SCIENCE SITREP
FROM: BRUCE D. SIDELL

P A L M E R S T A T I O N A N T A R C T I C A

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S-014 ENERGETICS OF THE ADULTS AND LARVAE OF THE ANTARCTIC KRILL, EUPHAUSIA SUPERBA. L B Quetin and R M Ross, University of California at Santa Barbara.

Personnel at Palmer during April were R Ross, T Frazer, D Carlini and C Wyatt. R Ross departed Palmer on 26 April, leaving T Frazer as leader of the field team.
Larvae were collected from the field during two short cruises in April. Force 8 and 9 winds during both cruises prevented trawling on the outside of Smith Island where we had collected calyptopis larvae in late March. Only 400 early calyptopis larvae were collected during the 2 day cruise from 13 to 15 April. But about 1000 mid-furcilia stage larvae were collected during a 2-day cruise (23 to 25 April) generously shared by S-036. Both sets of larvae were found near the Schollaert. The calyptopis larvae suffered high mortality on the first molt, but we anticipate that the mid-furcilia stage larvae will fare better.

The test of the three methods of stirring used to maintain the early calyptopis larvae showed that larvae survived far better on the roller stirrer than on either the Vidal stirrer or in the kriesel. Those larvae collected as C2 in late March are now predominantly furcilia 1. We also tested the starvation tolerance system for homogeneity of food concentrations. The STS system will be used for experiments during May and subsequent seasons to quantify the degree of tolerance to short and long periods of starvation (low food availability) of both early and late larval stages. With only slight modifications, e.g. extension of the stir bars, food concentrations in the cells were within 0.5 ug chla/liter of each other for 5 days.

Observations of the swimming behavior of the adults continued, but strong schooling with forward swimming was only occasionally observed. Usually adult krill merely maintained position against the current, or milled around near the center. On one occasion adults were seen swimming fast (about 20 cm/sec) in a tight school, but this behavior was not seen again this month.

From oxygen consumption experiments throughout the season during previous years we learned that oxygen consumption rates of adult krill in the winter were only 1/3 those in the summer, a considerable metabolic savings. The question remains as to whether that decrease was due to modifications in behavior or changes in the metabolic capacity of the animal. We hope that assays of several metabolic enzymes in conjunction with oxygen consumption experiments will help us answer this question. During April we developed a protocol to assay cytochrome oxidase, one of the

metabolic enzymes chosen, in krill. B Sidell was of great help in all phases of protocol development, and B Detrich suggested the ingredients for the "cocktail" necessary to inhibit the proteases in krill. Without the resident expertise of these two this protocol could not have been developed in such a short time.

We would also like to thank the Captain and crew of the Polar Duke for their interest in our trawling problems, and the support staff at Palmer Station for their prompt attention to all requests. The environmental room performed flawlessly throughout April, and the additional environmental room on the dock will make experiments possible at two temperatures throughout May.

S-034 EARLY LIFE HISTORY OF ANTARCTIC FISHES. R. Radtke, University of Hawaii.

Ichthyoplankton Survey

The primary objective our research this season is to conduct an ichthyoplankton survey along the length of the Antarctic Peninsula. This survey consists of eight transects and a total of forty-seven stations. Transects are perpendicular to the coast and cover the area from just north of Smith Island to Margarete Bay. The grid chosen is the same that was run aboard the German "Meteor" cruise in the 89/90 summer season. We plan to use this same grid at different seasons throughout the year in order to examine the seasonal variation in the ichthyoplankton community.

During the "Polar Duke" 91-3 cruise, we were able to successfully complete forty-five of the planned forty-seven stations in twelve days. Our sampling protocol was to sample the water-column in 600, 300, 200, 140, and 70 meter intervals. We had intended to use the bongo-net but the one-meter ring-net provided a greater sampling area. We used a 250um mesh net. The catch was carefully sorted for any fish larvae. When larvae were found, they were identified, morphometrics (standard length, total length, and head length) were recorded. the larvae were preserved in 90% isopropyl alcohol for transport to and further age-development analysis at the University of Hawaii. Hydrographic data was obtained with XBTs. This provided hydrographic data at every station and was much less time-consuming than CTD casts. We did have some mechanical difficulty with the XBT however, but this was able to be repaired well enough to allow us to continue using it.

The following species were found: Notolepis coatsi and annulata (53 specimens), Notothenia kempi (42 specimens), Bathylagus antarcticus (12 specimens), Electrona antarctica (33 specimens), and Nototheniops larseni (7 specimens). Notably absent were larvae of Pleuragramma antarcticum. This, however, was similar to what was found during the 89/90 "Meteor" cruise. As expected, Notolepis coatsi, Notolepis annulata, and Notothenia kempi were chiefly encountered in warmer water masses. Neither of these fish have the anti-freeze glycoprotein in their blood. The Notolepis species were found in a broad range of sizes and developmental stages suggesting a broad range of hatch dates while the Notothenia kempi were found in a relatively smaller range of sizes and developmental stages suggesting just the opposite. Notothenia kempi

were found further south in the grid while Notolepis were found distributed throughout the entire grid.

Rearing Experiments

While at the station, an otolith validation experiment was performed. The objective was to determine at what rate increments are formed and the otolith grows. Much work from a wide range of species throughout the world suggests that a daily increment deposition rate is universal. There have been, however, few such studies performed upon anarctic fishes.

Otoliths of living fish may be marked with oxytetracycline. By injecting oxytetracycline intramuscularly, a flourescent increment is deposited on the growing surface of the otolith. This offers a time-zero mark for age and growth studies.

Our experiment is run on juvenile and young adult Notothenia gibberifrons and Nototheniops nudifrons. Two experiments are currently being run simulataneously using different dosages of oxytetracycline. Fishes were injected March 31 and fish will be kept alive as long as possible until the end of cruise 91-4 in June. Another similar experiment is to be repeated beggining around the first of May.

Plans for Cruise 91-4

We plan to run through the entire grid a second time during our first two-weeks of ship time. During the second two-weeks, we will make surface tows in the Gerlache Straight for eggs of Notothenia neglecta and make an inshore icthyoplankton survey of the Gerlache, southern Bransfield, and Anvers Island areas. The eggs of Notothenia neglecta appear in the surface waters in late May and are among the only non-demersal eggs of all Nototheniid fishes. The eggs will be shipped alive back to Honolulu and will be reared until they are juveniles. This will allow a very detailed description of growth of the otolith and its relation to the growth and development of the fish.

S-036 PHYSIOLOGICAL AND ULTRASTRUCTURAL ADAPTATIONS OF ANTARCTIC FISHES TO CHRONICALLY COLD BODY TEMPERATURE. B. Sidell, University of Maine.

During April, we continued our studies of the physiological consequences of high lipid content in tissues of Antarctic fishes. Personnel at Palmer Station during this period were: B. Sidell (P.I.) and graduate students E.L. Crockett and N. Desaulniers. E.L. Crockett departed Palmer Station on 26 April for transit to Punta Arenas and return to CONUS at end of Polar Duke cruise 91-3. Sidell and Desaulniers remain at Palmer Station for the duration of cruise 91-4. We continued to make very good progress on our scientific objectives during the month of April.

1. During April, two short fishing efforts aboard R/V Polar Duke were conducted to provide specimens for our experiments. The first of these was carried out 10-12 April in conjunction with projects S-037 (see details in S-037 sitrep below) and S-041. The second was carried

out during 23-25 April and consisted of trawling off the s. shores of Low and Brabant Islands. Specimens of C. aceratus, N. gibberifrons, T. newnesi, P. charcoti, C. gunnari and N. neglecta were successfully captured, maintained in tanks aboard Polar Duke and transported to Palmer Station where they were transferred to aquarium facilities until use in experiments.

2. Approximately 150g wet weight of oxidative pectoral adductor muscle tissue was collected from C. aceratus specimens, lyophilized and prepared for shipment back to our CONUS laboratory for further studies with the intracellular fatty acid binding protein (FABP). A gel permeation column was prepared for additional partial purification of the protein; partially purified samples will also be lyophilized and transported back to our CONUS laboratory.

3. Two series of experiments were conducted to ascertain the relative roles of peroxisomal and mitochondrial intracellular compartments in hepatic beta oxidation of fatty acids in Antarctic fishes. Isolated organelles (peroxisomes, mitochondria) were prepared by density gradient centrifugation with self-forming Percoll gradients. Organelle fractions were harvested from gradients and incubated in vitro in the presence of 14C-labeled fatty acyl CoAs and equimolar concentrations of various unlabeled competing fatty acyl CoAs to ascertain substrate specificities of each organelle fraction. An additional series of experiments were conducted with crude homogenates of liver in the presence and absence of specific inhibitors of either mitochondrial or peroxisomal beta-oxidation of fatty acids. Outcome of these experiments awaits final reduction of data that will be carried out in our home laboratory.

4. An experimental setup for determining the solubility of oxygen in oxidative muscle tissues from Antarctic fishes was assembled and initial experiments performed. Instrumental detection of changes in PO_2 of bathing solutions are being carried out using a very high sensitivity oxygen electrode apparatus. Some initial difficulties have been encountered with recordings from this apparatus but control experiments are currently being conducted which promise to eliminate these problems.

In addition to continuing experiments in categories 2 and 4 above, during cruise 91-4, we will conduct pilot experiments to extract total mRNA from oxidative muscle of icefish, Chaenocephalus aceratus, as an initial step toward isolation and cloning of the gene for icefish FABP. Collectively, data from these lines of experiments will contribute toward understanding physiological significance of the very high lipid content of tissues characteristic of polar fishes.

S-037. ASSEMBLY AND STABILITY OF MICROTUBULES FROM ANTARCTIC FISH AT LOW TEMPERATURES. H.W. Detrich, Northeastern University.

During the month of April we continued to study the structural and functional properties of the microtubule proteins

[tubulins and microtubule-associated proteins (MAPs)] of Antarctic fishes. To support our work during April, specimens of three Antarctic fishes (the Antarctic cods Notothenia coriiceps neglecta and N. gibberifrons, and the ice fish Chaenocephalus aceratus) were collected during a short fishing trip (ca. 2 days, 1100 10 April to 0800 12 April; conducted in conjunction with S-036 and S-041) to Low and Brabant Islands. Fishes were transported alive to Palmer Station where they were maintained in seawater aquaria (0-1.5 deg C). At Palmer, we prepared tubulin and MAPs (e.g., dynein) from the brain and gonadal tissues of the three fish species by methods that we developed previously and improved this field season. After sacrifice and use by our project, most of these fishes were provided to other projects (S-034, S-036, S-041) for the preparation of additional samples.

This field season we focused our research efforts on three major objectives: 1) evaluation of the role of the acidic carboxy-terminal tails of the Antarctic fish tubulins in microtubule polymerization at low temperatures; 2) examination of the functional and structural properties of an important group of Antarctic fish MAPs, the cytoplasmic (brain) and flagellar dyneins; and 3) preparation of microtubule-protein and nucleic acid samples to support our ongoing studies at Northeastern University. Substantial progress was made in each of these areas. Chemical modification or proteolytic removal of the carboxyl termini of Antarctic fish tubulins enhanced their polymerization at low temperature; the degree of enhancement was similar to that observed for mammalian tubulins comparably modified at temperatures between 30 and 37 deg C. These results indicate that, to a first approximation, the carboxyl termini of Antarctic fish tubulins are not major sites for functional adaptation to low temperature. Specimens of the polymers generated by modified and unmodified tubulins were prepared for thin-section and negative-stain electron microscopy (to be performed in our CONUS laboratories). Functional studies of the Antarctic fish dyneins included preliminary measurements of their ATPase activities by spectrophotometric methods and examination of their microtubule-dependent "motor" activities by dark-field light microscopy. Analysis of these results is currently in progress. In addition, Antarctic fish sperm and dynein-containing flagellar axonemes were prepared for structural analysis by electron microscopy at our home institutions. Finally, we prepared brain and egg tubulins, brain and egg RNAs, and cytoplasmic and flagellar dyneins from the Antarctic fishes for use in our biochemical and molecular-biological work at Northeastern. Together, the results of our studies, both current and future, will contribute to an understanding of the structural and functional adaptations of the cold-stable microtubules of Antarctic fishes and, more broadly, to elucidation of the biochemical mechanisms of cold adaptation in marine poikilotherms.

On April 26, 1991, project members H. Detrich (P.I.), S. Parker, R. Williams, S. Marchese-Ragona, and W. Singer departed Palmer for Punta Arenas on board R/V Polar Duke. We leave Palmer having accomplished all of our objectives for the 1990-91 field

season. We wish to thank the personnel of Antarctic Support Associates and the captain and crew of R/V Polar Duke for the support that they provided to our project throughout the season. Their help has contributed greatly to the success of our research efforts.

S-041 : SOURCES, DISTRIBUTION AND FATE OF HYDROCARBONS IN THE VINCINITY OF BAHIA PARASIO, ARTHUR HARBOR, ANTARCTICA
Kennicutt, M.C., S.J. McDonald, J. Jobling, A. Trip, T. Wilkinson, and E. Haubold. Texas A&M University

All objectives of this field season were accomplished. All Bahia Paraiso spill inter- and subtidal locations were reoccupied and limpets and sediments were successfully collected at each location. Samples for aliphatic and aromatic hydrocarbon analysis
were collected including limpets at 32 intertidal sites, 2 subtidal control sites on Hermit Island, and 4 sites near the Bahia Paraiso. Sediment grab samples in Arthur Harbor and adjacent areas were collected at 21 sites (from the Polar Duke). Sediments from ten beach locations and eight fresh water ponds (Humble, Torgerson, and Christine Island) were also sampled for hydrocarbon contaminant analyses.
To evaluate hydrocarbon contamination emanating from Palmer Station seven transects around Gammage Point and Hero Inlet were collected in the intertidal and at approximately 15, 30 and 60 feet water depth. Sediments (10) and limpets (20) were collected along these transects
for hydrocarbon analysis. For comparison 5 transects were occupied at Old Palmer Station providing 6 sediment and 15 limpet samples for the same analyses. The composition of contaminants from Palmer and Old Palmer Station will be evaluated by the analysis of soil samples; 12 and 5 were collected, respectively. This portion of the program collected a total of 57 sediment, 73 limpet and 17 soil samples for hydrocarbon analysis. Twenty-three dives (2 divers/dive) were conducted for a total of 18 hours and 25 minutes of time in the water. These dives included 11 at Palmer Station (3 in support of station activities), 5 at Old Palmer, 5 at the Bahia Paraiso wreck, 1 at the Hermit Island control transect, and 1 to inspect the Polar Duke's seawater intakes.

The hydrocarbon metabolite portion of the program included sampling fish bile and stomach contents immediately after capture, time series sampling of fishes during storage in tanks, and dose/response experiments. Samples taken immediately after capture will be used to support previous observations of high naphthalene, phenanthrene and benzo[a]pyrene metabolite concentrations as well as document the exposure of these fishes to hydrocarbons. Metabolites will be measured in bile and stomach contents will be analyzed for hydrocarbons to determine if petroleum has been recently ingested. Fish directly from nets were sampled at Lowe Island (31 fish, Notothenia gibberifrons and Chaenocephalus aceratus)
and Dallmann Bay (10, N. gibberifrons). This will allow for initial intersite comparisions. Pooled samples of bile and

stomach contents were taken of fish held in tanks for various lenghts of time to evaluate handling and storage effects. Over 100 fish (N. gibberifrons, C. aceratus and N. coriiceps neglecta) were sampled to evaluate holding effects and provide a sufficient quantitiy of bile to perform GC/MS confirmation of individual hydrocarbon metabolites. To evaluate hydrocarbon exposure of fish near Palmer Station and the Bahia Paraiso, fish (N. coriiceps neglecta) were captured using hook and line and fish traps. Sixteen fish were caught near the Bahia Paraiso in traps and 8 were caught around Palmer Station using both hook and line and traps.

Three dose/response experiments were conducted using live Notothenia gibberifrons that were injected with diesel fuel. This fish (134) were sampled for bile, stomach contents, liver, gonads and muscle. Bile will be analyzed for naphthalene, phenanthrene and benzo[a]pyrene metabolite concentration to evaluate the rate of metabolite production/depuration and to confirm that metabolite production is inducible. The other tissues will be analyzed for petroleum hydrocarbon content to document the partitioning of hydrocarbons between tissues and to evaluate dose/response relationships for hydrocarbon exposure. Briefly either 100 or 500 ul of diesel fuel was injected either intramuscularly or near the base of the pectoral fins. Four to 5 fish were sacrificed at various time intervals ranging from 2 hours to six days to determine how quickly these fish are able to respond to hydrocarbon exposure and how quickly they are able to depurate.

We would like to acknowledge the cooperation and knowledgable support provided both in sample collection aboard the Polar Duke and laboratory support at Palmer Station. All person involved contributed to making this a highly successful field season for this activity.

S-106 -- VLF TRIMPI STUDIES AT PALMER STATION.
-- VLF REMOTE SENSING OF THUNDERSTORM AND RADIATION BELT COUPLING. U.S. Inan (P.I.),

No personnel on station. Equipment being monitored and maintained by station Science Technician Ned Wilson.

The usual weekly printouts of Trimpi data summary charts were faxed to Stanford University.

The Broadband and Trimpi sampling schedules were modified to accommodate special sampling in conjunction with an Atlantis Space Shuttle mission. Both Trimpi and Broadband VLF records were taken continuously between 2200 UT and 1000 UT from April 5 - April 10, 1991.

An intermittent transmission line problem that was believed to have been corrected reasserted itself as severe loss of E/W loop antenna signal. Previously, repair of a bad solder joint in one of the connectors was thought to be the solution. Detailed re-examination of the cable revealed several non-connector related locations of physical damage. After a splice was installed in a section that was worn by chafing against rocks at the base of the glacier, total operation was restored to the Broadband Audio and Trimpi Digital systems. It will be recommended that the above mentioned section of cable be

replaced, as water has traveled down the absorbent interior cable lining- apparently considerably further than the eight ft. section that was removed during repairs. At least one other damaged area was positively identified as a source of mild conductor leakage. Prior to the cable repairs, all affected Trimpi channels were patched into the N/S loop antenna, so that the digital data acquisition would not be compromised.

All Continuous Broadband VLF and Trimpi Digital data collected between March 8 and April 19, 1991 were shipped to Stanford on the Polar Duke, April 26.

S-275 UM/DOE ATMOSPHERIC MONITORING PROGRAM at Palmer Station. T. Snowdon, University of Miami; C. Sanderson/N. Chui, EML/DOE N.Y.

No personnel on station. System being run by ASA science technician Ned Wilson.

System continued to operate with a weekly schedule of calibration, background, and sample counts, with one sample filter being exposed for the duration of the week. Data was logged computer disk, as well as transmitted via NOAA satellites. On April 26, exposed filters for the weeks ending March 8, 15, 22, 29 and April 5, 12, 19 were shipped on the Polar Duke to Dr. J. Prospero, University of Miami.

T-312 TERASCAN SATELLITE IMAGING SYSTEM. R. Whritner, Scripps Institute ARC.

No personnel on station. System being run by ASA science technician, Ned Wilson.

The satellite collection schedule continued with four daily passes: (1) high elevation pass, one (1) pass to the east of Palmer over the Wedell Sea, one (1) pass to the west over the Bellingshausen and (1) pass of arbitrary elevation and azimuth. The satellite image data was collected digitally on 8mm video tape. Both HRPT and DMSP satellite data were recorded.

Eight (8) digital satellite data archive tapes (PAL092 - PAL099) were shipped to Bob Whritner, SIOARC on the Polar Duke, 26-APR-91.

Orbital elements were received and entered into the Terescan imaging and Telonics tracking systems.

Tracking system time continues to be controlled with the Omega clock which maintains accuracy to within one second, calibrated with the GOES satellite clock.

The DMSP satellite capture problem persisted, however careful monitering of the DMSP receiver and Bit-Sync unit allowed capture of about one DMSP pass per day. According to a message received from Bob Whritner, Scripps A.R.C., the problem has been confirmed as having the Bit-Sync unit as its source. Robert Bernstein of SeaSpace is looking into alternatives for replacement of the inadequate circuitry.

Several software updates, as well as new programs to accomodate TOVS satellite image processing were installed. The new "seatset" image processing display shell could not be accessed, however the old version is compatible with the system configuration and was re-installed. The quality of collected data is not compromised by this situation. There is not yet TOVS

satellite pass capture capability at Palmer Station and so this software could not be tested.

Bob Whritner contacted SeaSpace regarding progress on the long standing problem with being unable to upload 8mm magnetic tape data from the Exabyte Digital Recorder, providing them with supplementry input from himself. There may be new software [with the solution] forthcoming.

Images processed from data uploaded via the Vectra PC continue to look good.

T-313 NSF UV MONITORING EXPERIMENT. C. Booth, Biospherical Instruments.

No personnel on station. System being run by ASA science technician Ned Wilson.

Pursuant to the Monochromator replacement and general maintenance procedures that were performed at the end of March, data from the NSF UV Spectraradiometer "continues to look good", according to the principal investigators at B.S.I. Calibration data produced by the new Monochromator is consistant with the instrument's pre-shipment laboratory results. A daily scan schedule consisting of 19 data scans, 7 response calibration scans and two wavelength calibration scans continues.

A continuous temperature chart record of the vestibule instrumentation area was maintained as part of an effort to improve ambient temperature control. Chart records were faxed to BSI along with observations and suggestions. However no major modifications to the facility will be possible until construction personnel return to Palmer Station in August.

Two "back-to-back" Absolute Calibration scans were performed using two different 200 watt cal. lamps. The procedure allows a comparative history of the lamps to be established.