very large decrease in O_2 release rate following acetazolamide. A further point of interest in comparing fish and human red cells is that the Bohr rate constant in fish is about 1/2 that in man, despite the 600-fold difference in k_{enz} (Table 1). This shows, as in all other systems studied, that carbonic anhydrase is not rate limiting or regulatory.

Since 10^{-4} M methazolamide reduces the rate of the Bohr shift so greatly that it cannot mediate the release of O_2 in the capillaries, we may ask whether this question has been tested in vivo. This concentration of methazolamide (or acetazolamide, which has the same potency) is readily achieved in vivo following doses of 20-50 mg/kg in *S. acanthias* (Comp. Biochem. Physiol., 5:201, 1962; Amer. J. Physiol., 222:885, 1972). No overt toxicity has been observed; it remains for further investigation in this and other species to find whether limitation of the Bohr effect does impose any physiological disadvantage.

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ACUTE EXPERIMENTS ON THE EURYHALINITY OF *Fundulus heteroclitus* (Linn)

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The euryhalinity of *Fundulus heteroclitus* (Linn) does not appear to have been studied under crisis conditions, nor has the appearance of this well known condition in the adult fish been studied in the fry. Protected by its chorion, the developing embryo can be reared in all dilutions of sea water from full strength to distilled. Under these varying circumstances there are variations in the rate of incorporation of amino acid into proteins (Crawford, R. B., Heinemann, M.-H., and Wilde, Jr., C. E., Bull. MDIBL, 8:1968) but there appear to be no differences in overall morphogenesis. This latter statement requires further study in detail.

Fry are euryhaline from the moment of hatching. I report here two experiments in which intense osmotic stress was placed upon *Fundulus* fry for a period of hours by rapidly changing their ambient medium every ten minutes. They were kept under constant observation.

Seven *Fundulus* fry were removed from their growth medium, millipore filtered 50% sea water, and placed in millipore filtered distilled water. Seven fry were similarly placed in full strength millipore filtered sea water.

Every 10 minutes the fry were removed from their present medium and placed in fresh medium of opposite type, that is, if the fry were in sea water they were placed in fresh water or vice versa.

Ten cycles of change were carried out. The ambient temperature was 21°C and the media were equilibrated to that temperature. During the exchange maneuver care was taken to transfer a minimum of medium with the fry. The exchanges were carried out in the tips of a series of Pasteur pipettes. The fry were approximately 2 mm in length and the dishes of sufficient size so that the medium was essentially infinite in relation to the mass of the fry.

The fish were observed continuously for behavioral change, morbidity and mortality.

There were no apparent physiological or behavioral changes to be observed. The fry remained vigorous continuously and there was no morbidity or mortality. At the end of the experiment the fry were placed in full strength sea water for further observation and experiment.

The results led to a second experiment of similar type with the same fry except that the stress lay between distilled water and double strength sea water (kindly prepared and donated by

Dr. Karl Karnacky). The ambient temperature was 23°C on this occasion. Ten cycles of exchange were conducted between distilled water and 2x sea water, once every 10 minutes. Again the fry remained vigorous and healthy. They showed no behavioral change, nor any morbidity or mortality. At the end of the experiment they were returned to normal full strength sea water where they continued their development for several days before being returned to the sea.

I conclude that young *Fundulus heteroclitus* are euryhaline at hatching and infer that this physiological property is developed during embryogenesis. Adjustment to acute reversal of osmotic conditions of the medium is rapid (well within ten minutes), perhaps almost instantaneous and is continuously renewable and reversible over a period of several hours.

These data give rise to further questions with regard to the survival value of euryhalinity in estuarine fish and the selection processes through which this physiological characteristic has developed and is maintained. Further acute experiments are planned as well as an analysis of the bioenergetics of the process.

REPRODUCTIVE ECOLOGY OF SPINY DOGFISH, *Squalus acanthias*

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There are many examples of homeostasis at population levels amongst the higher vertebrates, by which population density is adjusted to meet changes in environmental resources. In deer and rats, for example, under conditions of high density and overcrowding, a proportion of mature females do not bear young and many pregnancies are aborted at an early stage. When population members are heavily reduced, the proportion of pregnant females rises and the incidence of multiple births increases (Severinghaus, J. Wildlife Manag., 15:73, 1951; Davis, Trans. N. Amer. Wildlife Conf., 15:461, 1950).

Elasmobranch fishes, like mammals, produce few large young and often provide them with some form of protection. The spiny dogfish, *Squalus acanthias* is ovoviviparous and retains the eggs within the uterii for about two years (the longest gestation period known in the vertebrates). There are no data on density-dependent fecundity relations in elasmobranchs.

The spiny dogfish in the North Atlantic provides interesting material for such a study because there are considerable differences in the density of the populations in European and American waters, and we can compare their fecundities and the commitment of energy to reproduction. The spiny dogfish, valued as a food in Europe, are heavily fished and population density is low. By contrast, the dogfish populations off the Eastern seaboard of America are little disturbed; they are unfished, their natural predators are few and, correspondingly, population numbers are high.

During the summer of 1976 a total of 370 mature female fish were sampled, ranging from 3.0 kg to 8.0 kg, and lengths from 92 to 108 cm. All the fish in this size range were mature; females of less than 3.0 kg body weight were immature. The length, weight and liver weight of each female was recorded. Intact egg capsules (candles) were carefully removed from females in their first year of gestation, capsule weight determined and the number of contained eggs counted. From females in the second year of gestation large embryos were removed, measured, and weighed, the yolk sac dissected free and weighed. Fish which appeared to have lost intrauterine young were not included in this analysis.