



METAL
BIOACCUMULATION AND
BIOMARKER RESPONSES
OF THE TIGERFISH,
HYDROCYNUS VITTATUS,
FROM THREE SOUTH
AFRICAN POPULATIONS.

Miss E. Fisher, Prof. V Wepener
& Prof. N. Smit



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PROBLEM STATEMENT:

- Top predators
- Distribution: Okavango, Zambezi, Phongolo and the Limpopo systems (Skelton 2001).
- Bioaccumulate and Biomagnify (Mhlanga 2000).
- Few bioaccumulation studies on tigerfish.
- Few studies indicating whether or not tigerfish experience stress as a result of bioaccumulation.





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AIM:

- To show that tigerfish bioaccumulate and biomagnify toxicants as a result of predatory habits.

- To show that tigerfish are experiencing stress as a result of metal exposure and accumulation.



HYPOTHESIS

- The degree of metal bioaccumulation in tigerfish is an indication of environmental exposure to metals.

- Concomitant biomarker responses will provide an indication of stress as a result of bioaccumulation.



STUDY OBJECTIVES

- To determine
 - The environmental partitioning of heavy metals in the Olifants and Levuvhu Rivers, and the Jozini Dam,
 - The spatial and temporal extent of heavy metals in the muscle tissue of tigerfish from these ecosystems.
 - Biomarker responses on a spatial and temporal level and
 - to relate the biomarker responses to the metal bioaccumulation in the muscle tissue of tigerfish.



LITERATURE REVIEW

- Pollution of increasing concern (Jamil 2000; Walker *et al.* 2006)
- Metals can adhere to solid matrix e.g sediment (Walker *et al.* 2006).
- Bioaccumulation: Movement of toxicants (Hoffman *et al.* 1995)
 - Food chain or environment
- Bioconcentration: non-dietary (Hoffman *et al.* 1995)
- Biomagnification: increase through trophic level (Hoffman *et al.* 1995)
- Exposure: only a portion taken up (Connell *et al.* 1999)
- Naturally occurring metals low
 - Changes cause bioaccumulation/bioconcentration (Nussey *et al.* 1999).

CONT. OF LITERATURE REVIEW

- Why tigerfish?
 - High trophic level (Skelton 2001)
 - Robbers, minnows, sardines (Skelton 2001)
 - Bioaccumulate and biomagnify (Mhlanga 2000)

Liver used for biomarkers

- Metabolism
- Site of accumulation
- Biotransformation (Braunbeck *et al.* 1998)





CONT. OF LITERATURE REVIEW

•Biomarkers:

- **AChE** (Ellman *et al.* 1961; Connell *et al.* 1999)
- **LP (MDA)** (Ohkawa *et al.* 1979; Uner *et al.* 2005) & **SOD** (Farombi *et al.* 2007)
- **CA** (Cohen *et al.* 1970)
- **EROD** (Viarengo *et al.* 1997; Flammation *et al.* 1998; Flammarion & Garic 1997; Burke & Mayer 1974; Besselink *et al.* 1997; Connell *et al.* 1999)
- **PC** (Parvez & Raisuddin 2005; Levine *et al.* 1990; Fernandes *et al.* 2008; Floor & Wetzel 1998)
- **Metallothioneins** (Viarengo *et al.* 1997; Viarengo *et al.* 1999; Atli & Canli 2008; Fernandes *et al.* 2008; Hubbard 2005; Connell *et al.* 1999)
- **CEA** (de Coen & Janssen 1997; de Coen & Janssen 2003)





SITE SELECTION

- Accessibility
- Historical data for tigerfish
- Sites used by KNP Aquatic Sciences
- Varying degrees of impacts (with respect to metal contamination only).
- Levuvhu: relatively un-impacted
- Olifants: heavily impacted
- Jozini Dam: slightly impacted





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SURVEYING AREAS: OLIFANTS





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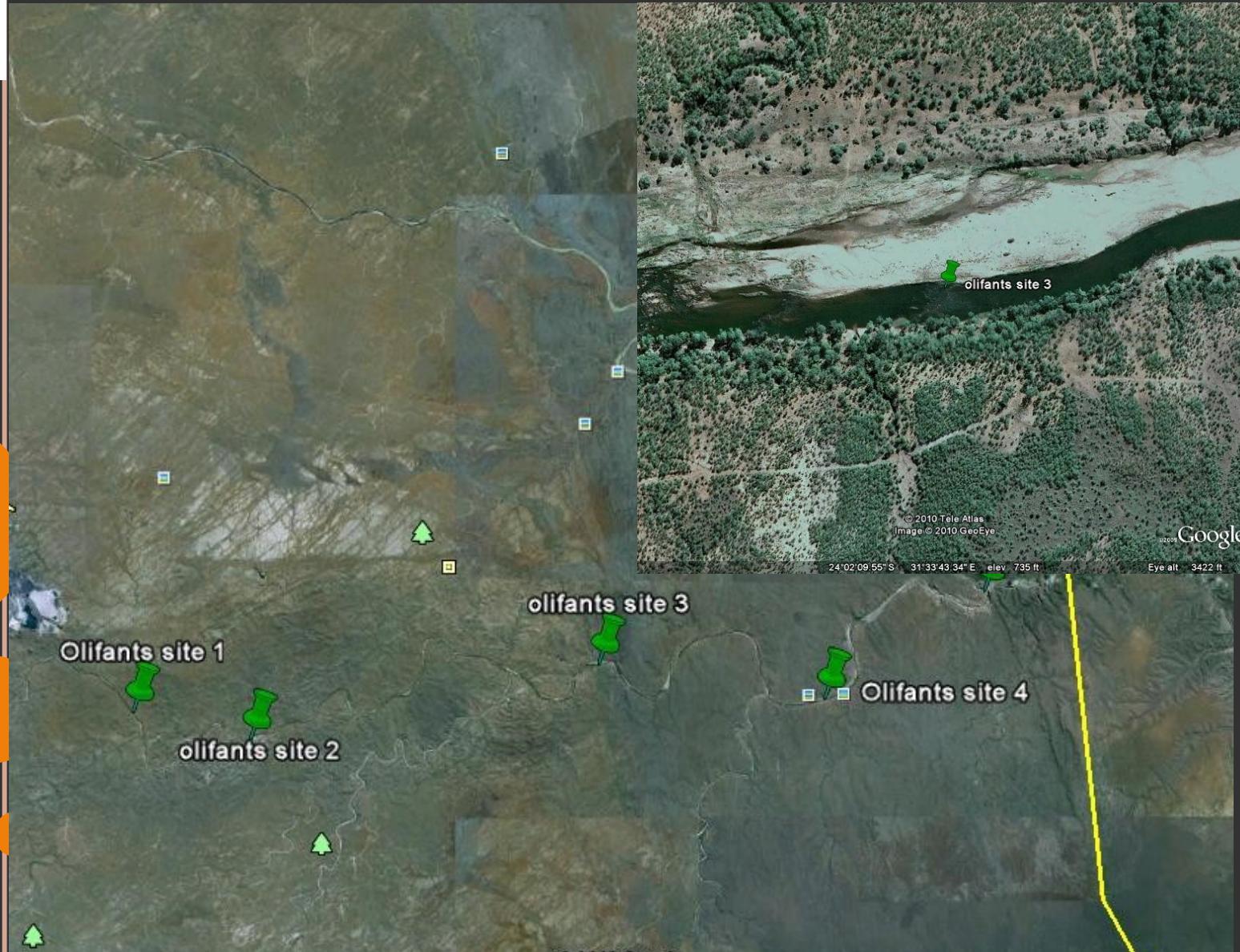
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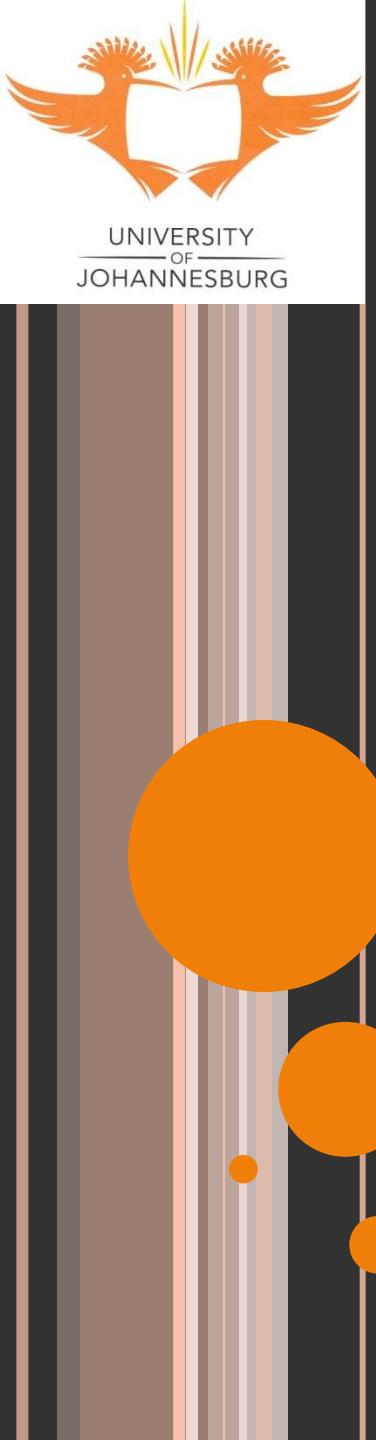




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SURVEYING AREAS LEVUVHU





SURVEYING AREAS

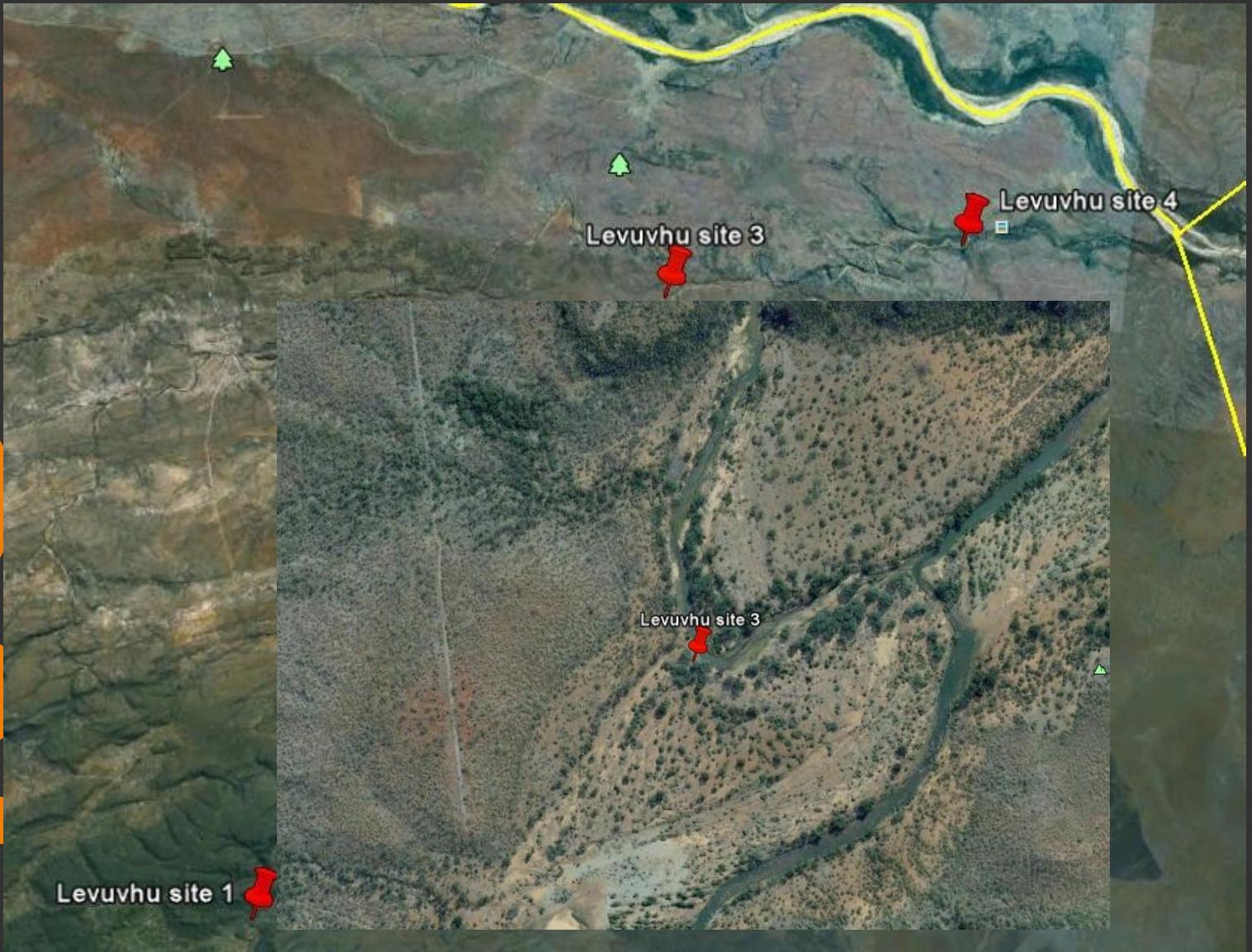
LEVUVHU





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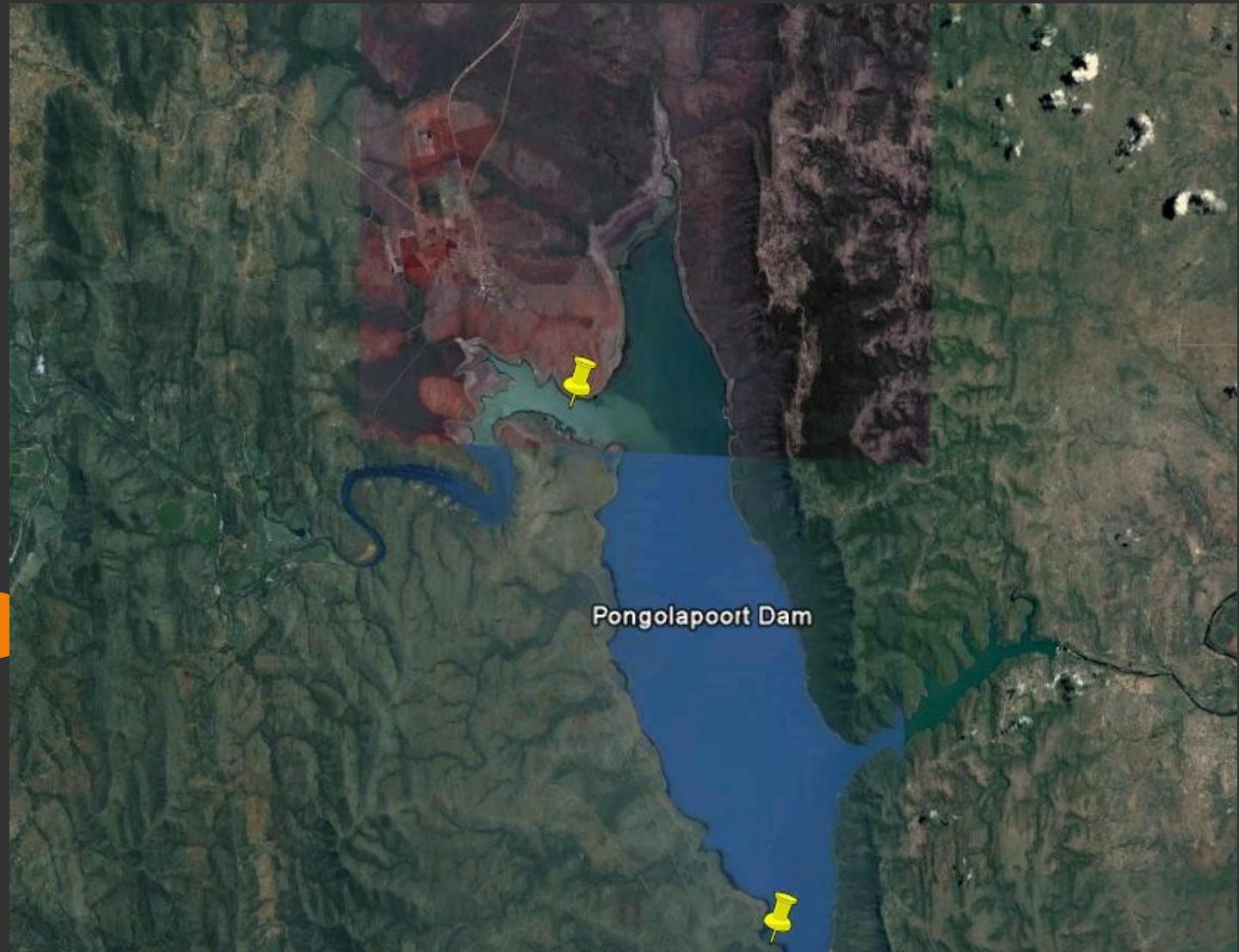
SURVEYING AREAS LEVUVHU





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SURVEYING AREAS JOZINI DAM





SAMPLING

- **Bi-annually**
- **Samples per site**
 - Water (triplicate, polypropylene jars)
 - Sediment (triplicate, polypropylene jars)
 - Tigerfish muscle (Bioaccumulation: polypropylene falcon tubes, Biomarkers: cryotubes & Hendrickson stabilisation buffer)
 - Tigerfish liver (biomarkers: cryotubes & Hendrickson stabilisation buffer)



CONT. OF SAMPLING

- **Physico-chemical characteristics of water & sediment**
- **Water quality parameters**
 - pH
 - Temperature
 - DO (Percentage saturation and content)
 - EC
 - TDS



CONT. OF SAMPLING

- Sediment Characteristics
 - Organic carbon content
 - Particle size distribution
 - Metal Concentrations using BCR sequential extraction (Ho and Evans 1997)
- Water Characteristics
 - NO_3^- , NO_2^- , NH_4^+ , PO_4^{2-} , SO_4^{2-} , Cl^- , Turbidity.
 - Dissolved metals
 - Suspended metals





CONT OF SAMPLING

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STATISTICS

- One-way analysis of variance and covariance will be used to compare the concentrations of metals and biomarker responses across sites and sampling periods.
- Data that deviate from normal distribution will be appropriately transformed prior to testing by parametric tests.
- The relationship between metal bioaccumulation and biomarker responses will be tested using regression and correlation analysis.

RESULTS EXPECTED

- Speciation and distribution of heavy metals
- Bioaccumulation
- Response of tigerfish
- Source of metal exposure





THANK YOU!!!!