Examination of data on the abundance of adult and nauplii stages in the Narragansett Bay and Block Island Sound areas (Deevey 1952; Faber 1966) for the time of year samples for this research were collected (July-August) showed that, although all seven species were present, only *A. tonsa*, *T. longicornis*, and *C. hamatus* were available in sufficient quantity to be considered major prey organisms. They represented 24.6, 10.8, and 10.4%, respectively, of the total copepods available, while the other four species were less than 3%. The results of this study in calories per gram ash-free dry weight (Table 1) show that *A. tonsa* had the second highest value while *C. hamatus* and *T. longicornis* had the two lowest values. In fact, the difference between *A. tonsa* and *T. longicornis* is 680 cal/g. This indicates, assuming equivalent assimilation rates, that predators utilizing the copepods like *A. tonsa* with higher caloric values may have an advantage in acquiring energy for growth and metabolic processes. Predators feeding on copepods with lower values, especially *T. longicornis*, would have to consume more prey organisms for an equivalent energy intake and, given the same density of plankton, would spend more energy searching for their prey.

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Literature Cited

COMITA, G. W., AND D. W. SCHINDLER.
1963. Calorific values of microcrustacea. Science (Wash., D.C.) 140:1394-1396.

COMITA, G. W., S. M. MARSHALL, AND A. P. ORR.
1966. On the biology of *Calanus finmarchicus*. XIII. Seasonal change in weight, calorific value and organic matter. J. Mar. Biol. Assoc. U.K. 46:1-17.

CONOVER, R. J.
1968. Zooplankton—Life in a nutritionally dilute environment. Am. Zool. 8:107-118.

CUMMINS, K. W.
1967. Calorific equivalents for studies in ecological energetics. 2nd ed. Univ. Pittsburg, Pittsburg, 52 p.

DEEVY, G. B.
1952. Quantity and composition of the zooplankton of Block Island Sound, 1949. Bull. Bingham Oceanogr. Collect., Yale Univ. 13:120-164.

FABER, D. J.
1966. Seasonal occurrence and abundance of free-swimming copepod nauplii in Narragansett Bay. J. Fish. Res. Board Can. 23:415-422.

FAUSTOV, V. S., AND A. I. ZOTIN.
1965. Changes in the heat of combustion of the eggs of fishes and amphibians during development. Akad. Nauk SSSR (Doklady) Biol. Sci. 162:965-968.

FISHER, L. R.
1962. The total lipid material in some species of marine zooplankton. Rapp. P.-V. Réun., Cons. Perm. Int. Explor. Mer 153:129-136.

OMORI, M.
1970. Variations of length, weight, respiratory rate and chemical composition of *Calanus cristatus* in relation to its food and feeding. *In* J. H. Steele (editor), Marine food chains, p. 113-126. Univ. Calif. Press, Berkeley.

OSTAPENYA, A. P., L. M. SUSHCHENYA, AND N. N. KHMELEVA.
1967. Caloricity of plankton from the tropical zone of the ocean. [In Russ., Engl. abstr.] Okeanol. Keanologiza 6:1100-1107.

PLATT, T., V. M. BRAWN, AND B. IRWIN.
1969. Caloric and carbon equivalents of zooplankton biomass. J. Fish. Res. Board Can. 26:2345-2349.

SARS, G. O.
1903. An account of the crustacea of Norway, Vol. 4, Copepoda Calanoida. Bergen Museum, Christiana, 171 p.

SIEFKEN, M., AND K. B. ARMITAGE.
1968. Seasonal variation in metabolism and organic nutrients in three *Diaptomus* (Crustacea: Copepoda). Comp. Biochem. Physiol. 24:591-609.

SLOBODKIN, L. B.
1962. Energy in animal ecology. Adv. Ecol. Res. 1:69-101.

SLOBODKIN, L. B., AND S. RICHMAN.
1961. Calories/gm in species of animals. Nature (Lond.) 191:299.

STEEL, R. G. D., AND J. H. TORRIE.
1960. Principles and procedures of statistics. McGraw-Hill Book Co., Inc., N.Y., 481 p.

THAYER, G. W., W. E. SCHAAF, J. W. ANGELOVIC, AND M. W. LACROIX.
1973. Caloric measurements of some estuarine organisms. Fish. Bull., U.S. 71:289-296.

TYLER, A. V.
1973. Caloric values of some North Atlantic invertebrates. Mar. Biol. (Berl.) 19:258-261.

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METHOD FOR RESTRAINING LIVING PLANKTONIC CRUSTACEANS[1]

Studies of the feeding and swimming mechanisms of small, active planktonic crustaceans require restraining the organisms so that water flow and limb movements can be observed under the microscope. The usual technique is to place the organism in a watch glass or cavity slide (Cannon 1928; Gauld 1966) or to secure the dorsal side of the animal to a drop of stopcock grease in

[1]Contribution No. 3488 from the Woods Hole Oceanographic Institution. This work was supported by NSF Grant GA-41188.

some type of water chamber (McMahon and Rigler 1963). For many studies, these methods are undesirable because of the confinement of the animal to a small volume of medium or because of the solid boundaries nearby, both of which affect the flow of water and possibly the movement of limbs or other behavior by the animal (Lowndes 1935). Whenever the animal must be placed within a relatively large volume of water, other methods must be used. In a study of mate-seeking behavior, Katona (1973) tethered female copepods by means of fine stainless steel wires looped about their bodies. While this method allows the subsequent release of the animals unharmed, the restraining wire can interfere with limb movements.

I have found a relatively simple method for restraining small crustaceans in large volumes of water for extended periods of microscopic examination. A short segment (1-2 cm) of nylon monofilament fishing line of small diameter relative to the organism is mounted in a dissecting needle holder or pin vise. The free tip of the monofilament is then cut off square with a razor blade. The animal is placed dorsal side up in a small drop of water on a microscope slide or watch glass. The tip of the monofilament is dipped in a fresh droplet of "instant" drying polymer glue (such as Dixon Duradix)[2] and quickly applied and held to the center line of the dorsal surface of the animal for about 5 s. The organism can then be lifted from the slide and placed in the test vessel, with the dissecting needle holder mounted in a micromanipulator or other type of clamping device. The rapid filming over of the glue and its tendency to spread when placed on the wet animal sometimes makes a neat attachment difficult and several attempts may be needed before a satisfactory mount is achieved.

Organisms restrained in this way appear to carry out swimming movements in a natural manner and live for several days on the mount. Removal of the animal from the monofilament usually results in its death. To make limb movements easier to observe, organisms can be vitally stained with neutral red prior to mounting (Dressel et al. 1972).

I have since found a description of this mounting technique given by Scourfield (1900) in which he regrets that no satisfactory cement could be found. The polymer glues appear to solve the problem.

[2]Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Literature Cited

CANNON, H. G.
1928. On the feeding mechanism of the copepods, *Calanus finmarchicus* and *Diaptomus gracilis*. Br. J. Exp. Biol. 6:131-144.

DRESSEL, D. M., D. R. HEINLE, AND M. C. GROTE.
1972. Vital staining to sort dead and live copepods. Chesapeake Sci. 13:156-159.

GAULD, D. T.
1966. The swimming and feeding of planktonic copepods. *In* H. Barnes (editor), Some contemporary studies in marine science, p. 313-334. George Allen and Unwin, Ltd., Lond.

KATONA, S. K.
1973. Evidence for sex pheromones in planktonic copepods. Limnol. Oceanogr. 18:574-583.

LOWNDES, A. G.
1935. The swimming and feeding of certain calanoid copepods. Proc. Zool. Soc. Lond. 1935:687-715.

MCMAHON, J. W., AND F. H. RIGLER.
1963. Mechanisms regulating the feeding rate of Daphnia magna Straus. Can. J. Zool. 41:321-332.

SCOURFIELD, D. J.
1900. The swimming peculiarities of *Daphnia* and its allies, with an account of a new method of examining living Entomostraca and similar organisms. J. Quekett Microsc. Club 7:395-404.

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OBSERVATIONS ON THE BIGEYE THRESHER SHARK, *ALOPIAS SUPERCILIOSUS*, IN THE WESTERN NORTH ATLANTIC

Thresher sharks of the genus *Alopias* are distributed throughout the tropical and warm temperate zones of the world's oceans. Of the two species reported from the western North Atlantic, the thresher shark, *A. vulpinus*, is commonly found in coastal waters of the middle Atlantic states (Bigelow and Schroeder 1948). The second member of the genus, the bigeye thresher, *A. superciliosus*, is a little known offshore resident of the continental slope and open sea.

Lowe first described the bigeye thresher in 1840 from a specimen taken off the island of Madeira (Bigelow and Schroeder 1948). The species was not reported again until 1941 when Springer (1943) documented the occurrence of a gravid female taken near Salerno, Fla. Records of other bigeye threshers from the Atlantic include a gravid female, two embryos, a juvenile male, and an 18-foot specimen all taken from the north