

26 September 1990 F/SWC2:GWB
CR9007-4.GWB

CRUISE REPORT

VESSEL: *Townsend Cromwell*, Cruise 90-07 (TC-155).

CRUISE PERIOD: 22 August-17 September 1990

AREA OF OPERATION: Palmyra Atoll and surrounding waters.

TYPE OF OPERATION: Personnel from the NMFS Honolulu Laboratory Fisheries Oceanography Research Program and the Joint Institute of Marine and Atmospheric Research (JIMAR), University of Hawaii conducted biological and oceanographic sampling in waters surrounding Palmyra Atoll to assess the distribution of larval and juvenile fishes relative to the ocean environment.

ITINERARY: 22 August Departed Snug Harbor at 1000 and calibrated MOCNESS flowmeter. On board George W. Boehlert, Ilse Hamann, Donald R. Kobayashi, Bruce C. Mundy, Christopher D. Wilson, and Ronald K. Yoshimoto. Tested MOCNESS, ADCP, CTD, and acoustic release in waters off Oahu.

25 August Arrived at 10°00' N, 163°00' W. Began CTD/XBT/ADCP transect to identify the latitudinal position of the Equatorial Countercurrent.

27 August- September Deployed two ARGOS satellite drifters 2 upstream of Palmyra Atoll. Began bathymetric survey and ADCP measurements. Conducted ADCP/CTD stations, MOCNESS hauls, and Cobb trawls.

2-3 September Deployed ARGOS satellite drifter and began CTD/ADCP synoptic sampling stations.

4-5 September Entered Palmyra Lagoon. Anchor station, overnight. Conducted small net plankton sampling and light trap station in lagoon.

5-13 September Conducted MOCNESS and Cobb trawl sampling, ADCP/CTD stations, and deployed additional ARGOS satellite drifter.

13 September Entered Palmyra Lagoon for CTD casts and dropnet plankton sampling. Departed approximately 1700 from vicinity of Palmyra Atoll.

17 September Arrived at east end of Penguin Bank, Molokai, and conducted calibration run for ADCP. Arrived at Snug Harbor at 1700. Disembarked George W. Boehlert, Ilse Hamann, Donald R. Kobayashi, Bruce C. Mundy, Christopher D. Wilson, and Ronald K. Yoshimoto. End of Cruise.

MISSION

AND
RESULTS:

- A. To collect early life history stages of island-related fishes in the waters surrounding Palmyra Atoll to determine the distributional patterns relative to ocean currents, current-topography interactions, distance from the island, and vertical structure of the water column.

Young stages of fishes were collected with five types of gear, including the 1 m² MOCNESS plankton net, the MANTA neuston net (.7 by .7 m), the Cobb midwater trawl, 1 m plankton dropnet, and a single light trap station.

The MOCNESS and MANTA nets were generally deployed concurrently. Two types of sampling efforts were undertaken. The first was vertical stratification sampling. Six deployments of the MOCNESS net were made on the night of 27-28 August and the day of 28 August with each tow centered at approximately 5°51' N, 161°58.5' W. Each deployment was accompanied by a single deployment of the MANTA neuston net. The depths targeted by the MOCNESS were 200-160 m, 160-120 m, 120-100 m, 100-80 m, 80-60 m, 60-40 m, 40-20 m, 20-0 m. Within each depth bin, the sampling was stepped oblique to insure relatively equal sampling effort within each depth bin. The object of the vertical stratification series was to first determine the gross vertical distribution of larvae, used to assign the depth bins for the second type of sampling, and also for later analysis of diel patterns of vertical distribution. All MOCNESS samples were approximately 12 min duration; the MANTA tows were approximately 24 min duration. A total of 31 MOCNESS samples and 4 MANTA samples were taken in this sampling.

The second type of MOCNESS and MANTA samples were a set of stations geographically placed around the island. Based upon the vertical physical structure of the water column and visual inspection of the night samples from the vertical distribution series, three depth intervals, 110-70 m, 70-30 m, and 30 m to the surface, were chosen; we slightly modified the deep bin to account for variations in the mixed layer depth and chose the maximum depth by sampling to the depth of the 26.5 isotherm if it was deeper than 110 m (although we limited the depth to 130 m). This sampling was only conducted at night; each night of MOCNESS/MANTA sampling consisted of three sets of the nets. Six samples were taken with each deployment of the MOCNESS; the first net was used to lower to depth, then nets 2, 3, and 4 sampled the deep, intermediate, and shallow strata, respectively. Net 5 was also used for lowering with no sample taken, and nets 6,7, and 8 (or 9, after net 8 was damaged) again sampled the deep, intermediate, and shallow strata. One 24 min deployment of the neuston net was made during each MOCNESS cast. All MOCNESS samples were 12 min duration. A total of 295 MOCNESS samples and 50 MANTA samples were taken in this sampling.

Finally, we conducted daytime shallow MOCNESS sampling to replace days lost due to problems with the stern winches. They differed in location and sampling strategy from the nighttime sampling and constituted a study in themselves; the goal was to determine the distribution of shore fish

larvae in relatively shallow waters around the island relative to physical factors. The tows were attempted along the 100 m isobath, when possible, and were all oblique tows from the surface to 50 m. The MOCNESS was never allowed to come closer than 10 m to the bottom. Tow direction, duration, and extent were largely dictated by the vessel's safety and steering considerations. A single 24 min Manta tow was again taken in conjunction with each MOCNESS deployment. A total of 53 MOCNESS samples and 8 MANTA samples were taken in this effort.

On the afternoon of 4 September, the *Townsend Cromwell* entered Palmyra Atoll and anchored in the lagoon overnight. During this period, we used the ship's whaler to sample larval fishes. During the afternoon hours, a 1 m dropnet was used to sample the dropoffs close to reefs to determine the ichthyoplankton evident in shallow waters; 10 samples were taken with the dropnet, with each sample consisting of three drops of the net. At night, the dropnet was again used; ten samples were taken in deeper waters of the lagoon, each consisting of two drops of the net to 20 m. These samples will be used to assess the abundance and species composition of shore fish ichthyoplankton for comparison with samples from outside. Larvae were also sampled with a light trap from the stern of the *Cromwell*, and eight samples were taken between 0000 and 0535.

We entered the lagoon a second time on 13 September. The shallow daytime MOCNESS stations had shown a distinct difference between plankton and ichthyoplankton composition and abundance between northern and southern flanks of the island. Because of the possibility that fish were being advected from the lagoon, we decided to further examine the distribution of larvae in the lagoon during daytime. Dropnet samples were taken at different maximum depths to get an idea of the daytime vertical distribution of larvae by subtraction, resulting in 13 samples collected. Also, CTD profiles were made in the deepest portions of the west lagoon to assess the vertical structure of the water column and the relative exchange of water between the lagoon and offshore.

To sample larger larvae and pelagic juveniles, the Cobb Midwater Trawl was used. All Cobb trawl deployments were made during daylight hours, although midway through the cruise we planned to make two night hauls on the northern and southern flanks of the atoll platform. The first series of three Cobb trawls was a vertical stratification series designed to make a preliminary analysis of the depth distribution of the shorefish species and scombrids. The hauls each spent about 1.5 hr fishing at depth. Problems with the Furuno netsonde precluded accurate depth estimates, although the system was functioning properly on the last of these three tows. An additional 36 Cobb trawl stations were planned as a geographic distribution series. Typically, three stations were occupied each day. The depth sampled for these hauls was from 120 m to the surface, in a stepped oblique fashion. On 8 September, after a total of 22 Cobb trawl hauls (19 of which were in the geographic series), the starboard winch level wind mechanism self-destructed, precluding further stern

trawling activities. This left some significant gaps in the planned sampling strategy. This is the most recent manifestation of the poor history of stern trawling winch performance aboard the *Townsend Cromwell* and seriously calls into question the planning of scientific efforts dependent upon the stern trawling capability of this vessel. Despite a long history of requests for improvements in stern trawling capability, PMC has consistently used a bandaid approach detrimental to the research mission of the users of the vessel. To use the days freed up by lack of ability to use the stern winches, we developed the daytime MOCNESS stations (above), the ADCP downstream transect, and conducted additional CTD stations.

- B. To collect oceanographic data to determine the current patterns and vertical structure of the water column for the evaluation of distribution of fish larvae and juveniles.

A variety of sampling techniques was planned for collection of physical oceanographic data. These included XBTs, CTD, the acoustic Doppler current profiler (ADCP), a single current meter mooring, and ARGOS satellite drifters. We also planned to use the integrative capabilities of the MICROVAX SCS to map surface salinity and temperature from Thermosalinograph records. In addition to the shallow T-6 XBTs deployed for routine SEAS casts, we deployed 27 T-7 XBTs, which sample to 750 m. The first series of CTD and XBT stations and an ADCP transect were made along 163° W longitude, from 10° N to 5° N to determine the axis and velocity of the equatorial countercurrent upstream of Palmyra Atoll. A total of 6 CTDs and 10 T-7 XBTs were cast on this survey; a total of 40 CTD casts were made on the cruise, excluding the test done off Oahu. After this survey, two ARGOS drifters were deployed upstream of Palmyra Atoll on 27 August; additional drifters were deployed in similar locations on 2 September and 9 September. Locations of these drifters were faxed to the vessel with 3-4 daily position locations to assess the surface current patterns upstream of the Atoll during biological sampling.

Plans were made to deploy a single Andraea current meter (model RCM-4) in waters upstream of Palmyra Atoll at a depth of approximately 100 m, with the meter at a depth of 40-60 m. The purpose of this deployment was to assess the variation in current structure at a single location and to judge the tidal currents for comparison with ADCP-derived currents and quasi-geostrophic current estimates. On 27 August, a detailed bathymetric survey was made on the upstream flank of the island platform. Based upon the bottom topography, it was determined that the steep sides and strong currents (to 100 cm/sec) were such that it would not be possible to successfully deploy the meter; moreover, the very steep sides would probably cause measurement of boundary effects given that the meter would be quite close to the bottom slope. Given this situation, we explored the shallower waters of the platform, inside the 100 m contour. The only appropriate flat area was in a depth of 15-20 m, meaning that it was unlikely that

current meaningful to the general background flow would be measured. We thus decided against deploying the current meter.

ADCP data were collected at virtually all times that GPS data were available. These data were processed in near real time aboard the vessel to provide assessment of currents during sampling activities. CTD and ADCP stations were conducted at virtually all available times, particularly near sunrise/sunset between MOCNESS and Cobb sampling periods. We also conducted a synoptic CTD survey on 2-3 September with a grid of CTD stations around the Atoll. A special study with the ADCP was conducted on 10 September to assess the downstream wake of the island. The ADCP was calibrated during repeated runs over Penquin Bank on 17 September.

Our intention to use the Microvax SCS was thwarted on several fronts. One of the most important planned uses, outside of simple data collation, was the transfer of files containing records from the thermosalinograph (TSG) and location information from the GPS to the PC. The intention here was to develop horizontal contour plots of the temperature and salinity field from data collected from the vessel trackline. During the cruise, it became evident rather early that insufficient experience and knowledge of the SCS was available, both from the vessel and scientific crew, despite training of two ship's and one scientific crew in its use; this is not a comment on the qualifications or capabilities of the individuals involved, but rather reflects the great complexity of the SCS and its software relative to the training received. Aside from being unable to transfer data files, we could generally not even ascertain whether or not data were being collected. We concluded that significant work will be necessary before the SCS becomes a useful instrument for data collection and scientific support. While great potential exists for the SCS, our experience supports the need for a trained survey tech aboard the TOWNSEND CROMWELL to serve as a system manager.

- C. To collect larval and juvenile stages of tunas to determine the abundance as a function of distance from the island.

Analysis of the samples described above under objective C will fulfill this objective as well. Larval and juvenile tunas were collected in this gear.

- D. General observations and miscellaneous activities.

1. Bird flock, fish school, and marine mammal sightings were recorded by the ship's officers and crew during daylight hours when possible.

2. Standard weather observations were made at 0000, 0600, 1200, and 1800 (GMT) during transit.

3. XBT casts were made at 0000, 0600, 1200, and 1800 (GMT) during transit and at 0000 (GMT) when in the vicinity of Palmyra Atoll.

4. Trolling from the vessel produced several sizable yellowfin tuna and fewer skipjack and ono. When relatively undigested stomach contents were noted in these specimens, the contents were preserved in formalin for later examination.

SCIENTIFIC
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