Dec 12th, 1:30 PM - 3:10 PM

Determining barotrauma in the Pictus catfish, *Pimelodus pictus*, experimentally exposed to simulated hydropower turbine passage

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Institute for Land,
Water and Society
Charles Sturt University

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Bernardo Beirão, Luiz Silva, Richard Brown and Ricardo Walker

INTRODUCTION

Electricity consumption

World's consumption - demand

China – Non OECD Asian-countries (India, Thailand, etc)

Renewable energy

Further development should be focused on renewable sources

**Clean Development Mechanism
CDM – 2005**

**Sustainable Development Mechanism
SDM - 2016**

Hydropower boom

Impacts on fish

DEVELOPMENT AND ENVIRONMENT

Balancing hydropower and biodiversity in the Amazon, Congo, and Mekong

Basin-scale planning is needed to minimize impacts in mega-diverse rivers

By K. O. Winemiller,* P. B. McIntyre, L. Castello, E. Fluet-Chouinard, T. Giarrizzo, S. Nam, I. G. Baird, W. Darwall, N. K. Lujan, I. Harrison, M. L. J. Stiassny, R. A. M. Silvano, D. B. Fitzgerald, F. M. Pelicice, A. A. Agostinho, L. C. Gomes, J. S. Albert, E. Baran, M. Petrere Jr., C. Zarfl, M. Mulligan, J. P. Sullivan, C. C. Arantes, L. M. Sousa, A. A. Koning, D. J. Hoeinghaus, M. Sabaj, J. G. Lundberg, J. Armbruster, M. L. Thieme, P. Petry, J. Zuanon, G. Torrente Vilara, J. Snoeks, C. Ou, W. Rainboth, C. S. Pavanelli, A. Akama, A. van Soesbergen, L. Sáenz

areas and feeding grounds
tions bring about an ecolog
whereby a dynamic system
tural and functional com
relatively homogeneous an
Tropical reservoir fisheries
nated by low-value species

Interaction with dam components

- Turbines
- Spillways

- Scenario A – turbine passage
- Scenario B – turbine stop/start-up operation.

Rapid decompressio

BOYLE's LAW

Brown *et al.* (2014)

$$P_1 V_1 = P_2 V_2$$

Expansion of gases
inside the body (swim
bladder)

STEPHENSON *et al.*, 2010

Study aims

- Massive mortality events
- High frequency of catfish – genus *Pimelodus*
- Scarcity of hard data

Understand the effects of rapid decompression in the Pictus catfish (*Pimelodus pictus*).

MATERIAL AND METHODS

Species and fish husbandry

Institute for Land,
Water and Society
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Pacific Northwest
NATIONAL LABORATORY

Hypo-hyperbaric chamber

STEPHENSON *et al.*, 2010

Four stages:

- Acclimation
- Spike preparation
- Determination of pressure of neutral buoyancy
- Decompression

Hypo-hyperbaric chamber

- $FO_i = (N_i / N_{ti}) * 100$
- N_i = N fish with a certain injury
- N_{ti} = N fish with at least one injury

Rare (<25%); Common (>25<75%); Frequent (>75%)

- $RPC = P^{NB} / P_N$ Decompression timespan - T_D

Data analyses

- Non-linear logistic regression →
  - RPC x Injury
  - Grouped into T_D

Fastest T_1 ($T_D < 0.1s$); Middle range T_2 ($0.1 < T_D < 0.2s$); Slowest T_3 ($0.2 < T_D < 0.3s$)

- Simple linear regression → Correlate swim bladder rupture with other injuries

RESULTS

Injuries

- Swim bladder rupture
- Emboli
- Haemorrhage
- Exophthalmia

Non-linear models

$\circ$ $0 < T_1 \leq 0.1$ s

$\square$ $0.1 < T_2 \leq 0.2$ s

$\diamond$ $0.2 < T_3 \leq 0.3$ s

Intestine rupture

Emboli

Non-linear models

Swim bladder rupture

Internal haemorrhage

Simple linear regression

- a) Emboli
- b) Intestine rupture
- c) Internal haemorrhage

CONCLUSIONS

Conclusions

- Negative buoyancy → Benthic or benthopelagic species
- Swim bladder rupture at low RPC (1.2 compared to 2.0 for Chinook salmon (Stephenson *et al.* 2010))
  - ↳ Although anaesthesia may relax the pneumatic duct
  - Three-chambered swim bladder
  - May not be influenced by acclimation pressure alone
- Rate of pressure change seems to be important – needs more investigation

Conclusions

- Negative buoyancy may explain higher susceptibility to turbine entrainment of *Pimelodus*
- Clear need to diversify species tested – different responses of *P. pictus*
- Need to diversify methods to study benthic/benthopelagic species

Acknowledgments

THANK YOU!

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