

Aquatic pollution investigation

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Water borne pollutants

- Continuous long-term or single or intermittent exposure
- Fish often first indicator of aquatic pollution.
- Many fish have a significant biomass - can be collected and processed for toxicological examination.



Direct toxicological examination of the water and sediments forms an integral part of the investigation



Offending pollutant may no longer be present at time of the investigation.



Sampling could include organisms that **bio-accumulate** pollutants or suffer identifiable pathological changes



Histopathological examination

- Can reveal further valuable information on the possible type of pollutant involved
- Confirm absence of obvious pathology related to other causes of disease.
- Characteristic changes in organs of animals, often not visible macroscopically.



Field personnel

- Sample collection
- Samples must allow differentiation between pollution related and natural mortalities.



History

- Details pertinent to the fish kill
- Obvious sources of pollution
- Industrial and agricultural activity upstream
- Weather patterns preceding the mortality, excessive heat, hail storms, angling activity, etc



Consider other important causes of non-pollution related mortality

- Koi herpesvirus



Epizootic ulcerative syndrome



Cold weather immune suppression – commonly seen in young tilapia during the winter



On site observation of fish

Numbers and sizes of dead fish

Presence of diseased live fish

Species involved, single or multiple species,

Behaviour of live fish:

- lethargy,
- near bottom
- near surface
- gasping, erratic swimming movements, jumping,



On site observation of water

- Obvious abnormalities in the water:
 - milkiness
 - algal bloom, off odours
 - silt load,
 - presence of blue green (cyanophyte) algal mats covering submerged objects
 - presence or absence of invertebrate life, particularly under submerged stones.



On site testing of water

- Dissolved oxygen
- Oxygen saturation
- Suspended solids
- pH
- Electrical conductivity

Various digital hand held instruments available (Hach, Hanna Instruments etc)

Early phytoplankton bloom is a sign of eutrophication



The Olifants River in South Africa

- Silt load draining the heavily industrialised Mpumalanga highveld



Sampling

- water samples
- sediment samples
- fish tissues on ice
- fish tissues in 10 % formalin



Water for toxicological analysis

- Collect suspect water samples in new clean plastic bottles.
- Rinse bottle 6 times with water to be collected from pollution site before filling.
- Pack on ice to reduce biological activity in the sample.



Tissues for toxicological analysis

- Collect at least 200 gram of fresh material including liver, kidney, fat and muscle
- Preferably not less than 25 gram from each organ
- Specimens from individual fish can be pooled
- Put on ice or freeze within 6 hours of collection
- When fish are less than 10 cm in length collect whole fish
- Use new plastic bags or clean sampling jars.



Histological sampling

- Freshly dead or euthanized fish
- From large fish collect specimens - approximately 10 mm x 10 mm x 3 mm from organs - fix in 10 % buffered formalin
- Include liver, intestine, pyloric caecae if present, kidney, heart, spleen, skin and muscle, one or two gill arches with gill lamellae attached
- When sampling small fish remove entire organ cluster, dissect out the gills from one side of the fish and cut a 5 mm wide crosssection of the body on the level of the dorsal fin.
- With very small fish, incise along the ventral midline and fix entire fish in formalin.
- Samples should be submitted from at least 6 fish.

Pollutants that bio-accumulate in fish Heavy metals

- Lead
- Cadmium
- Mercury
- [nickel, chromium, tin, copper, zinc and aluminium]
- unless a specific metal is under suspicion.



Pollutants that bio-accumulate in fish Pesticides

- DDT and its metabolites DDD and DDE
- Organochlorines (chlorinated hydrocarbons)
- Organophosphate insecticides
- Carbamates
- Pyrethrins (botanical insecticides)
- Sample tissues high in lipid (brain and fat) - most are highly lipid soluble.
- Immediately freeze and analyse within 7 days.

Pollutants that bio-accumulate in fish Industrial toxicants

- Polycyclic aromatic hydrocarbons
- Predominantly from burning of fossil fuels
- Reach the aquatic environment by run-off from contaminated land, airborne contamination and oil spills
- Hydrophobic properties result in adsorption onto particulate matter - settles and concentrates in the sediments of water bodies
- Of importance to bottom feeding fishes
- Samples must include liver, intestines, muscle and fat.

Pollutants that bio-accumulate in fish Industrial toxicants

- Polychlorinated biphenyls
- Chemically stable oils used in transformers, condensers and closed heaters
- Main source of pollution is from municipal sewage and landfill runoff
- Fat, liver and brain should be sampled

