

Acute Toxicity of A Native Mummichog Population (*Fundulus heteroclitus*) to Mercury

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In recent years the estuary has become the object of studies involving heavy metal contamination of the aquatic environment. In particular a number of workers have focused on the toxicity of mercury compounds to fish, including the mummichog Fundulus heteroclitus (AMEND et al 1969, RUCKER and AMEND 1969, GIBLIN and MASSARO 1973). Published reports relative to the response of this eurytopic teleost to mercury intoxication have been limited to descriptions of the specific tissue pathology. JACKIM et al (1970) and JACKIM (1973) have demonstrated the effect of mercuric chloride on selected liver enzymes, while GARDNER (in press) has investigated the histopathology of respiratory, lateral line, and olfactory systems.

To date there has been no adequate description of the dose-response of native mummichog populations to mercury. The continued use of this important estuarine inhabitant in experimental research justifies such knowledge of its tolerance limits to environmental toxicants.

Methods and Materials

Specimens of Fundulus heteroclitus were collected with baited traps during July 1974 from a single site in Sandy Hook Bay, New Jersey. Only male specimens weighing 3.3 - 3.5 g were retained. These fish were acclimated in the laboratory for at least 7 days at 20°C and 20 ‰ salinity prior to use in experiments. During the holding period mummichogs were fed actively on a diet of beef liver and freeze-dried shrimp. Feeding was suspended 24 hours prior to and during the test period.

All exposures were conducted for 96 hours at 20°C in covered glass battery jars containing 10 liters each of an aerated, synthetic seawater (Instant Ocean) of 20 ‰ salinity and pH 8.0. The photoperiod simulated habitat conditions at the time of capture. Test groups of 20 healthy fish each were incubated in one of 11 different dosages of mercuric chloride ranging from

0.23 - 4.6 mg/liter. A total of five repetitions (or 100 animals) were conducted at each test concentration. Dead animals were removed twice daily. Controls consisted of 220 mummichogs maintained in synthetic seawater under comparable conditions.

Results and Discussion

As shown in Table I and Figure 1, 100% survival was obtained with dosages of mercuric chloride ranging up to 0.86 mg/liter. These fish showed no visible response to the presence of the toxicant. However, an increasingly sluggish behavior developed in those fish surviving exposure levels above 1.15 mg/liter. Survivors of dosages exceeding the calculated TLM (2.0 mg/liter) demonstrated a pronounced negative phototaxy.

TABLE I

Percent survival of mummichogs following 96 hour exposure to mercuric chloride. Mean number (\pm Standard Deviation) of survivors based on 5 repetitions of 20 animals per concentration.

HgCl ₂ (mg/l)	Total Surviving	Mean \pm 1 S.D.	% Survival
0.00	220	20.0 \pm 0	100
0.23	100	20.0 \pm 0	100
0.58	100	20.0 \pm 0	100
0.86	100	20.0 \pm 0	100
1.15	89	17.8 \pm 0.4	89
1.44	76	15.2 \pm 0.4	76
1.73	62	12.4 \pm 0.5	62
2.01	49	9.8 \pm 0.4	49
2.30	39	7.8 \pm 0.4	39
2.88	21	4.2 \pm 0.4	21
3.45	8	1.6 \pm 0.5	8
4.60	0	0.0 \pm 0	0

Expiring mummichogs exhibited two distinctly different responses, depending on the toxicant dosage. Fish exposed to intermediate levels (1.15 - 2.0 mg/l) characteristically developed uncoordinated swimming movements, suggestive of equilibrium dysfunction. On the other hand, exposure to maximal levels of the toxicant invoked a marked increase in the opercular rate, reflecting obvious respiratory stress. Such fish always died within 24 hours after initial exposure.

It is interesting to note that GARDNER (in press) has observed necrosis of the lateral line epithelium and hypertrophy of the gills, as related to abnormal mummichog behavior.

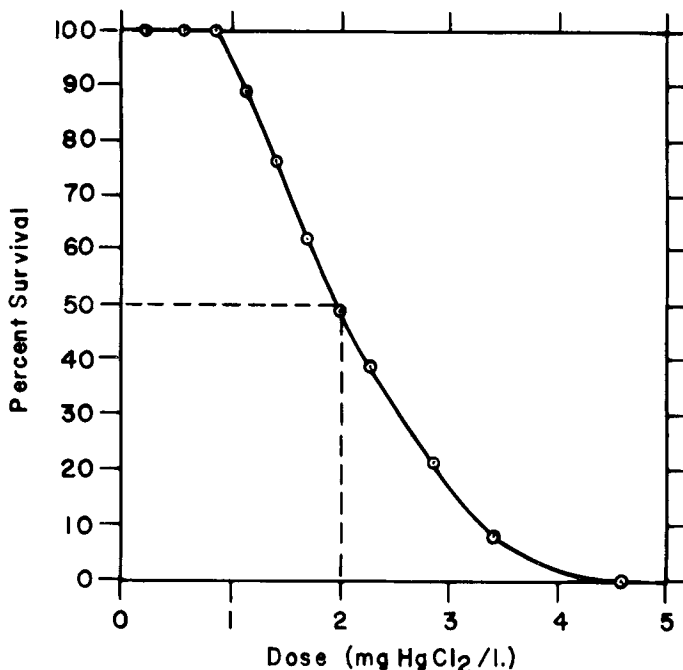


Figure 1. Dose-response curve for mummichogs exposed to increasing concentrations of mercuric chloride.

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