OSMOREGULATION IN *FUNDULUS* AT 4°C DEPENDS ON PRIOR ACCLIMATION

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In previous studies of the water fluxes in intact *Fundulus* as measured by a repetitive weighing technique (Kidder, BMDIBL 39:11), it was concluded that at 16° C this fish could maintain its osmolarity in any external solution salinity from 0.5 ‰ (fresh water) to 35 ‰ (seawater). However, at 4°C, the fish gained water when in fresh water (FW), and lost water to seawater (SW), as would be expected if their active osmoregulatory machinery could not function properly in the cold. This was true regardless of the previous salinity to which the fish were acclimated. All periods of acclimation were either at ambient temperature (in the water trough outside Hegner Lab during the summer) or in an aquarium maintained at 17°C at Illinois State University. Except for some SW acclimated fish which did not readily lose water in SW at 4°C, there was nothing which suggested that *Fundulus* was capable of osmoregulation in the cold.

However, a series of experiments done in late August - early September of 2000, suggests that this conclusion must be modified. Figure 1 shows the results from a series in which fish acclimated to either FW or SW were tested in both waters. It can be seen that fish acclimated to FW lose water at 4°C in SW, as expected, and that fish acclimated to SW gain water at 4°C in FW water, again as expected. However, fish tested at 4°C in the same water to which they were acclimated show no significant water changes, and seem capable of good osmoregulation at least during the 5 days shown.

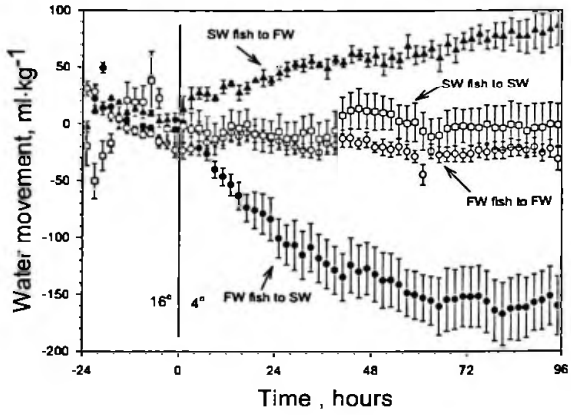

Figure 1. Acclimation salinity affects osmoregulation at low temperatures. Fish from SW gain water in FW at 4°C, but maintain their weight in SW at 4°C; the converse is also true. Each symbol is the mean of 6-8 fish, ± SE. Only every other hour is plotted, for clarity.

The significant difference between these and previous experiments would seem to be the temperature of acclimation. Aquarium temperature in the Hegner Lab trough depends on ambient temperature, insolation (which varies with time of day and cloud cover) and for SW conditions, the state of the tide and the flow rate into that aquarium. The temperatures of the FW aquaria are most variable, since these are recirculating systems. We did not record temperatures in these tanks except in the course of other experiments, and it it seems likely that the acclimation temperatures in the two weeks preceding these experiments were in the range of 10 - 15 °C, which is at least 5°C lower than the temperatures that seem to prevail in July and early August.

These observations require a modification of our previous assumption that *Fundulus* can not osmoregulate at winter water temperatures in the field, but is forced to seek an osmotic refuge in the bottom sediments. It now appears that *Fundulus* may indeed osmoregulate at 4°C if acclimated at a cool temperature. What has not changed, however, is the observation that *Fundulus* appear incapable of synthesizing their osmoregulatory machinery at 4°C, and can therefore only osmoregulate in the water to which they were acclimated. Clearly, more carefully controlled experiments are necessary to confirm and elaborate on these results.