

June 10, 1998

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CRUISE REPORT

VESSEL: *Townsend Cromwell*, Cruise 98-05 (TC-231)

CRUISE PERIOD: 23 April to 10 May 1998

AREA OF OPERATION: Waters north of the Hawaiian Archipelago in the vicinity of the Subtropical Front (Fig. 1)

TYPE OF OPERATION: Personnel from the Southwest Fisheries Science Center (SWFSC) Honolulu Laboratory (HL) and the University of Hawaii Department of Oceanography (UH) conducted a series of conductivity-temperature-depth (CTD) casts and discrete depth water sampling for extracted chlorophyll and nutrient determinations along meridional transects to support ongoing studies characterizing the physical and biological oceanographic properties associated with the Subtropical Front. Estimates of in situ ocean currents' direction and velocities were also obtained along the cruise track with a shipboard acoustic Doppler current profiler (ADCP). Underway measurements of sea surface temperature and salinity with a hull-mounted thermosalinograph (TSG) were also used to help conduct the near real time synoptic assessment of the oceanography. Fishing operations with an experimental squid driftline were conducted to continue evaluating the potential of the technology as a future resource assessment tool and to collect samples for ongoing life history and ecology studies on the flying squid, *Ommastrephes bartramii*.

ITINERARY:

23 April - Departed Snug Harbor, Honolulu, at 1700. On board Colleen Allen, Nancy L. Ash, Robert R. Bidigare, Christine L. Huffard, Markus Koebl, Carrie L. Leonard, Robert Nishimoto, Michael P. Seki, and Happy A. Williams. Conducted trial CTD cast and

calibration of time-depth-recorders (TDRs) off Barber's Point, Oahu.

- 24 April - Arrived at lat. 23°N, long. 158°W. Commenced conducting a series of 500 m CTD casts spaced 15 nmi apart (0.25° latitude) and squidline sets generally at locations occupied during night hours. Continued sampling strategy northward along the 158°W meridian to 33°N latitude. The 158°W hydrographic transect samples through the region traditionally frequented by commercial longline vessels during this seasonal period.
- 1 May - Arrived at lat. 33°N, long. 158°W completing the hydrographic section. Transited to lat. 32°N, long. 156°W and resumed oceanographic and fishing operations on a southward transect along 156°W longitude.
- 4 May - Rendezvoused with the fishing vessel (F/V) *Edward G* at lat. 28°N, long. 156°W to explore possible oceanographic sampling around their longline set. A tentative longline and environmental sampling set was scheduled for the ensuing evening of 5 May at lat. 28°N, long. 158°W.
- 5 May - Continued oceanographic sampling southward along 156°W to 27°N latitude where the transect would be abandoned and the transit to lat. 28°N, long. 158°W to meet the F/V *Edward G* undertaken. Upon arrival at lat. 28°N, long. 158°W, hydrographic conditions were deemed unacceptable by the F/V *Edward G* captain for longline deployment and therefore, sampling plans were aborted. Time constraints and the extensive movement of the fishing vessel away from the area of operation in search of more productive fishing grounds precluded any attempt to reschedule a set. The oceanographic survey of the fishing grounds resumed with sampling conducted back southward along the 158°W longitude.
- 7 May - Completed oceanographic sampling at last scheduled station, lat. 24°N, long. 158°W.
- 10 May - Arrived Snug Harbor, Honolulu. Disembarked Allen, Ash, Bidigare, Huffard, Koebl, Leonard, Nishimoto, Seki, and Williams. End of cruise.

MISSIONS AND RESULTS:

- A. Describe the oceanographic features characterizing the Subtropical Frontal region through CTD casts and continuous ADCP and TSG measurements.

A total of 76 CTD casts were conducted with a SBE 9/11+ CTD system along three discrete sampling transects over the duration of the cruise. These data together with continuous observations obtained from the ship-mounted ADCP and TSG were used to characterize hydrographic conditions through the water column associated with the Subtropical Frontal Zone and the mesoscale dynamics that characterize the region. Two distinct frontal systems delimiting the Subtropical Frontal Zone were traversed at 27.5°N to the south and about 32°N to the north on the 158°W meridian, and at about 28.5°N and 31°N on the 156°W longitude (e.g., Fig. 2). Uplifting (and depression) of isotherms, isohalines and isopycnals responding to the divergent (and convergent) dynamics associated with frontal regions at these features are illustrated in the vertical sections of the sampled parameters along the tracklines. Steepest physical gradients were encountered between 27.5° and 28°N latitudes on the northbound track along 158°W longitude where the $\Delta T \approx 3^\circ\text{C}\cdot 50 \text{ km}^{-1}$, $\Delta S \approx 0.7 \text{ PSU}\cdot 50 \text{ km}^{-1}$, and $\Delta \sigma_t \approx 0.6\cdot 50 \text{ km}^{-1}$.

- B. Assess the influence of the physical dynamics associated with the frontal region on biological productivity through CTD-mounted fluorometer measurements and discrete depth water samples with Niskin bottles for extracted phytoplankton and nutrients assessment.

In situ total chlorophyll was estimated with CTD-mounted fluorometer measurements at all 76 CTD stations. In addition, water samples from discrete depths were collected for determination of extracted chlorophyll (fluorescence) and pigments (high performance liquid chromatography (HPLC)) and unfiltered nutrient concentrations. For discrete depth-extracted phytoplankton analyses, seawater was acquired from depths of 200 m, 150 m, 125 m, 100 m, 80 m, 65 m, 50 m, 35 m, 20 m, and at the surface. Water samples of volumes 1-L for fluorescence and 2-L for HPLC were vacuum filtered through 47 mm diameter, 0.7 μm Gelman TCLP glass fiber filters. Measurements of fluorescence to yield total chlorophyll, chl-a and phaeophytin concentration were made at sea on a Turner 10-AU fluorometer after 24-h extraction in acetone. Filters containing pigments for HPLC were frozen in liquid nitrogen and returned to the UH for analysis. Unfiltered water samples (120 ml) for nutrients (nitrate + nitrite, orthophosphate and silicate) determinations were collected at 500 m, 300 m, 150 m, 125 m, 100 m, 80 m, 65 m, 50 m, 35 m and at the surface; all samples were frozen and returned to the HL for analysis.

Preliminary analysis revealed enhanced chlorophyll concentrations occurring primarily at the deep chlorophyll maximum at regions adjacent to the cold side of the frontal systems coincident with shoaling of isotherms and isopycnals (e.g., Fig. 2d). Observed patterns are consistent with that expected with input of nutrients into the euphotic surface waters from below and the subsequent advection and accumulation of phytoplankton at adjacent frontal convergences. A two-fold increase of surface chlorophyll was measured upon the crossing of the Subtropical Front at about 32°N lat. into waters of the Transition Zone.

- B. Conduct trial deployments of the experimental squid driftline and evaluate the potential of the gear as an instrument for future resource assessment.

Nineteen deployments of the experimental squid driftline were made each with about 29 droppers (jigs) set per deployment. Three Wildlife Computers time-depth-recorders (TDRs) were also attached to the line to help determine actual depths fished. Catch on the squidline was composed of a total of 17 *Ommastrephes bartramii* and 6 *Sthenoteuthis oualaniensis*. An additional 28 *O. bartramii* and 4 *S. oualaniensis* were collected incidentally on rod and reel. In total, the catch of *O. bartramii* was composed of 17 females, \bar{x} = 48.0 cm (range = 44.8-51.7 cm, sd = 1.9) dorsal mantle length (DML) and 28 males, \bar{x} = 32.5 cm DML (range = 30.4-34.8 cm DML, sd = 1.1); all sexually mature. Eight females, \bar{x} = 22.2 cm DML (range = 16.7-26.5 cm DML, sd = 3.6), 1 male (18.7 cm DML) and 1 immature (22.5) made up the *S. oualaniensis* catch. Whole specimens of and stomachs, beaks, optic ganglia, gills, and a mantle subsample from *O. bartramii* were saved for ongoing life history and ecology studies.

**SCIENTIFIC
PERSONNEL:**

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Attachments