



Wild Yellow Perch (*Perca flavescens*) Oxidative Stress Induced by Cadmium and Low Selenium Exposures

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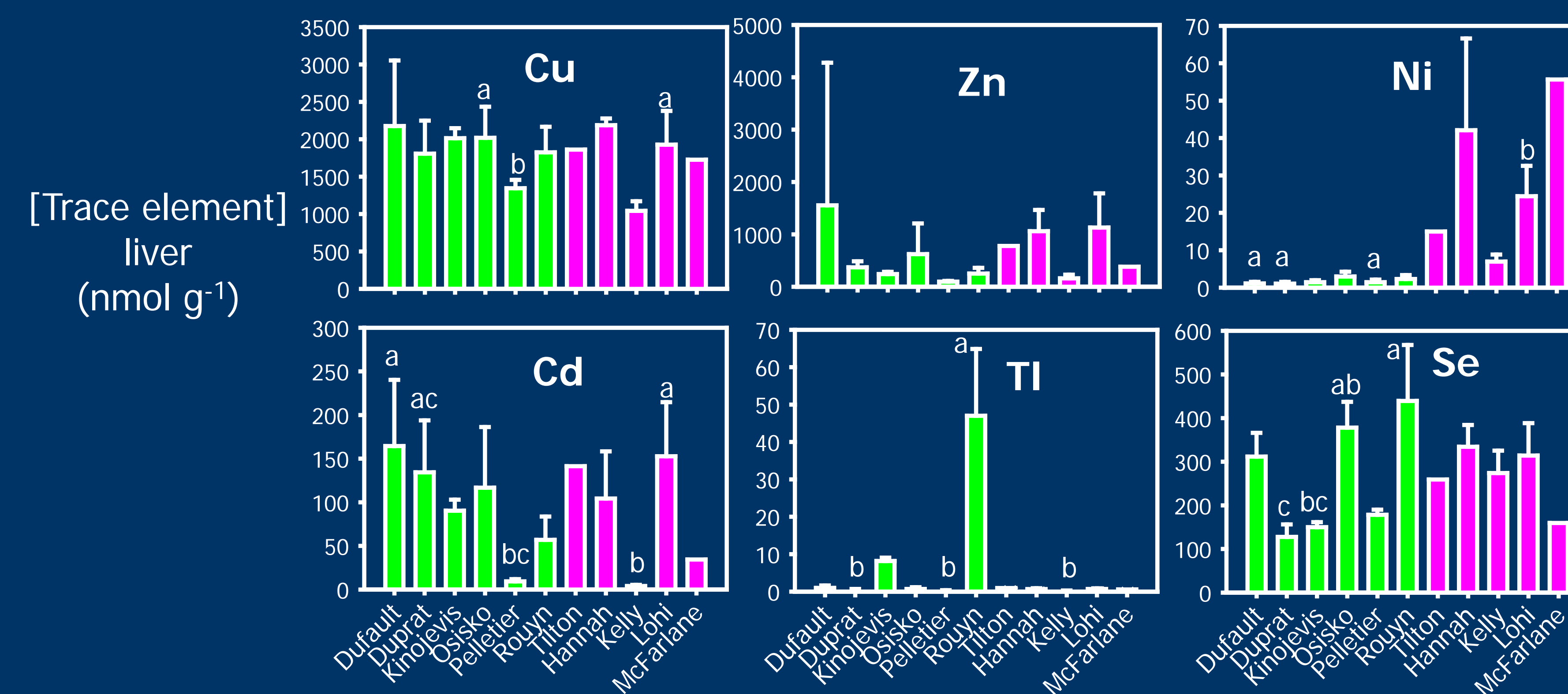
Abstract

Yellow perch (*Perca flavescens*) collected from lakes in the mining regions of Sudbury (ON) and Rouyn-Noranda (QC) display wide ranges in their concentrations of trace elements (Cd, Cu, Ni, Se, Tl and Zn). To determine if these fish are suffering oxidative stress, we measured the concentrations of glutathione (GSH), its disulfide (GSSG) and malondialdehyde (MDA). We conclude that 44% of the individuals collected from eight lakes were at risk of cellular oxidative stress and lipid peroxidation. However, selenium appears to act as an antioxidant because higher fish selenium concentrations were coincident with lower proportions of GSSG as opposed to GSH and lower concentrations of MDA. Furthermore, fish suffering oxidative stress had higher proportions of some trace metals (Cd and Zn) in sensitive subcellular fractions (organelles and heat-denatured proteins), which suggests that oxidative stress causes the release of these metals from metal-binding proteins and that Cd further exacerbates the negative effects of the low Se exposure.

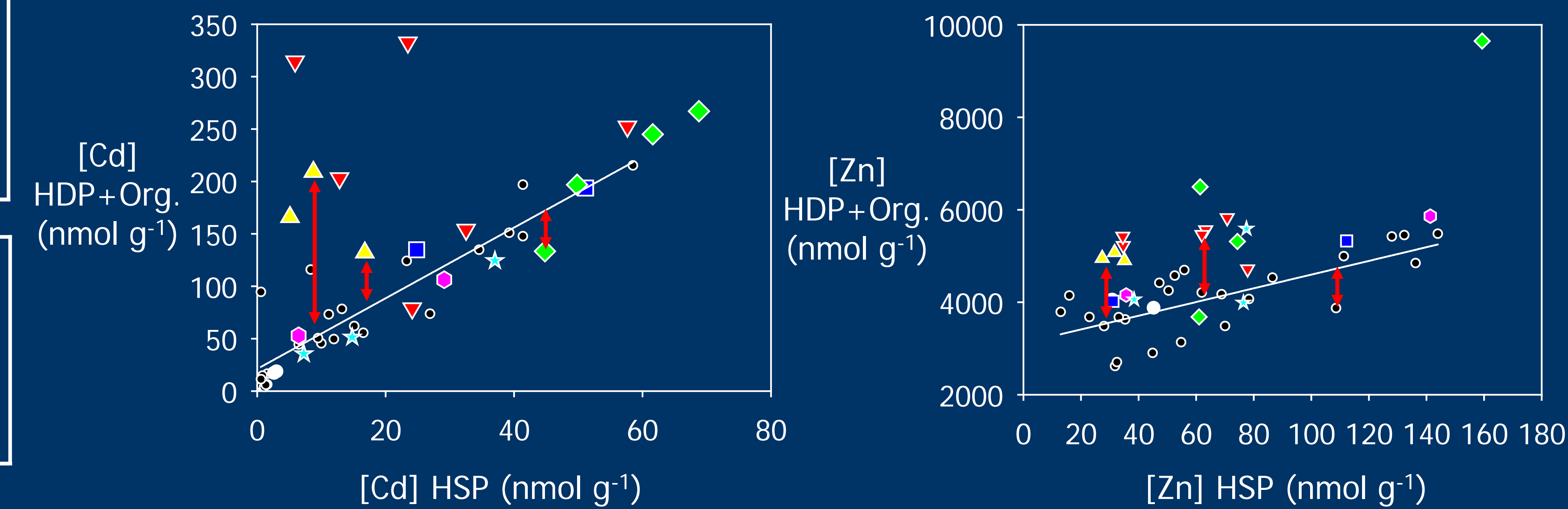
Introduction

- Selenium in high concentrations in some metal-contaminated lakes.
- Selenium can be toxic, but can also protect from metal-induced effects because it can act as an antioxidant.

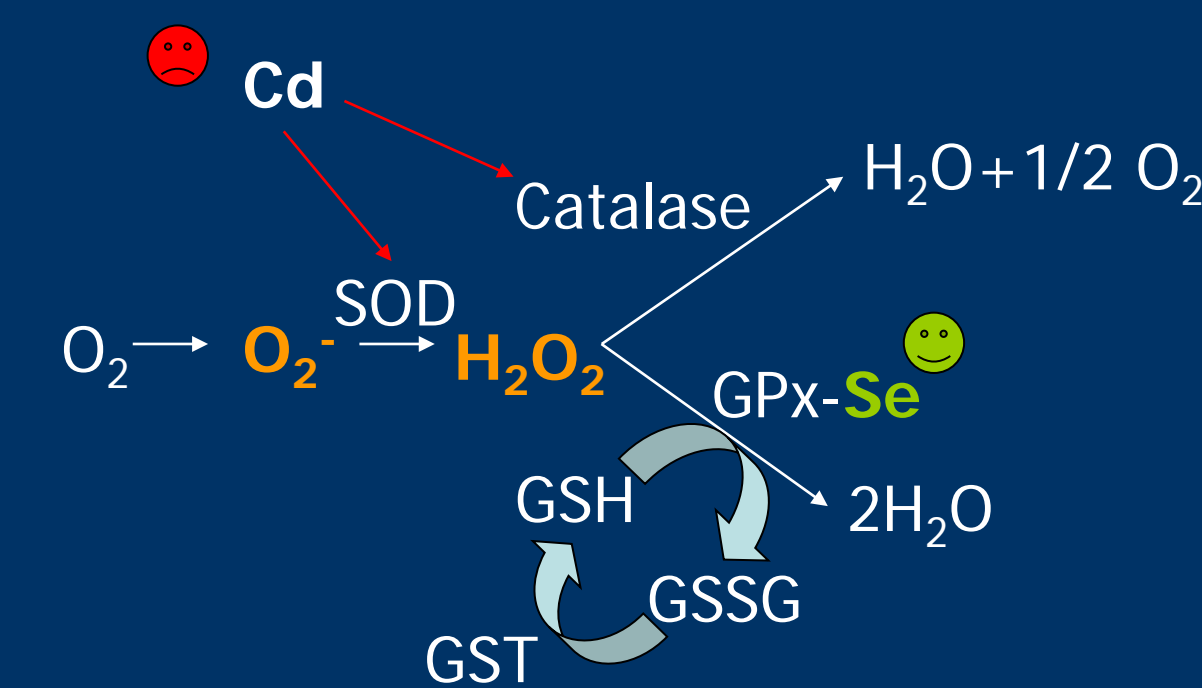
Results and Discussion



Trace element concentrations in yellow perch liver vary widely among lakes



Fish suffering oxidative stress have higher concentrations of Cd and Zn in sensitive cell fractions (HDP+Organelles) compared to those in the detoxified (HSP) fraction

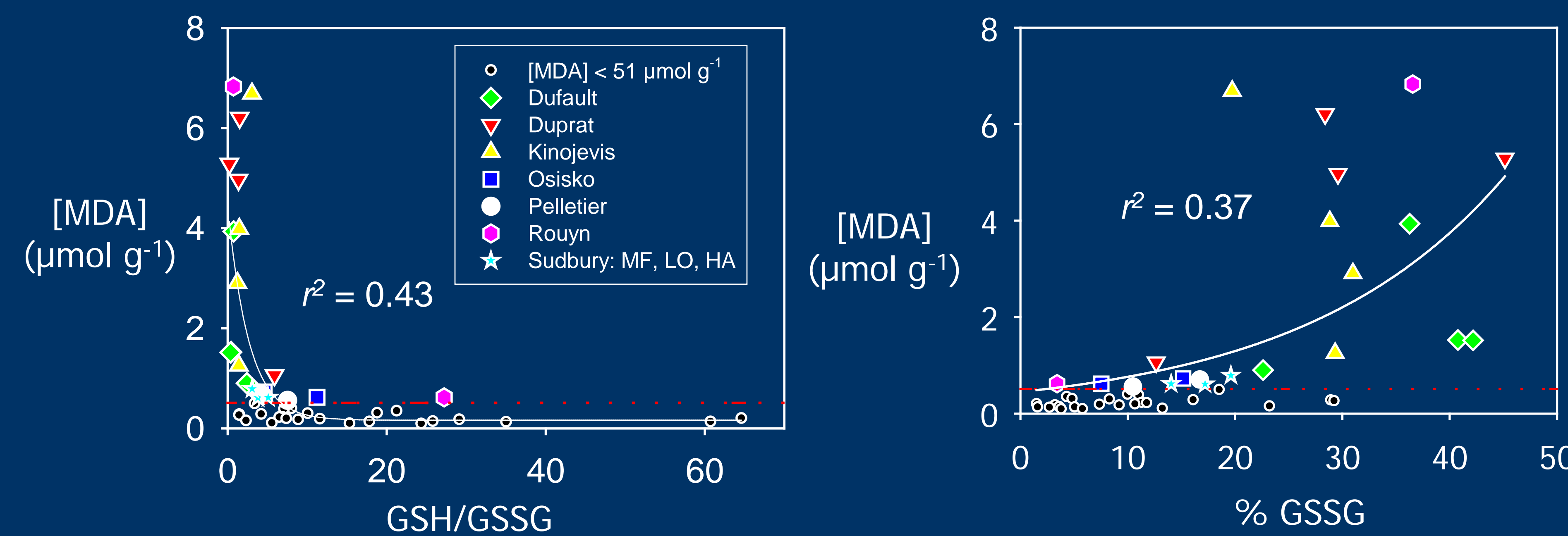
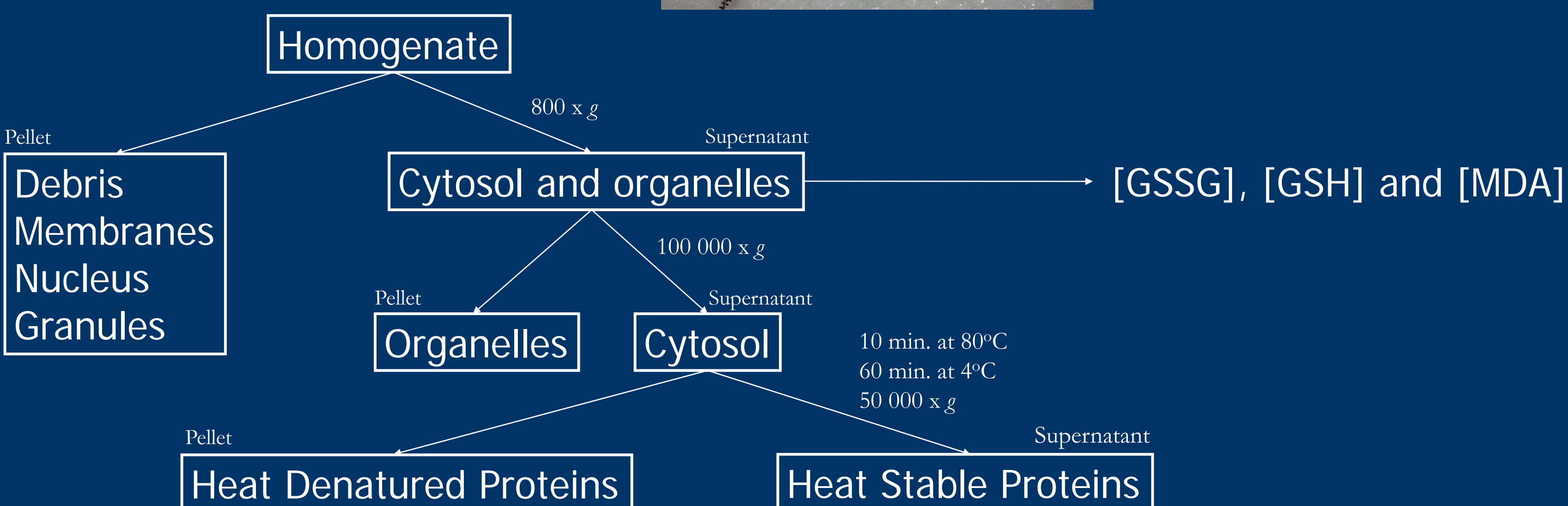


Methods

Field
We collected 1-8 yellow perch in each of 11 lakes and froze their livers in liquid nitrogen.

Laboratory
We separated individual livers into 5 pieces. We measured: trace elements, malondialdehyde (MDA), glutathione (GSH) and glutathione disulfide (GSSG).

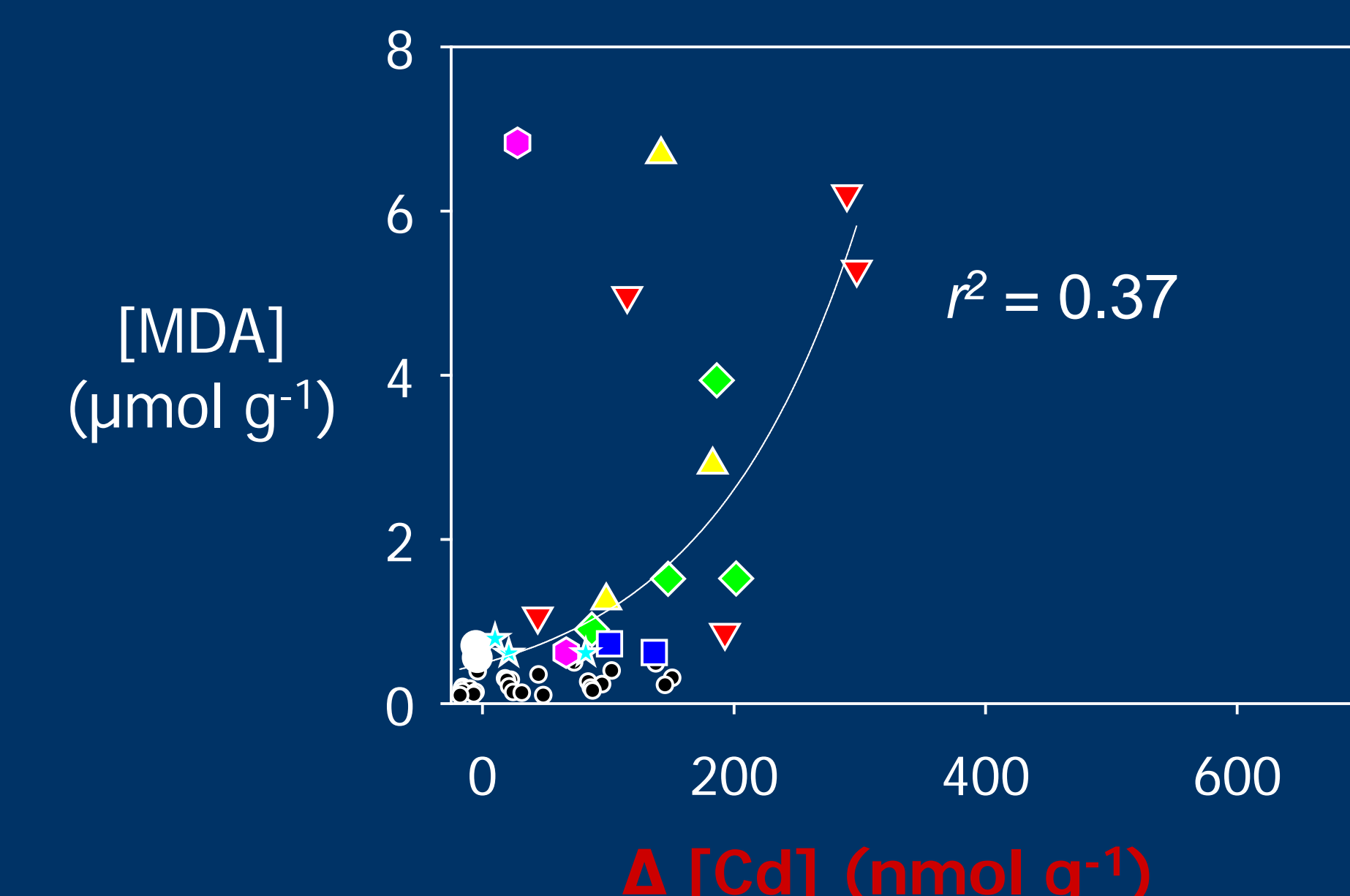
We separated liver cells into fractions and measured trace elements in heat-denatured proteins (HDP), organelles (Org.) and heat-stable proteins (HSP).



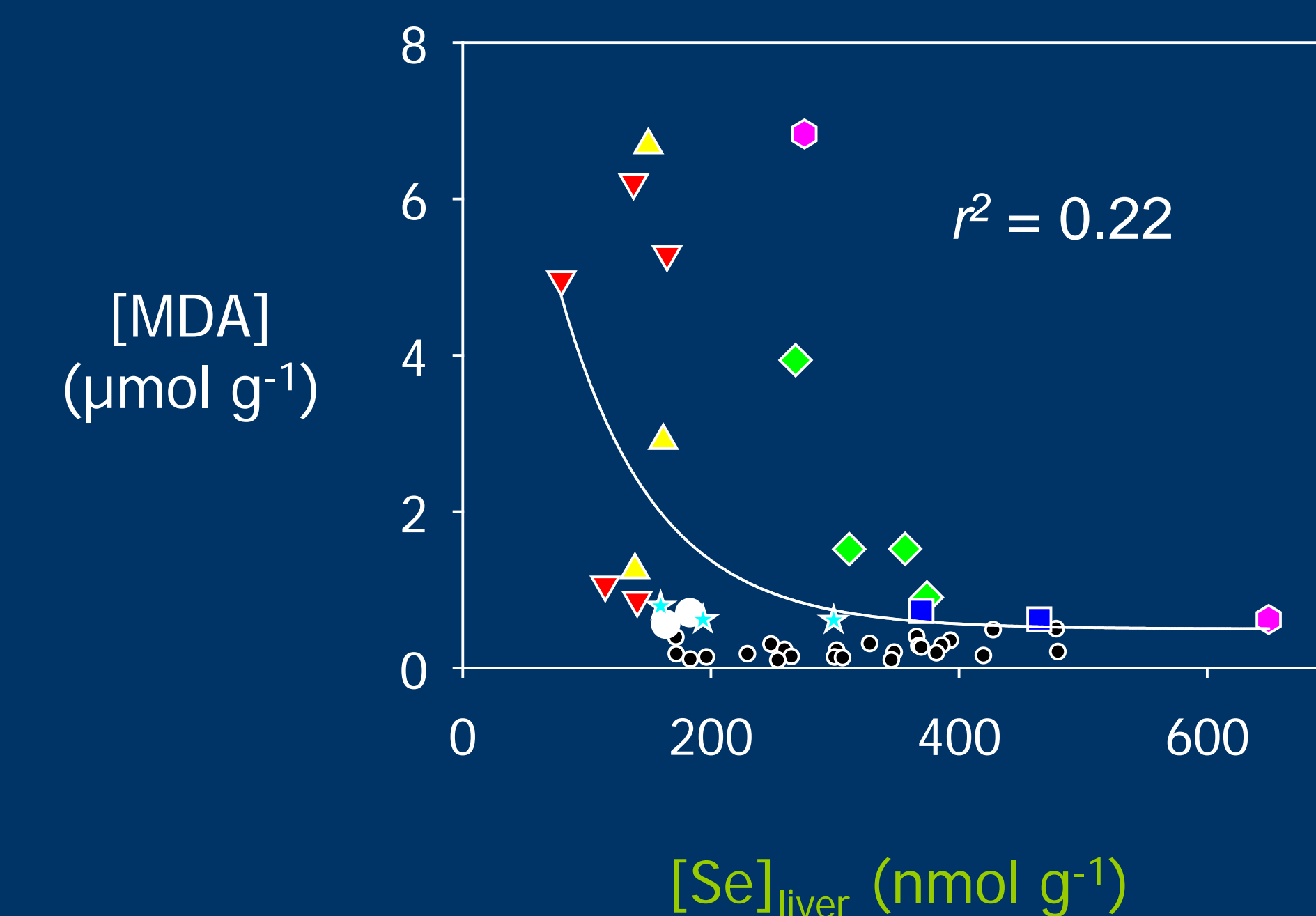
44% of the yellow perch collected suffer lipid peroxidation (high [MDA]). High proportions of GSSG relative to GSH indicate the presence of free radicals.

We used this equation to quantify Cd and Zn spillover:

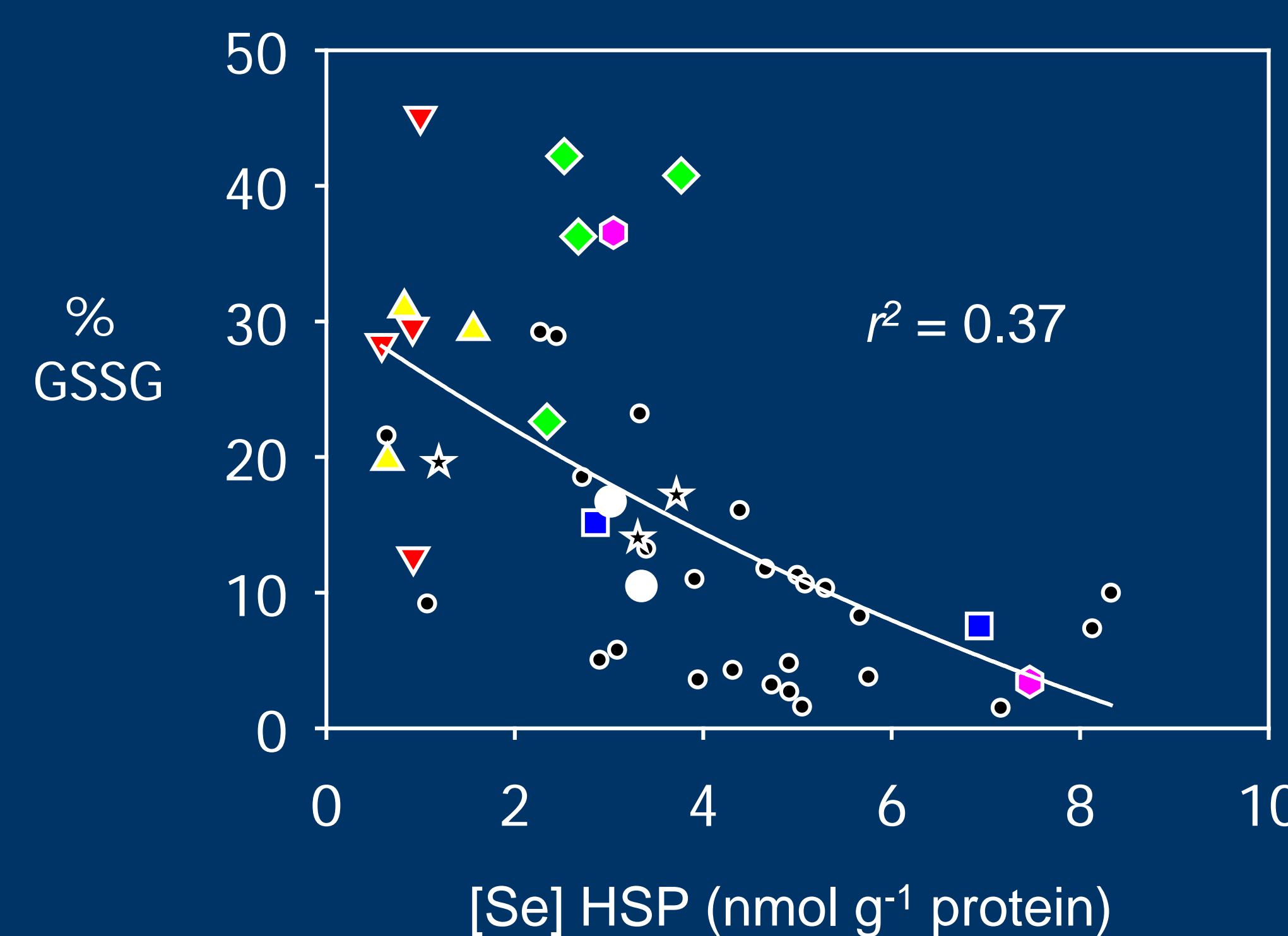
$$\Delta[M] = [M]_{\text{HDP}} + [M]_{\text{Org.}} - (a_m[M]_{\text{HSP}} + b_m)$$



Cd spillover is positively related to lipid peroxidation



[Se] in the liver is negatively correlated with lipid peroxidation



Proportion of GSSG is related to the [Se] in the HSP fraction, which suggests that higher [Se] reduced oxidative stress

Our study is the first to observe an antagonist effect in nature between selenium and a metal other than mercury