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Injury and Mortality of Two Mekong River Species to Turbulent Shear Forces

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LARReC
Living Aquatic Resources Research Center
National Agriculture and Forestry Research Institute

Charles Sturt University

Background

Mekong River Basin

- Approximately 1,200 native fish species
- Largest freshwater fishery
- Second [illegible]

Freshwater [illegible]

- Major source of protein
- High species diversity
  - Size
  - Abundance
  - Life cycle

Many dams are planned

- Small and large
- Mainstem and tributaries

Little information available to guide construction of downstream fish-friendly hydro systems in a manner safe for Lower Mekong species

Background

Sources of injury

Mechanical Strike

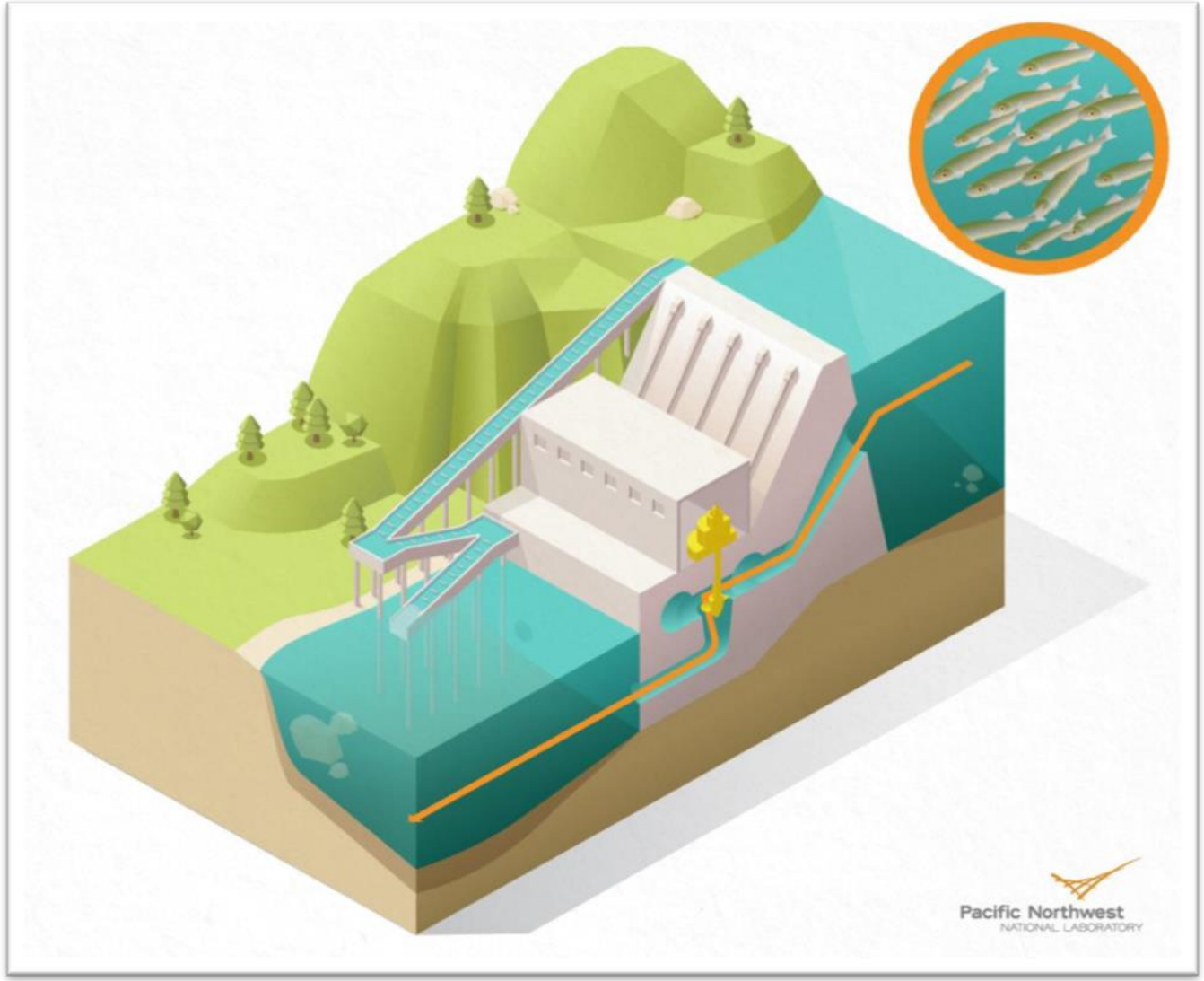
- Bruising
- Cuts
- Ruptured blood vessels

Shear Forces

- Bruising
- Cuts
- Gill damage
- Eye damage

Rapid Decompression

- Swim bladder rupture
- Exopthalmia (eye pop)
- Emboli/emphysema
- Ruptured blood vessels



Objectives

Evaluate effects of shear stress

- Two Mekong River native species
  - Blue gourami (*Trichopodus trichopterus*)
  - Iridescent shark (*Pangasianodon hypophthalmus*)

Determine strain rate thresholds

Inform design and operation of turbines

General Approaches

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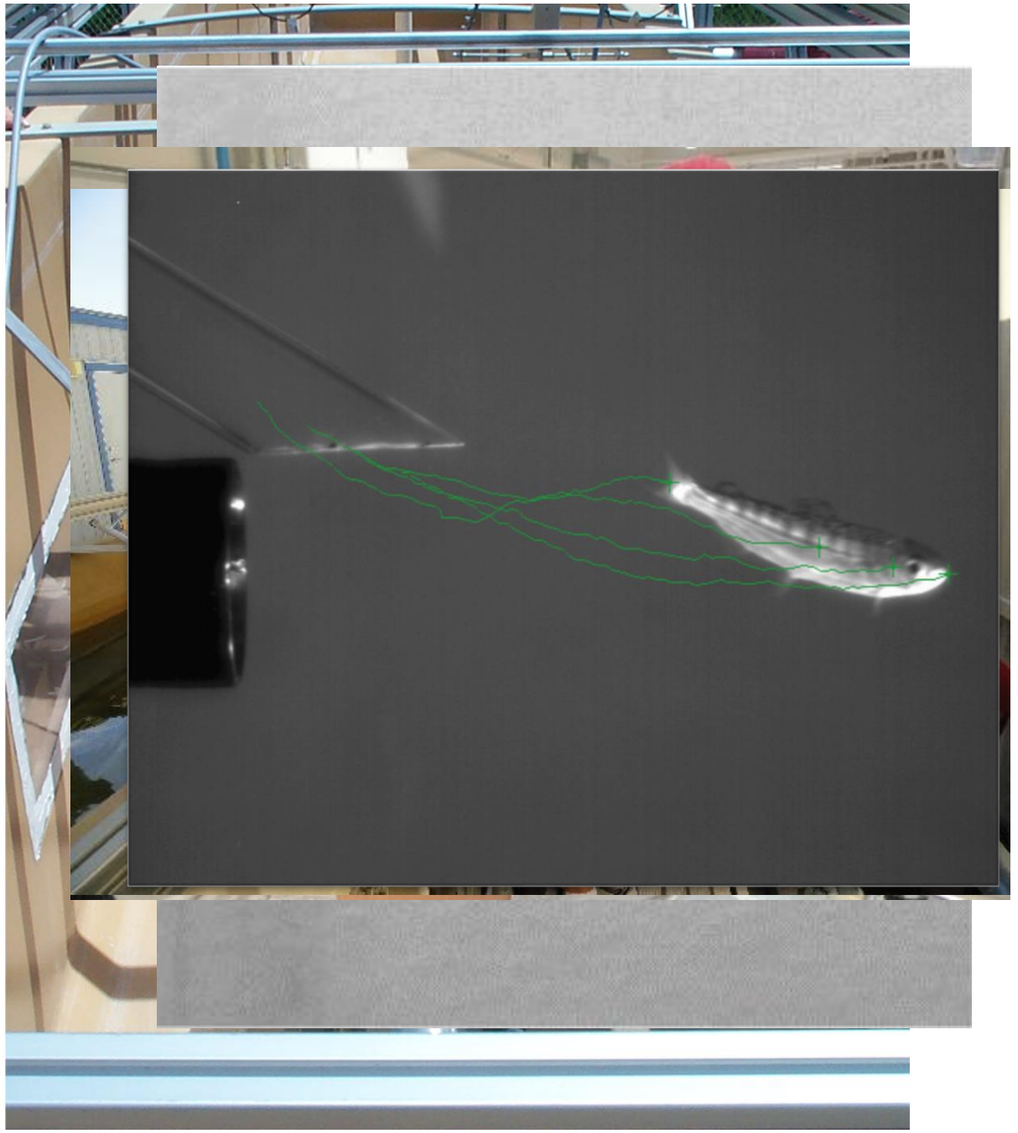


Experimental variables

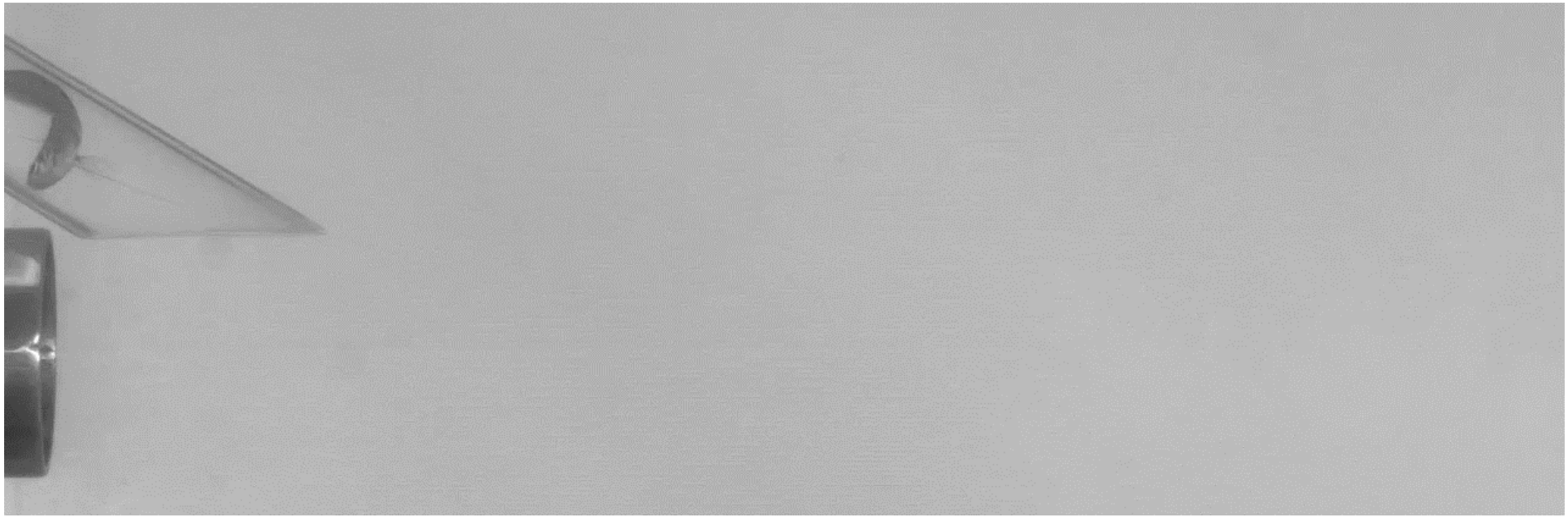
Jet velocity (m/s)	Strain rate (s^{-1})	Blue gourami	Iridescent shark
3.0	168	✓	✓
6.1	339	✓	
12.2	688	✓	✓
15.2	852	✓	
18.3	1,008	✓	✓
21.3	1,185	✓	✓ S & L

Sample size = 15 fish per treatment

Species	Length (mm) median (Range)	Mass (g) median (Range)
Blue gourami	58 (45 - 72)	3.7 (1.6 - 6.2)
Iridescent shark small	56 (43 - 67)	2.6 (1.5 - 4.3)
Iridescent shark large	76 (70 - 86)	7.1 (4.7 - 10.5)

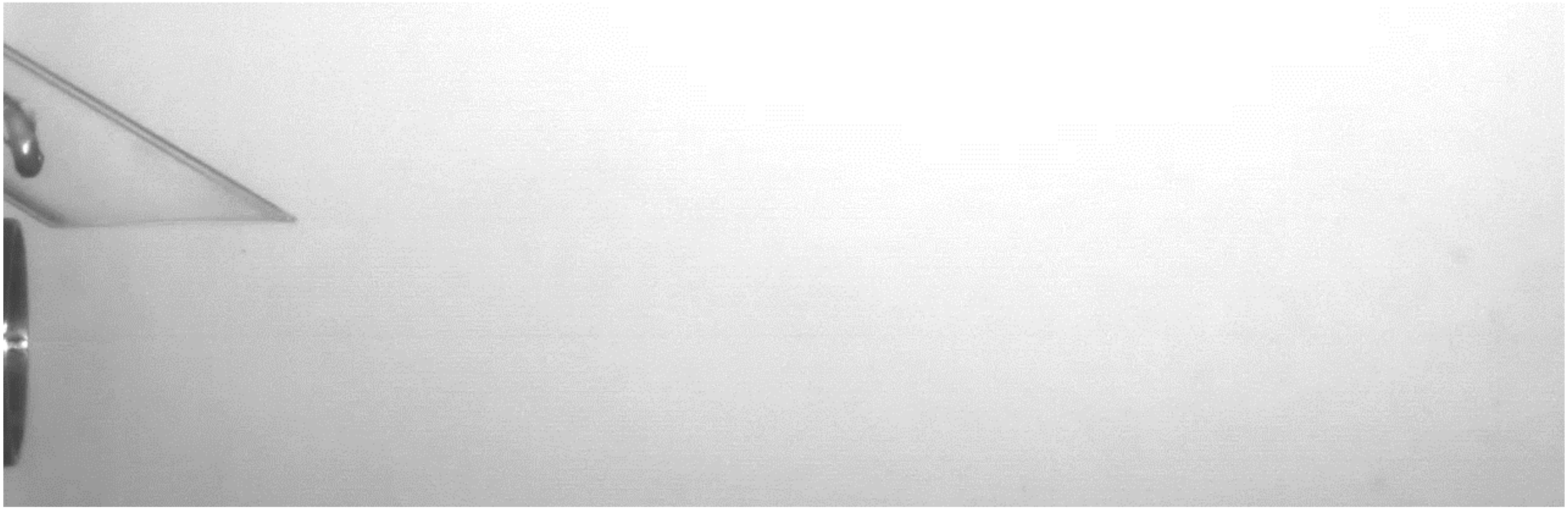
High speed video

Blue gourami



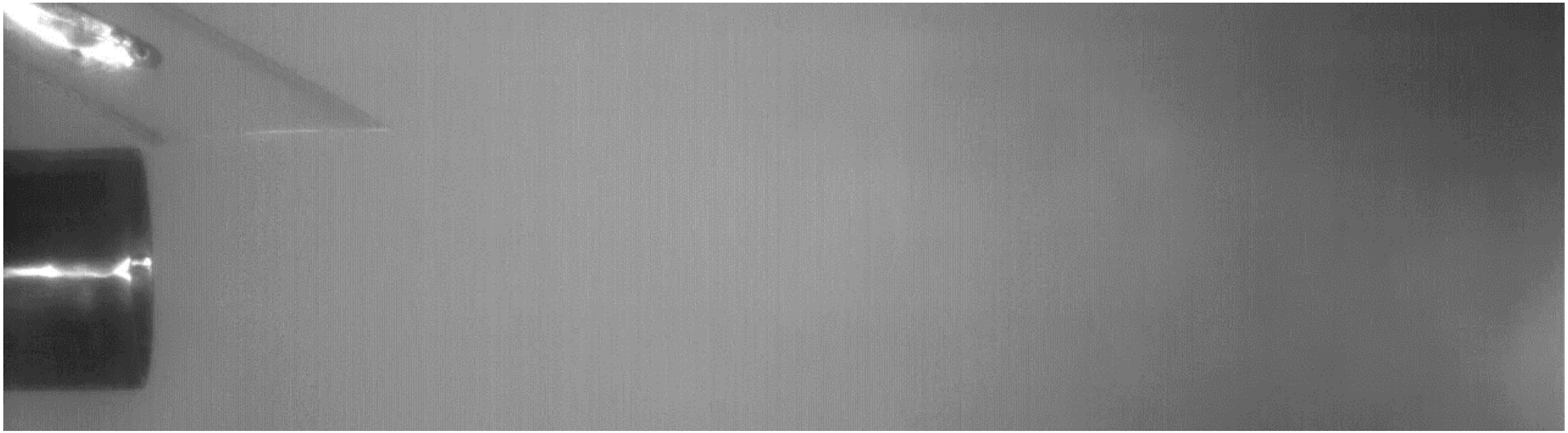
High speed video

Iridescent shark



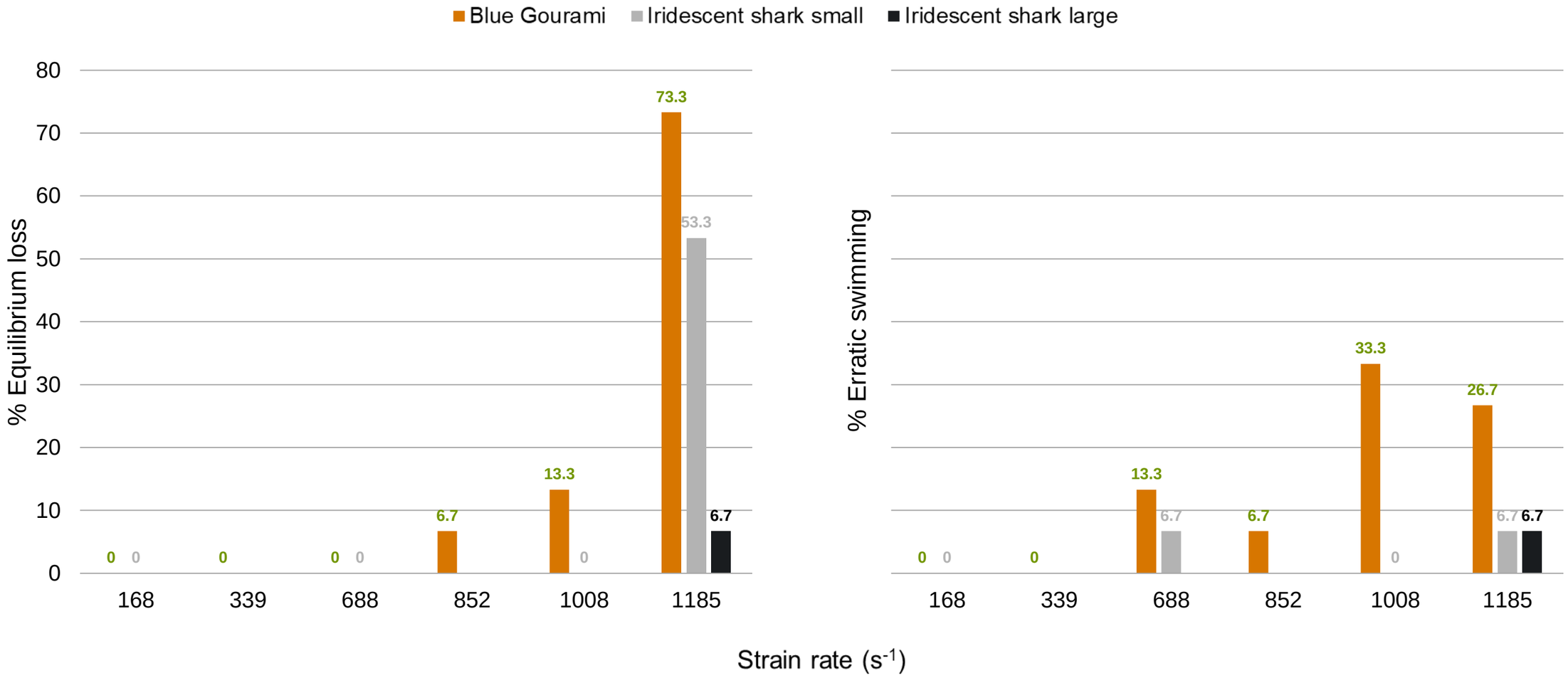
High speed video

Chinook salmon



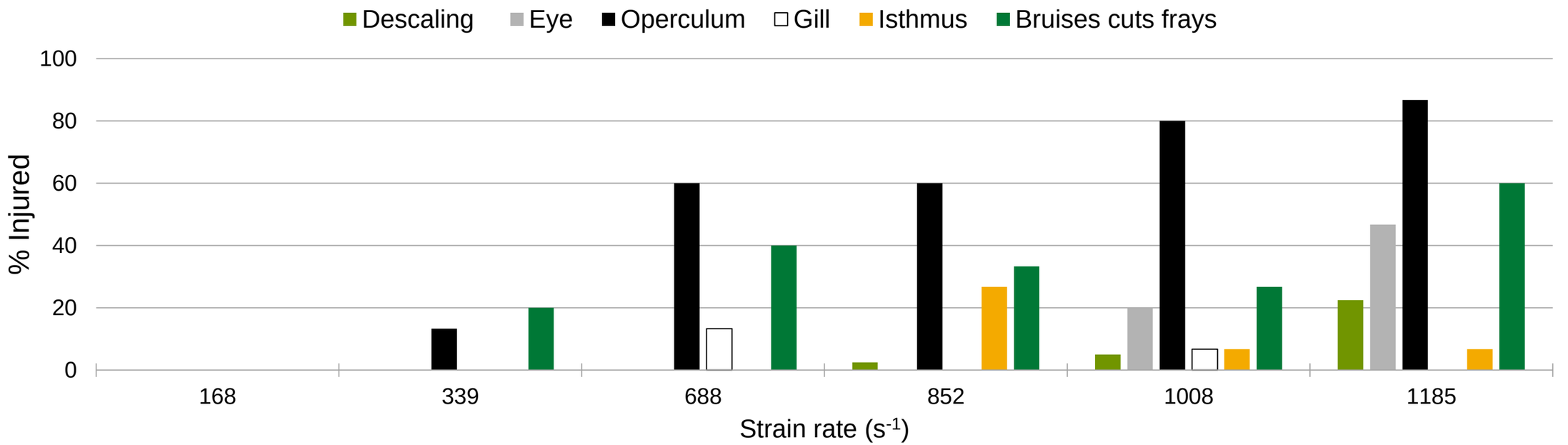
Results

Equilibrium loss and erratic swimming



Results

Injury – blue gourami



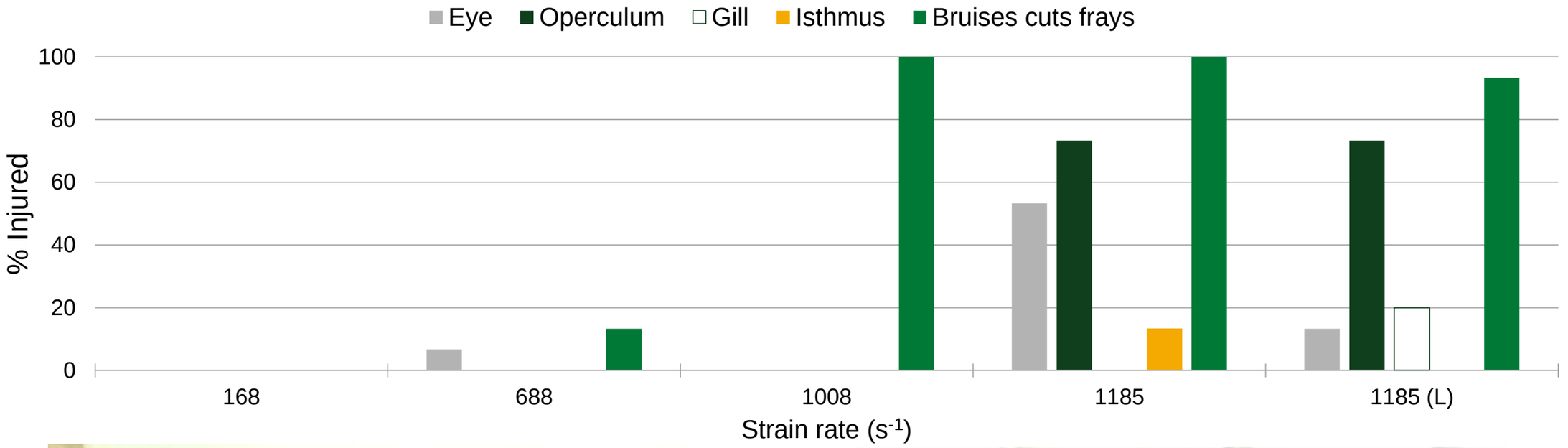

Torn Isthmus


Damaged operculum

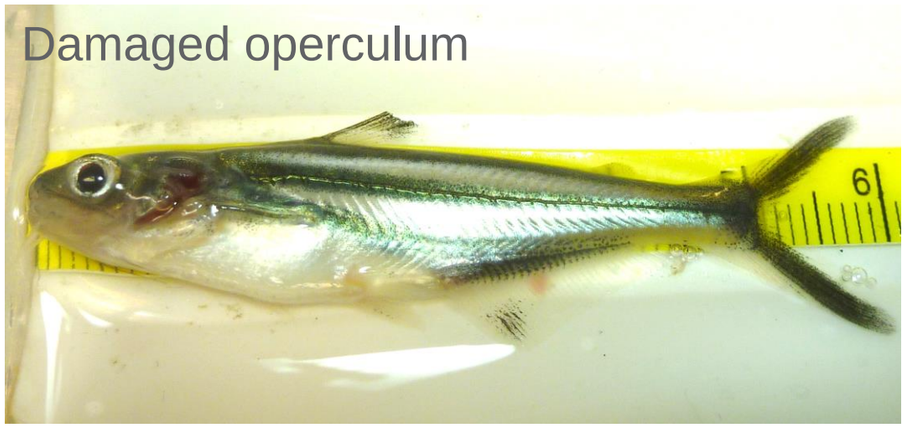

Eye hemorrhage and descaling

Results

Injury – iridescent shark



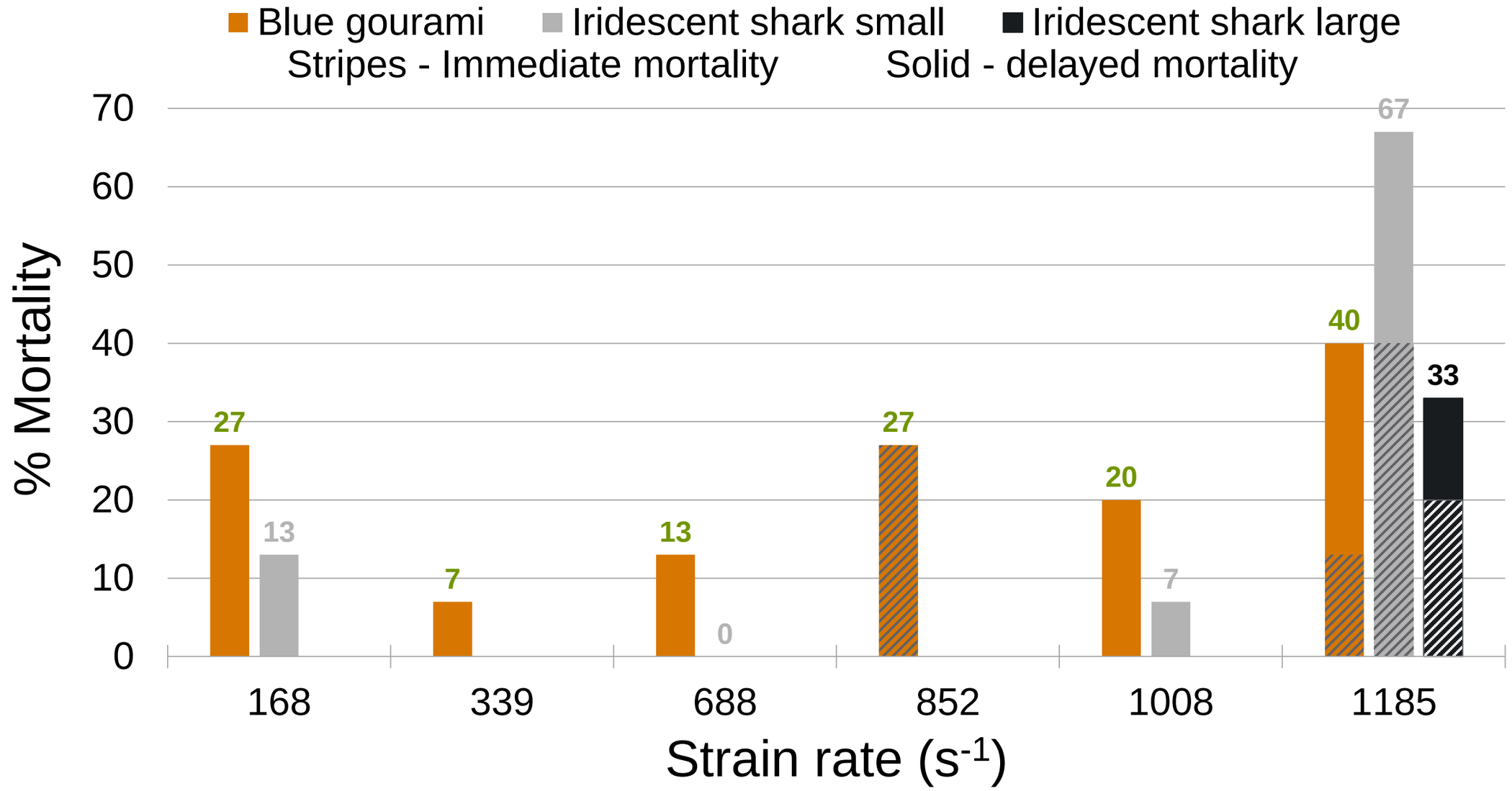
Damaged operculum



Missing eye

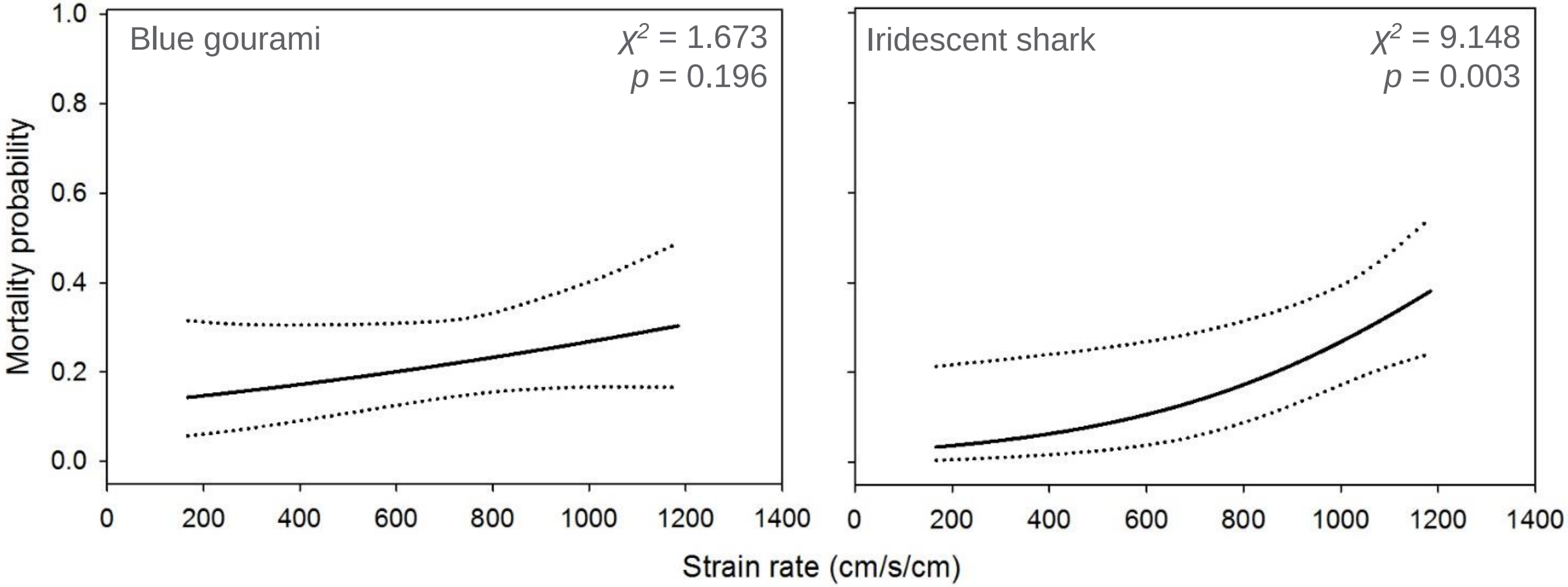
Results

Mortality



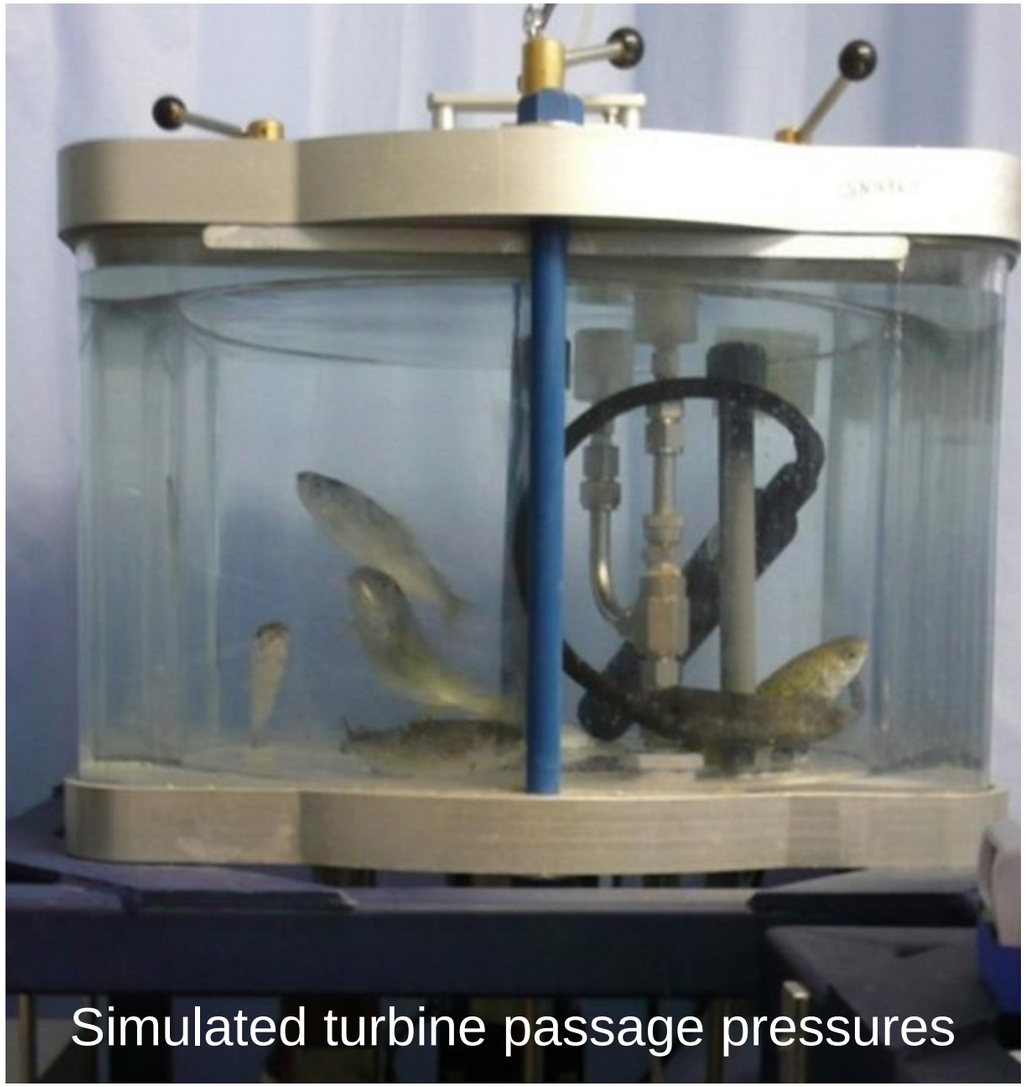
Results

Probability of mortality



Parallel research

Exposure to rapid decompression



Simulated turbine passage pressures

Blue Gourami – emphysema in peritoneal cavity

*Most common injury

Summary

Abnormal behavior (equilibrium loss and erratic swimming)

- Increased with exposure to higher strain rates
- Gourami more susceptible than iridescent shark

Injuries

- Increased with exposure to higher strain rates
- Operculum damage most common injury
- Gourami more susceptible than iridescent shark

Mortality

- Ranged from 0-67% per treatment
- Highest immediate and delayed mortality rates observed 1,185 s-1
- Similar rates to juvenile American shad
- More susceptible than juvenile Chinook salmon, rainbow trout, and steelhead

Recommendations

Species responded different to shear stress exposure

- Examine additional important species

Negative effects increase with shear force severity

- Minimize shear stress in hydroturbine design and operation

Pa soi (*Henicorhynchus lineatus*)

Snakehead (*Channa striata*)

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