

**THE EVOLUTIONARY ADAPTATION OF THE MOSQUITOFISH,
GAMBUSIA AFFINIS TO HEATED EFFLUENT WATERS
OF STEAM ELECTRIC GENERATING STATIONS**

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The purpose of this study was to document the adaptation of Gambusia affinis to the perturbed environment of heated power plant effluents. Also, the dynamic nature of this adaptation to increased thermal regimes was investigated. Electrophoresis and thermal tolerance methods were used in the study. Three steam electric station cooling lakes were studied, Lake Fairfield, Lake Alcoa and Lake Colorado City.

Electrophoretic differences in gene frequency were found at phosphoglucose isomerase (PGI-2) and phosphoglucomutase (PGM-3). Subpopulation frequencies at PGM-3 appeared random at both Lake Fairfield and Lake Alcoa. Subpopulation frequencies at PGI-2 were nonrandom with heated populations having consistently higher frequencies of PGI-2^b than nonheated populations. Linear regression analyses showed PGI-2^b allele frequency and water temperature to be positively correlated at both Lake Fairfield and Lake Alcoa. Linear regression analyses showed PGM-3^b allele to be slightly negatively correlated with water temperature in both lakes. Seasonal variation in the PGI-2^b frequency was found at both lakes in peak summer temperatures while lowest PGI-2^b frequencies were seen in the coldest temperatures of winter. These results were consistent in both lakes and all sites. Clinal variation was, also, evidenced at the PGI-2 locus. The cline in gene frequency paralleled the cline in water temperature very closely. This was seen in both Lake Fairfield and Lake Alcoa. Although gene frequencies changed throughout the year the clinal nature of the variation seen was always consistent. Lake Alcoa has higher gene frequencies for PGI-2^b than Lake Fairfield possibly due to the fact that it has received heated effluent for twice as long. Heat denaturation electrophoresis results were consistent with other data but inconclusive independently.

Critical thermal maxima (CTM) data revealed higher CTM's for populations inhabiting heated effluents in both lakes. This was seen in both populational means and modal differences. Differences were slightly significant at Lake Fairfield while being significant at Lake Alcoa.

Sexual differences in CTM were seen in addition to acclimation temperature differences. Absolute lethal data show similar results as the critical thermal maxima with Lake Alcoa having significant differences between heated and nonheated populations. Absolute lethal techniques were shown to be accurate measures of upper thermal tolerance since higher

acclimation temperature had no effect on absolute lethal values. Genotype and critical thermal maxima were determined for a sample of mosquitofish. No significant correlation between either locus (PGI-2 or PGM-3) and critical thermal maxima existed.

These results document the adaptation of G. affinis populations to heated effluents 6-8°C above ambient. Adaptation is at least at two levels, single gene frequency changes and overall thermal tolerance. This adaptation is due to the selective force of the temperature regime. As the temperature regime in a habitat fluctuates so does the structure of the genetic pool of that habitat fluctuate.

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