HEAVY METAL EFFECTS ON CLEAVAGE AND LARVAL DEVELOPMENT OF THE MARINE GASTROPOD MOLLUSK, ILYANASSA OBSOLETA STIMPSON

Gary W. Conrad
Division of Biology, Kansas State University, Manhattan, KS 66506

Along the coast of Maine, clams represent a significant economic resource. However, as the clam beds become depleted by intense harvesting, collectors are beginning to harvest mussels as well in increasing numbers. The spawning areas for these organisms are in intertidal zones and therefore may be exposed to surface water run-off containing heavy metals. At high tide, the concentrations of these metals may be diluted adequately to prevent deleterious effects, but when run-off continues over extensive mudflats that remain exposed for hours during intertidal periods, as in Maine, the adults and embryos of these bivalve mollusks may be exposed repeatedly to significant concentrations of heavy metals. Determining the concentrations of various heavy metals tolerated by the embryos of mollusks therefore is of economic interest. Larval toxicity bioassays to determine metal concentrations causing abnormalities exceeding a standard 10% of the embryo population have been conducted with Mn^{2+} and Mo^{2+} on the larvae of Mytilus edulis (Morgan, J.D. et al. 1986. Bull. Environ. Contam. Toxicol. 37: 303-307).

The cleavage patterns and larval development of the gastropod mollusk, Ilyanassa obsoleta Stimpson (Nassarius obsoletus Say) are very similar to those of Mytilus edulis, and were used in the experiments to be reported here. Egg capsules of this mollusk are layed on eel grass in the same intertidal areas in which spawning of Mytilus occurs. Ilyanassa were collected from intertidal mudflats on the coast of Thompson Island, ME, and maintained in running sea water aquaria, where they deposited egg capsules containing fertilized eggs. The latter were reared at 20° C in Millipore (0.45 um)-filtered natural seawater containing 50 ug/ml gentamycin sulfate (MFSW-G). Fertilized eggs from a single capsule, which develop synchronously, were allowed to form their second polar body (and resorb their second polar lobe) and then were distributed into MFSW-G containing one of five 10-fold dilutions of a single heavy metal. Cellular shape changes (polar lobe formation and cytokinesis), cleavage, and differentiation of tissues in free-swimming veliger larvae were photographed periodically over a 10 day period.

First cleavage and polar lobe formation were stopped by (lowest effective concentrations): 2×10^{-10} M Ag^{+}, 10^{-5} M Hg^{2+} and Cu^{2+}, 5×10^{-3} M Cd^{2+} and Cr^{3+}, 10^{-2} M Zn^{2+}, but not by 10^{-2} M Pb^{2+}. Early cleavage was stopped at the ~2-8 cell stages by: 2×10^{-11} M Ag^{+}, 10^{-6} M Hg^{2+} and Cu^{2+}, 10^{-3} M Cd^{2+} and Cr^{3+}, 10^{-2} M Pb^{2+}, but not by Zn^{2+}. Later cleavage patterns were made abnormal by: 10^{-11} M Ag^{+}, 10^{-7} M Hg^{2+}, 10^{-6} M Cu^{2+}, 10^{-5} M Pb^{2+}, 10^{-4} M Zn^{2+}, 10^{-3} M Cd^{2+}, but not by Cr^{3+}. Veliger development was distinctly abnormal in 0.7×10^{-12} M Ag^{+}, 10^{-7} M Hg^{2+}, 10^{-6} M Cu^{2+}, 10^{-5} M Zn^{2+}, Cd^{2+},

and Pb^{2+}, and in 10^{-4} M Cr^{3+}. Development of apparently normal, free swimming veligers occurred in: 10^{-12} M Ag^{+}, 10^{-8} M Hg^{2+}, 10^{-7} M Cu^{2+}, 10^{-6} M Zn^{2+}, Cd^{2+}, and Pb^{2+}, and in 10^{-5} M Cr^{3+}. Because our earlier ultrastructural studies have documented microfilament and microtubule requirements for cleavage and polar lobe formation in Ilyanassa (e.g., Schmidt et al. 1980. Develop. Biol.76: 126-140), the heavy metal effects on these processes, as described above, may arise from interactions with cytoskeletal elements.
Supported by NIEHS 1 P30 ES03828 (to MDIBL), and by NASA NAGW-1197 and NIH HD07193 (to GWC).