

# *Lutjanus jocu* (Dog snapper) as a bio-indicator of emerging contaminants and changes in environmental condition.

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## INTRODUCTION

Extensive research has shown that anthropogenic inputs have led to coastal degradation, altering environmental conditions in estuarine ecosystems [1] and adding toxic substance harmful to the environment.

Ongoing research show variations in environmental conditions such as dissolved oxygen and pH, and alarming concentrations of emerging pollutants in the estuarine system of San Juan, PR [2].



To study these issues it is necessary to develop rapid, sensitive, and low cost biological assays for marine and estuarine ecosystems.

Biological endpoints such as startle response (C-start) in fish can provide critical and highly sensitive tools to help understand how organisms respond to changes in their environment [3].



## OBJECTIVES

1. Assess behavioral and neurological impacts of environmental changes (e.g., pH, dissolved oxygen) on estuarine fishes.
2. Characterize contaminants of emerging concern (CEC's) in fish and water from Condado Lagoon, San Juan Bay Estuary and determine their neurotoxic effects.
3. Correlate behavior with neurophysiology to develop a sensitive bio-indicator.

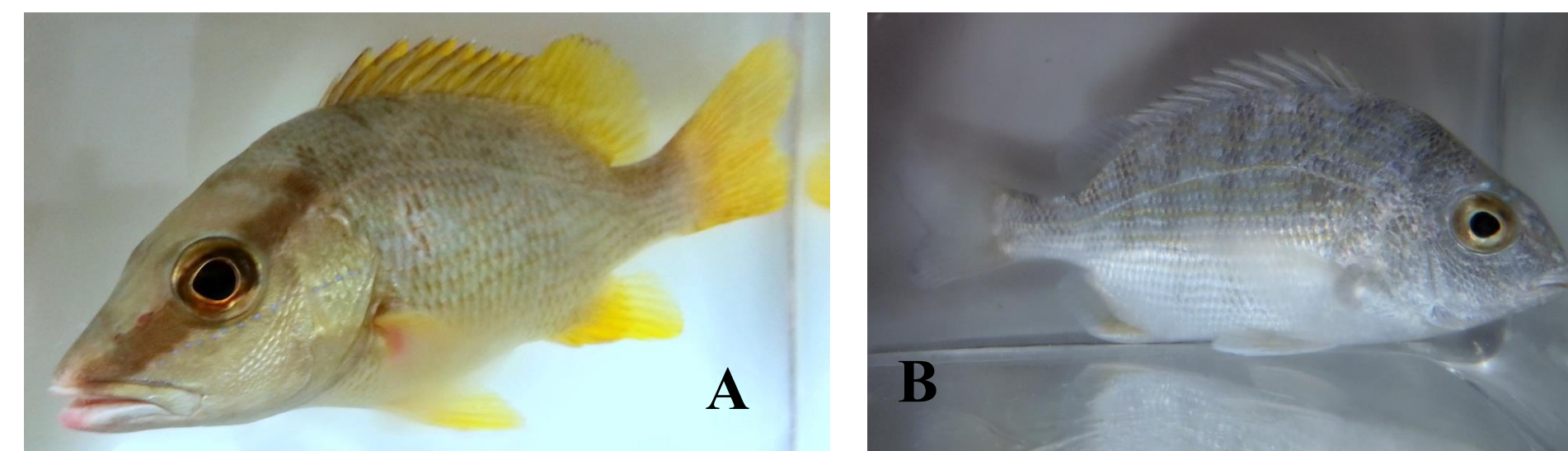
## METHODS

### Study site



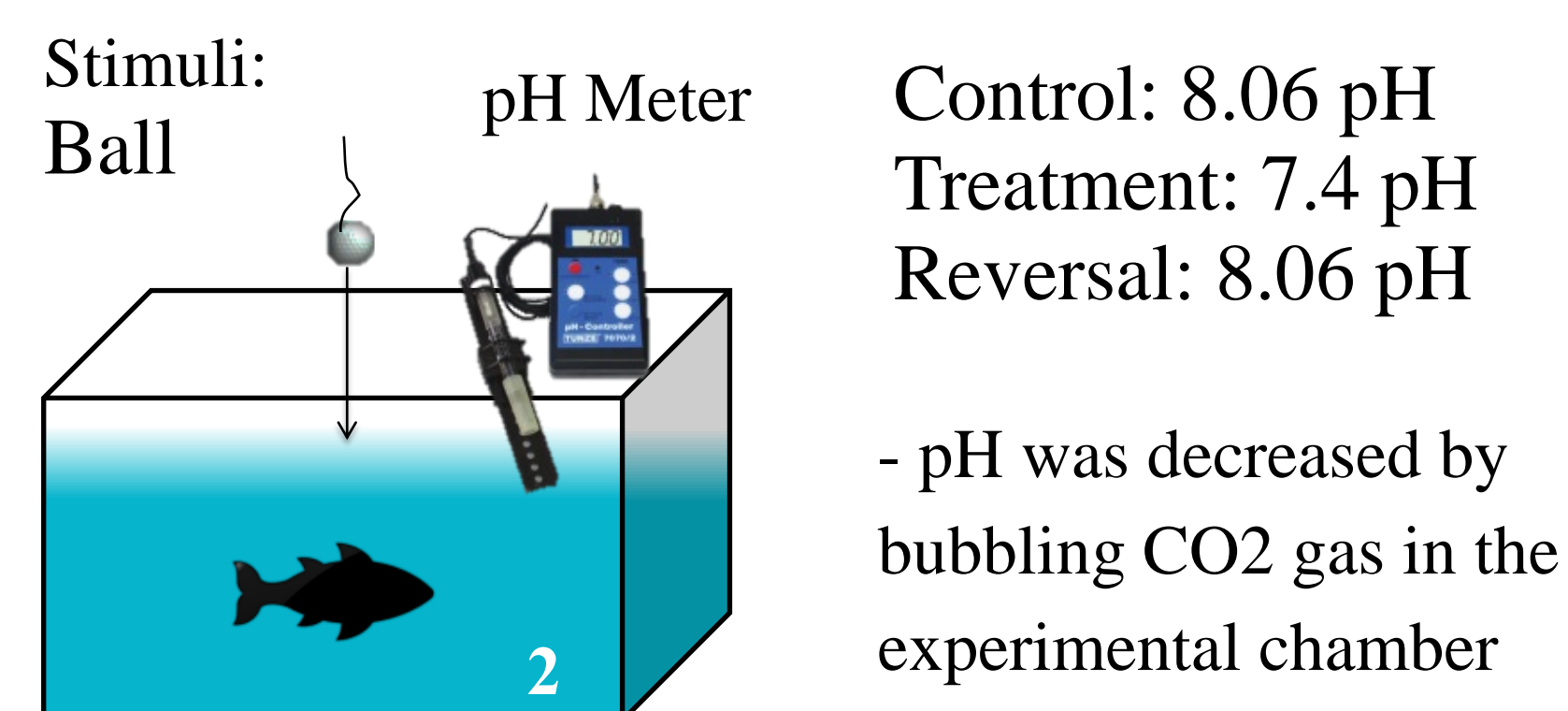
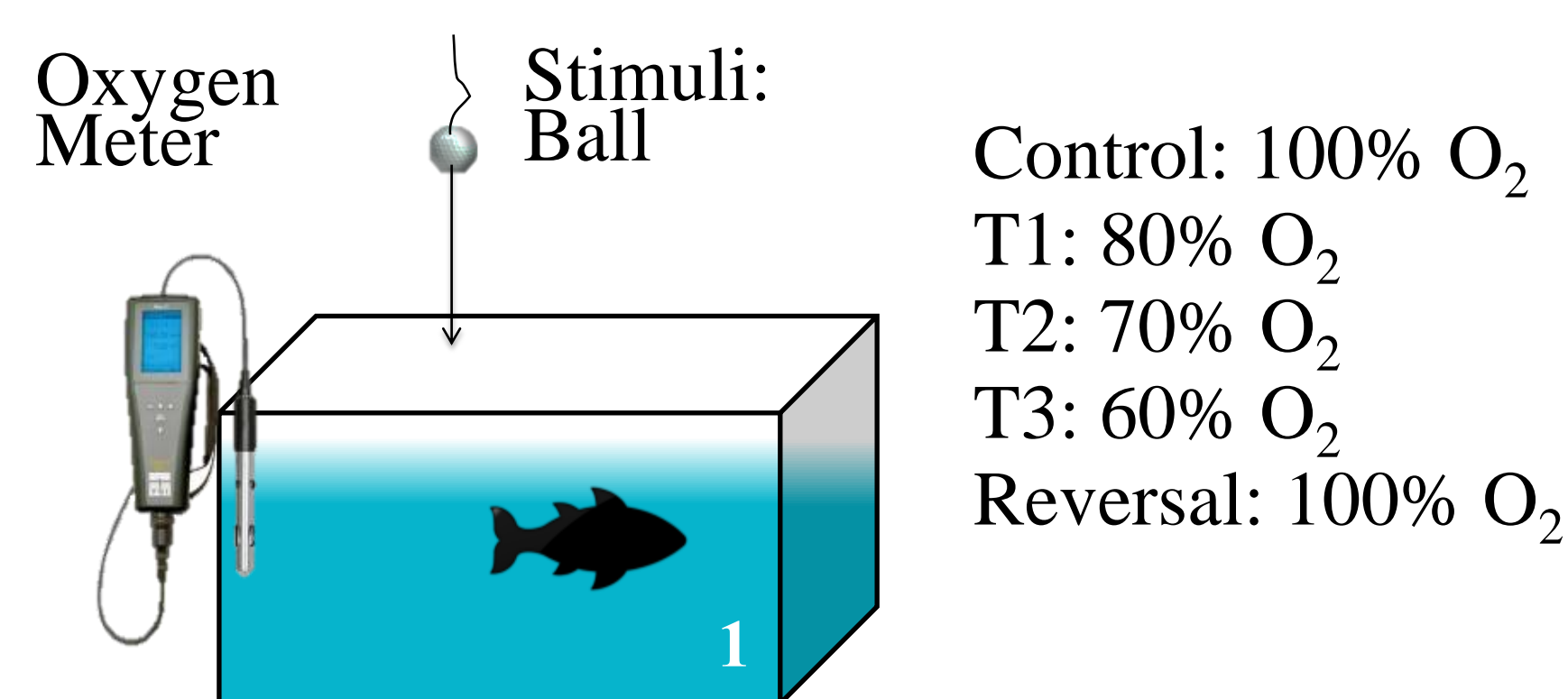
The **study site** is located in the San Juan Bay Estuary (SJBE). Fish were collected in the Condado Lagoon. The population of the San Juan metropolitan area was 2,664,889 in 2010 (U.S. Census Bureau). Photos by the SJBE.

### Behavior Assessment



A) *Lutjanus jocu* B) *Haemulon plumierii*

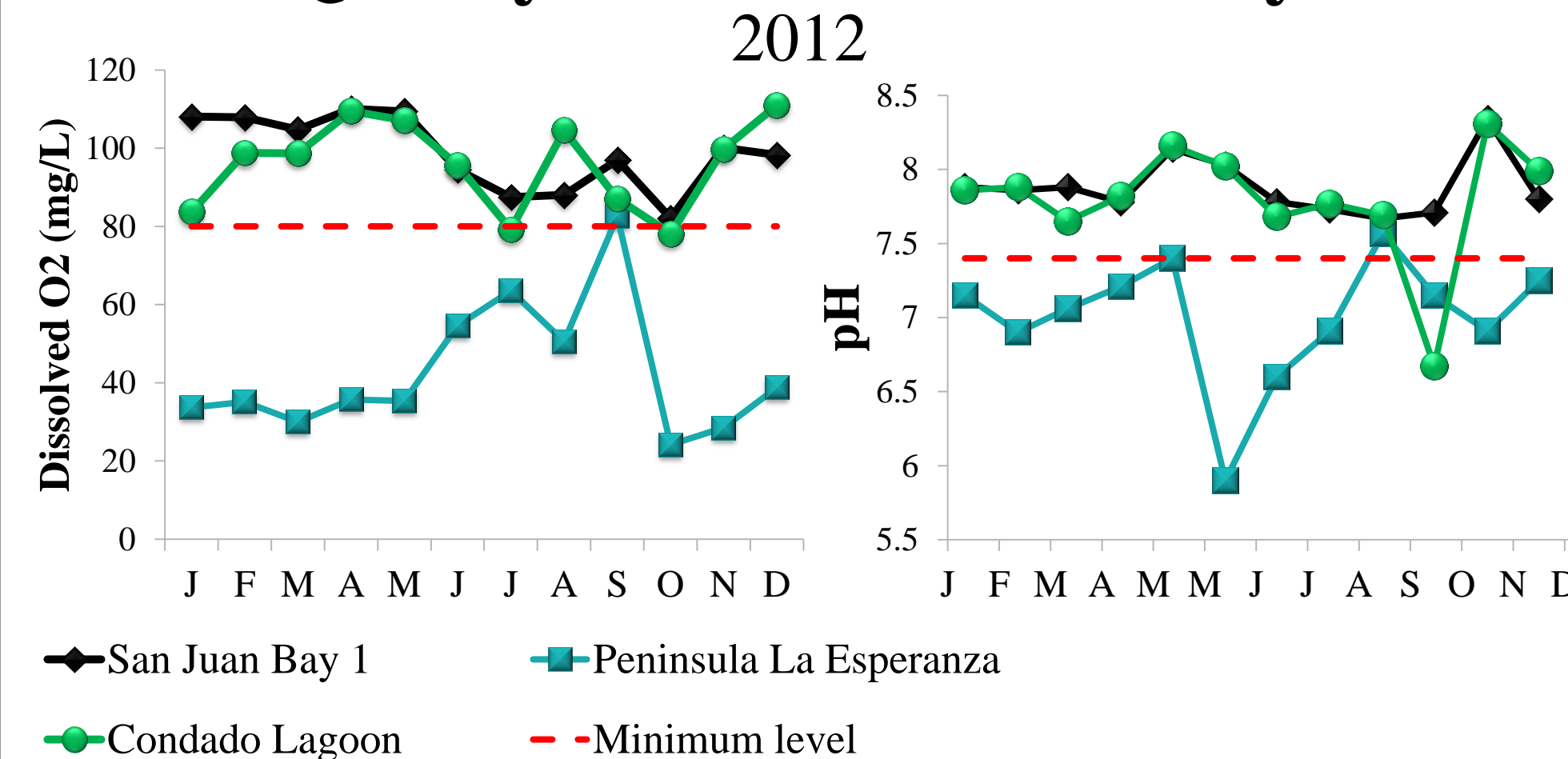
### Experimental set up



Schematic diagram of the behavioral testing apparatus used to elicit C-start response to changes in oxygen (1) and pH (2).

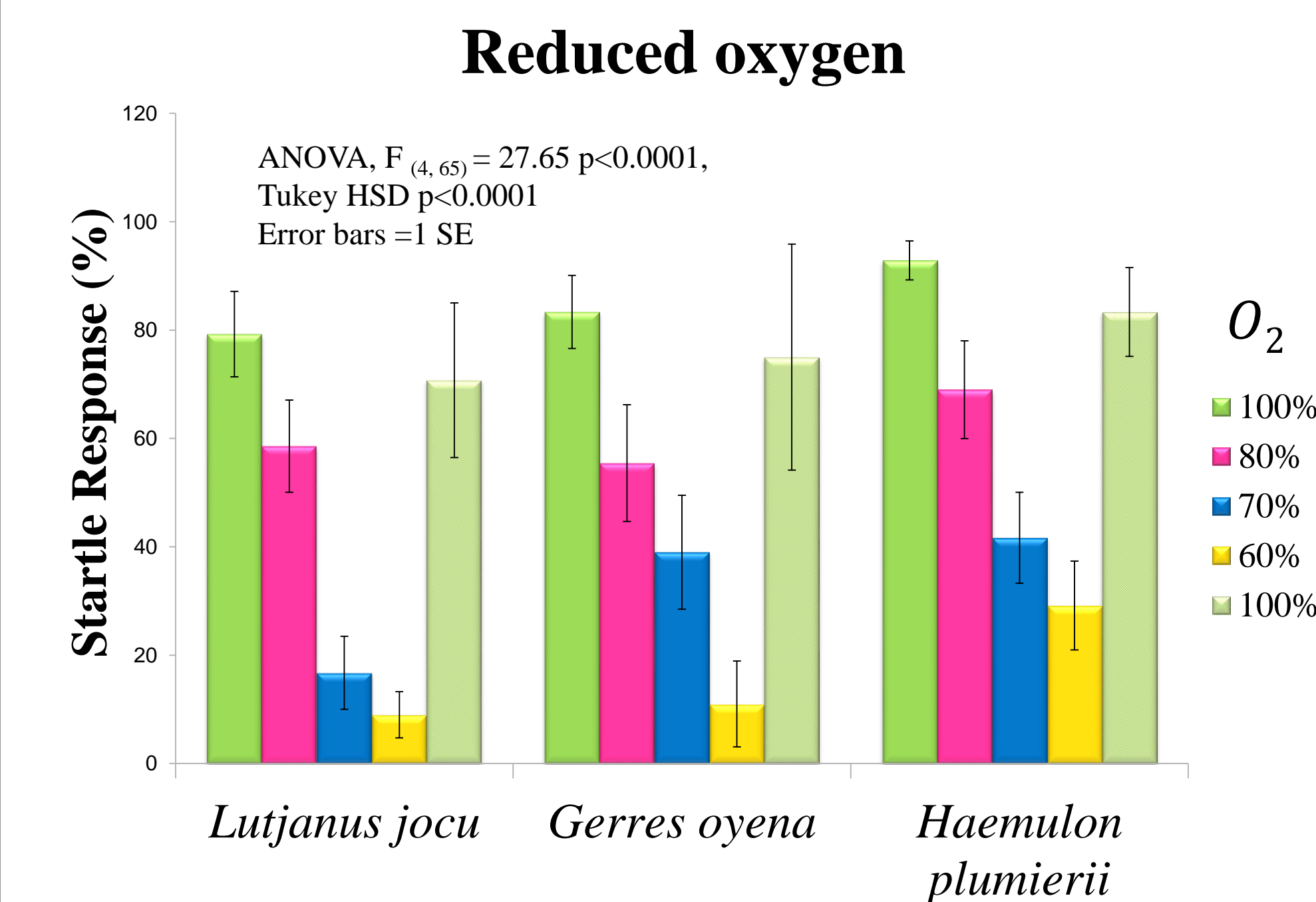
## RESULTS

### Water Quality in the San Juan Bay Estuary

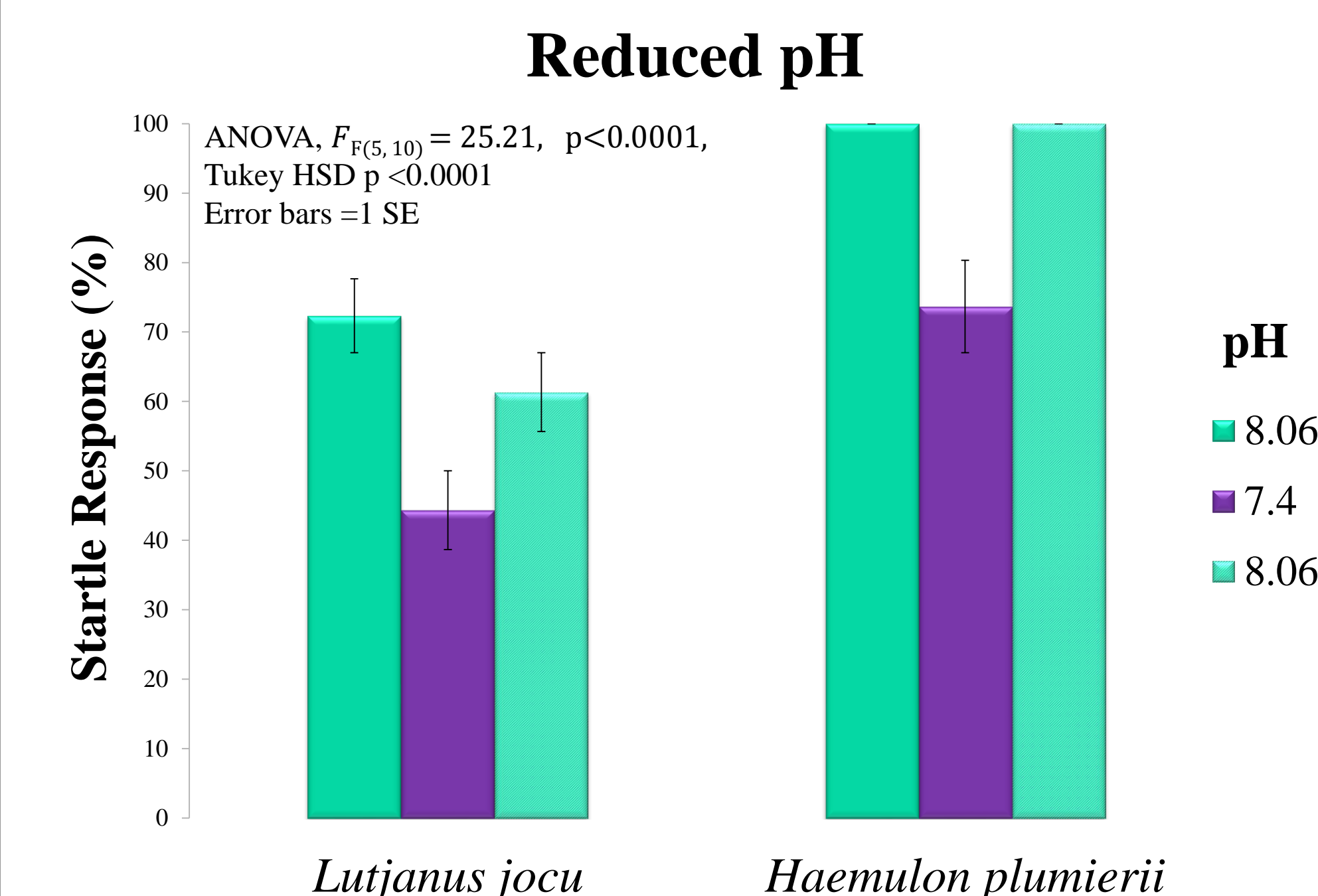


pH and dissolved oxygen fell below optimum levels at various locations in the estuary, including Condado Lagoon, and could impact fish distribution and survivorship at these sites [4].

### Behavior Assessment



Startle response decreased by 27% at 80% O<sub>2</sub> and dropped as much as 94 % in the most sensitive species (*L. jocu*) at only 60% O<sub>2</sub>. Oxygen levels in the estuary can drop below 40% in some areas for a large part of the year.



Startle response also decreased significantly at low pH, with *L. jocu* exhibiting escape behavior 39 % less often than at normal pH.

## CONCLUSIONS

- Our results demonstrate that poor water quality has a negative impact on fish behavior and could lead to loss of ecosystem function.
- Variability in the response among species will influence survival rates linked to predator avoidance.
- Changes in C-start response reflect interference in Mauthner Cell circuitry and offers great promise as an ideal biological assay for coastal ecosystem degradation.

## FUTURE DIRECTIONS

1. Assess the synergistic effects of environmental changes on the mechanics of C-start response using high speed cameras and sound stimulation.
2. Determine the effects of environmental changes and neurotoxic CEC's on fish Mauthner cells (M-cells). M-cells initiate the startle response and therefore are the most likely central neuron to be affected by environmental changes.

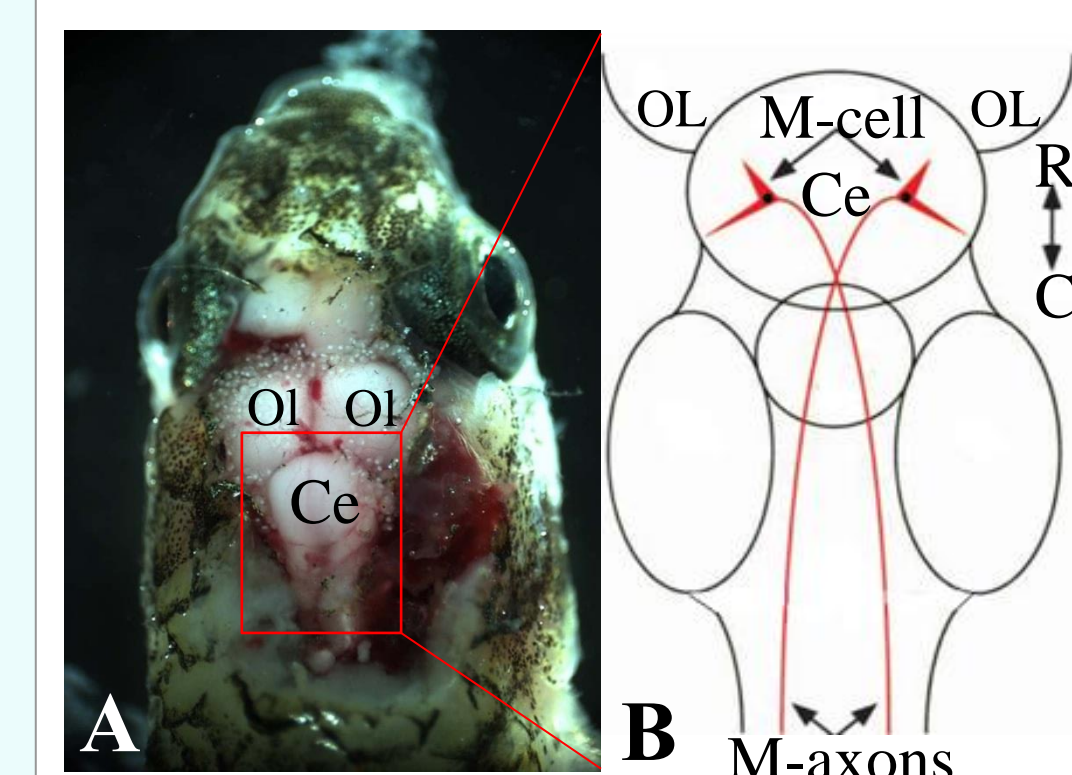


Image (A) and schematic (B) of the dorsal view of fish brain showing the location of **Mauthner Cells** (M-cell) in the hindbrain, behind the optic lobes (OL) below the cerebellum (Ce) [5]. Image by Dave MacGhee Imaging Planet

Category	Tissue	Water
Plasticizer	9	2
Pharmaceutical	3	1
Pesticides	2	1
Unknown	1	0
Hydrocarbons	1	1
Personal Care	1	6
Multi use	8	4
<b>TOTAL</b>	<b>25</b>	<b>15</b>

Total of 40 organic compounds were found in preliminary screening of tissue and water samples from the Condado Lagoon, San Juan P.R. Water data from X. Perez (Unpublished data).

## REFERENCES

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4. San Juan Bay Estuary Program. *San Juan Bay Water Quality Monitoring Data 2012.* (2012).
5. Zottoli, S. J. Recovery of C-starts, equilibrium and targeted feeding after whole spinal cord crush in the adult goldfish *Carassius auratus*. *J. Exp. Biol.* 206, 3015–3029 (2003).

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