

Bystander Effects Induced by Exposure to Sublethal Radiation and Heavy Metals in Atlantic Salmon

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These experiments were designed to identify cellular effects in 3 key organs in Atlantic Salmon (*Salmo salar*, L.) after exposure in vivo to very low doses of radiation, and subtoxic levels of aluminum (Al) and cadmium (Cd) or copper (Cu) alone or in combination. The salmon (approx. 35g) were exposed to doses of 4, 18 and 75 mGy doses of gamma radiation, respectively, administered over 5 hrs in untreated lake water or with Cd, Al or Cd+Al added to lake water. Six fish per group were sacrificed after exposure and the head kidney, fin and gill were dissected and sent for tissue culture. The Al and Cd speciation in the water and the levels in fish gills were measured as well as physiological parameters associated with stress. Small explants of each tissue were set up as tissue cultures using RPMI 1640 medium supplemented with serum, insulin, hydrocortisone and antibiotics. After 2 days, the culture medium was harvested and filtered then placed on a reporter cell line for determination of stress signal activity (bystander effects). Radiation doses as low as 4 mGy alone or in combination with Cd and / or Al, caused bystander signals to be produced in tissues harvested from in vivo exposed salmon. The effects vary between different organs and are not consistently additive or synergistic for a given treatment. Individual results were recorded for each individual fish. Some individual fish were consistently more sensitive to the stressors. Tissue type also appears to be critical, with gill cells showing high degrees of synergism between radiation and metal exposure. Most data for Cd suggests that lower toxicity is found when the metal is used in combination with radiation exposure. This may be due to competition between calcium and Cd since calcium is a key component in the signal transduction pathway being followed. The results indicate that this stress signal response will be a useful indicator of combined environmental stress in species inhabiting aquatic ecosystems.