performed on each fishing day except 11 July (sta. 3). Two CTDs were performed on 17 July (sta. 9 and 10), 20 July (sta. 13), and 21 July (sta. 14). Tracked two yellowfin tuna on 11 and 13 July (sta. 3 and 5) off the Kona coast (Fig. 1).

23 July Transit to Snug Harbor and tie up at 0800. Proceed to off-load longline shooter and spooler, and float bin.

Leg III

- 13 August Embarked scientists (except Curran and Seki) and departed at 1500 for Island of Hawaii.
- 14-15 August Conducted longline operations each day 20 nmi west of Hawaii (sta. 16 and 17, Fig. 2). Conducted one CTD and Niskin bottle cast each day at ca. 0930.
- 16-17 August Took shelter close to shore on the south Kona coast in anticipation of Hurricane Fernanda. Repaired radio buoy antennae and set up TDRs.
- 18-26 August Conducted longline operations from 0500 to 2200 on each day and conducted a CTD cast each day from 0900 to 1000. Areas of operations included seamounts Finch, Daly, Washington, Bishop, Ellis and Dutton and extended to lat $16^{\circ}24'S$ (sta. 18-26, Fig. 2).
- 27 August Arrive at Snug Harbor ca. 0800. End of Leg III and end of cruise. Proceed to off-load equipment, supplies, and specimens.

MISSIONS AND RESULTS:

- A. Measure the fishing depth of the longline hooks using TDRs and measure the time at which blue marlin, yellowfin tuna, and associated species of fish are captured using hook timers.
1. The depth of the main line at points 0.5 of the line length between serial floats; (the deepest points) was recorded with TDRs on 8-13 baskets in each of the 20 full-scale sets. (A basket is one interval of gear between two floats; ca. 30-45 baskets were used in each full-scale set. The depth of the main line at an intermediate position (0.2 to 0.3 of the distance between two floats) was also recorded with TDRs on 1-4 baskets per set. TDR records of fishing depths indicated that the deepest part of the main line was typically 150-300 m. Watertight integrity was maintained by all TDRs. However, three TDRs disappeared from the main line under unexplained circumstances.
 2. Almost every hook set was equipped with a hook timer. Hook timers indicated that fish were caught throughout the period while the longline was in the water but predominately while the longline was at its settled depth rather than while it was sinking during deployment or rising during haulback. Hook timers

indicated that fish survived for many hours after being captured, with tuna tending to survive longer than billfish.

- B. Collect fish catch and effort data to index relative gear efficiency as a function of gear configuration and fishing depth.
1. A total of 25 sets were made including 20 full-scale sets, 4 short sets made at the beginning of each leg, and 1 practice set made without bait at the beginning of the cruise. (One set was made at each station except station 10). Effort totaled over 12,300 hooks, and 402 fish (23 species) were caught. Compared to previous cruises, the catch was less diverse and was composed of more target species. Nontarget species caught included lancetfish 55 (*Alepisaurus ferox*), 22 mahi mahi (*Coryphaena hippurus*), and 69 (7 species) sharks and pelagic stingrays. Billfish (63 caught, 4 species) were less numerous than tuna (153 caught, 4 species). The catch-per-unit effort (CPUE) for the target species was above average (5.1 yellowfin tuna per thousand hooks and 1.5 blue marlin per thousand hooks).
 2. Depth information on the catch has yet to be compiled, but bigeye (*Thunnus obesus*) and albacore tunas (*Thunnus alalunga*) tended to be caught on the deeper hooks and on sets that reached 200 m or deeper. Yellowfin tuna and billfish were mostly caught on shallower hooks close to the floats.
 3. Actual calculations of the efficiency of different gear configurations will require further analysis. Data collected from the target species (tunas and billfish) should be sufficient to provide meaningful efficiency estimates.
- C. Collect environmental data and physically locate longline gear to test hypothesis regarding the distribution of fish in relation to mesoscale eddies, eddy boundaries, the thermocline and oxycline using daily satellite imagery from Coast Watch, thermosalinograph data, temperature (XBT), salinity (CTD) and oxygen (Niskin bottle) depth profiles, and current profiles (ADCP).
1. Twenty-six CTD and Niskin bottle casts were made at 24 stations. Salinity samples were collected from each cast, and dissolved oxygen (DO) determinations were made from 12 of the bottle casts. Thermosalinograph, depth and current profiles were also recorded. Satellite images provided through the Coast Watch Node

were sent from the Honolulu Laboratory to the ship via a facsimile.

2. A subsurface oceanographic feature observed on TC-92-08 was found to influence CPUE for bigeye tuna. On Leg III a similar oxycline feature was found at two stations ($16^{\circ}28'N$ and $16^{\circ}24'N$) and fishing to the north of this feature produced abundant catches of albacore, yellowfin, and bigeye tunas.
 3. ACDP data was examined in real time and was very useful for predicting the longline drift, which was invariably in the direction of the upper layer of water and often against the prevailing wind.
- D. Tag, mark with injection of oxytetracycline, and release blue marlin and other billfish captured alive. Tag and release yellowfin tuna and other pelagic species captured alive. Attempt videographic measurements of released fish and collect (for John Lucy, VIMS) measurements of dead fish for use in estimating weight from videographic measurements.
1. A total of 71 fish were tagged and released. These included 21 yellowfin tuna, 13 bigeye tuna, 5 albacore tuna, 15 blue marlin, 11 shortbill spearfish (*Tetrapterus angustirostris*), 3 striped marlin (*Tetrapterus audax*), 2 wahoo (*Acanthocybium solandri*), 1 opah (*Lampris guttatus*), and 1 barracuda (*Sphyræni* sp.). Most of the billfish tagged and released were injected with oxytetracycline.
 2. The mission to collect videographic measurements and related morphometric measurements was abandoned at the onset of the cruise.
- E. Tether live yellowfin or bigeye tuna to test method of recovering tethered fish for ultrasonic tracking after the longline operation is completed. Conduct ultrasonic tracking experiments for fish much larger than any tracked before (e. g., >70 kg yellowfin tuna or >30 kg bigeye tuna).
1. A total of eight fish were recovered alive and tethered. These included five yellowfin tuna, two blue sharks (*Prionace glauca*), and one opah. Three of the five yellowfin tuna were recovered alive and released. They had been hooked up to 5 hours before being tethered, spent up to 14.5 hours on the tether, and ranged in depth from 80 to 210 m. Both blue sharks were recovered alive and released. The opah was dead on recovery. All fish except for one yellowfin tuna had a TDR attached at the snap end of the branch line.

2. Two yellowfin tuna (73 and 60 kg) were tracked on Leg I for periods of 40 minutes and 5.5 hours. The duration of each track provided limited data. The tracking operations were hampered by the limited effective range of the sonic transmitter and receiver system. Signals from a 50-kHz sonic transmitter attached to each fish were received by a towed sensor with four fixed hydrophones oriented starboard, forward, port, and aft. The ship's propulsion system rendered the aft hydrophone useless. Sound propagation by the ship or blocking by the hull eliminated reception by the port hydrophone and reduced the forward and starboard hydrophone range from 0.8 to 0.4 nmi. The area of the hydrophone search pattern was then reduced to 9% of the effective 360°-0.8 nmi range possible from a quieter platform. The faster, larger tuna (4 kts) can pass through this zone in less than 6 minutes, the time required for not more than one careful search pattern by circling the ship (Fig. 3). Unless the system is improved, results obtained using the *Townsend Cromwell* as a tracking vessel may be limited to slower and less active fish.

- F. Record measurements (fork length, morphometric measurements, organ and body weights), determine sex, and photograph dead fish. Collect and preserve various tissue samples.
1. Of the 402 fish caught, data on length, weight, sex (if possible) were recorded, and samples were collected from 243 fish. The other fish were released or escaped while fighting on the branch line alongside the vessel. Very few dead fish dropped off the line or were partially eaten and could not be sampled (ca. <10 fish).
 2. Otoliths, vertebrae and selected spines were collected from 14 albacore for use in comparison and age determination studies.
 3. Parasitic copepods were collected from 16 large (>90cm FL) albacore in the area of the anal vent. The information is used to determine an association of large albacore and ectoparasitic copepods.
 4. Twenty samples of red and white muscle tissue from wahoo, skipjack (*Katsuwonus pelamis*), shortnose spearfish, albacore, and blue marlin were collected for monoclonal antibody and DNA stock identification work.
 5. Gonadal samples were collected from five yellowfin and one bigeye tunas. Samples will be used to compare histological techniques used to determine spawning

frequency. Two of the five yellowfin tuna samples were preserved in two different treatments to test preservation methodology.

6. Fifty-six heart samples were collected to quantify the density of adrenergic receptors in the tissue mass and to identify the importance of chromotropic regulation in the thunnids. The samples came from 7 species, which included 5 yellowfin tuna, 9 albacore, 3 bigeye tuna, 7 wahoo, 3 blue marlin, 10 spearfish, and 19 lancetfish.
 7. Fourteen pelagic stingrays (*Dasyatis violacea*) were collected for age determinations and stomach contents. Nineteen lancetfish stomachs, particularly juvenile snappers, were collected for contents.
 8. Tuna physiology experiments were conducted on 10 yellowfin tuna to determine contraction time and force development in red and white muscle at different locations along the length of the fish. Two yellowfin tuna were carefully dissected to determine red and white muscle cross-sectional area and the number and thickness of myotomes at different locations on the fish. The data collected will compare large fish samples collected at sea with smaller tunas held in captivity at Kewalo Research Facility. A total of 25 tail sections were collected from yellowfin, albacore, skipjack tunas, and wahoo to measure tensile strength and elasticity of the large tail tendon.
- G. Participation in the "Teacher at Sea" program and with cooperative scientists.

The four teachers and two cooperating scientists participated in all phases of the cruise. This included the setting and hauling of the longline gear, collecting and recording catch data, and monitoring CTD operations. The teachers used their hands-on experiences and exposure to the operation of a research vessel to develop lesson plans and returned with samples of data collected from the cruise and samples of fishing gear for their classrooms. The cooperating scientists also collected information and specimens for their own investigations. Much of this information is unique to a research longline cruise, and most observations complemented research presently conducted by NMFS personnel.

**SCIENTIFIC
PERSONNEL:**

Leg I:

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Attachments

Labels:

Figure 1. -- TC-93-05, (TC-183) Leg I: Longline operation stations. The dotted line indicates the 1000 fm contour, and the dashed line indicates the 200-mi Exclusive Economic Zone.

Figure 2. -- TC-93-05, Leg III: Longline operation stations. The dotted line indicates the 1000-fm contour, and the dashed line indicates the 200-mi Exclusive Economic Zone.

Figure 3A. -- Horizontal area of effective tag reception.

Figure 3B. -- Cross section of volume of total effective search pattern and the effective volume above 300 m.