Infrared spectroscopy as an environmental monitoring tool in frog populations

Amphibians are regarded as sensitive indicators of environmental pollution due to their highly permeable skin and complex life cycle. This consists of both aquatic and terrestrial phases making amphibians, like frogs, susceptible to exposure to a large number of environmental contaminants. Pollution is considered to be one of the major threats to amphibian populations, and thus it is crucial to develop cost-effective techniques in order to monitor the health of amphibian populations in the field.

Current techniques used to measure the effects of pollution in amphibians are time consuming, costly and in some cases reliant on the use of hazardous solvents. As an alternative, a technology being tested for use in environmental monitoring by scientists at Lancaster University is Attenuated Total Reflection Fourier-Transform Infrared (ATR-FTIR) spectroscopy: a technique which requires minimal sample preparation. Components of biological cells absorb light in the mid-infrared range depending on the chemical bonds present e.g. protein, carbohydrate and DNA. Changes in the spectrum can give important information about the structure and function of the tissue being analysed.

Becky Strong, a toxicology PhD researcher, has found that ATR-FTIR spectroscopy is able to show differences between tadpoles of the Common Frog from rural or urban ponds. As well as the ability to discriminate between ponds, ATR-FTIR spectroscopy provides an information-rich spectrum which shows how particular biomolecules within organisms are affected by their environment. In this case, it would appear that carbohydrates such as glycogen are depleted in tissues from the more polluted urban pond. This may be due to increased energy expenditure by the tadpoles as environmental contaminants are detoxified.

It is hoped that a larger study will provide information about changes over time in frog populations as well as differences between ponds.

For more details about the reports above or about Ecology, Conservation and Environmental Biology courses on offer at Lancaster University please contact the Biology Admissions Staff, Lancaster Environment Centre, Lancaster University, LA1 4YQ, UK Email: lec.ug@lancaster.ac.uk or see our website: www.lancaster.ac.uk/lec

Top: Adult Common Frog, Rana temporaria.  
Middle: Tadpoles of Rana temporaria.  
Bottom: Average ATR-FTIR absorbance spectra of liver samples taken from R.temporaria tadpoles; the pink line shows the spectrum of those from a rural pond and the blue line denotes the spectrum of tadpoles from an urban pond. Clear differences are apparent, particularly in regions associated with protein and glycogen.