

Fish Screens

A tool for fish protection at hydropower projects

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The Challenge: Protecting Fish Populations From Turbine Entrainment And Habitat Disruption

- Importance of hydropower as a renewable energy source.
- The ecological challenge: protecting fish populations from habitat and migration disruption and turbine entrainment.



Most solutions to improve fish passage focus on <u>upstream</u> passage. What about <u>downstream</u> passage?



Types of Fish Passage Through Hydropower Projects





Reducing fish interactions with turbines

Passage through hydropower turbines is not always safe for fish – high injury and mortality rates can occur.

Fish screens may be an option to reduce fish interactions with hydropower projects.





What are Fish Screens?

Definition: Physical barriers that **prevent** fish from entering turbines or water intakes.

Function: Guide fish toward safer passage routes while allowing water to flow efficiently.



A wire-mest screen prevents fish passing into a diversion shannel The Sectamento Biver, California runs left to right in foreground of photo and the diversion channel runs to the upper right.

Hortle, Kent. (2018). Hortle 2017 Mitigation of the impacts of dams on fisheries - A primer. Mekong Development Series No. 7.



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The Need for Screens

Legal and environmental mandates require fish protection measures in many other parts of the world.

- Policy and Regulations
 - U.S. Endangered Species Act and Clean Water Act requirements.
 - European Union Water Framework Directive.
 - National policies promoting 'fish-friendly' hydropower.
 - Australian guidelines

Much of the scientific literature relates to screen designs for European, North American, Australian and New Zealand species to comply with legislative requirements and to improve fish conservation at water infrastructure projects.





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The practical guide to modern fish-protection screening in Australia

How do Fish Screens Work?

- Designed to match fish size and swimming behaviour.
- Low water velocity (<0.3 m/s) at intake areas to prevent fish from being trapped.
- Self-cleaning mechanisms to maintain water delivery efficiency and prevent clogging.



- Water velocity fast
- Holes too big
- Easily blocked

- Same volume, lower velocity
- Fine mesh Self cleaning





Boys, Craig & Rayner, Thomas & Baumgartner, Lee & Doyle, Katherine. (2021). Native fish losses due to water extraction in Australian rivers: Evidence, impacts and a solution in modern fish- and farm-friendly screens. Ecological Management & Restoration. 22. 10.1111/emr.12483. Illustrated by Sam Davies.

Types of Fish Screens

Screen material (e.g. wedge-wire, mesh, perforated mesh)



Screen aperture (0.1mm – 150 mm)





Screen type



Objectives of Fish Screens in Hydropower

Which screen? Choosing a screen depends on the objective:

- 1) Protect and divert fish (often downstream migration)
- 2) Prevent access of non-native (pest) fish





Examples

1) Protect and divert fish (downstream migration)

Sieg River, Germany, 96 and 92% of the eels in 2014 and 2015 respectively **passed** safely around the dam.



Økland, F., Teichert, M. A. K., Havn, T. B., Thorstad, E. B., Heermann, L., Sæther, S. A., Tambets, M., and Borcherding, J. (2017). Downstream migration of European eel at three German hydropower stations. Report 1355, NINA, Trondheim, Norway.



Examples

2) Prevent access of non-native (pest) fish

Snowy Hydro 2.0 Pumped Hydropower Station (NSW, Australia). Pest fish (European perch) eggs, most larvae, juveniles and adults **prevented** from travelling out of the upper reservoir.



Doyle, K., Ning, N., Weatherman, K., Vu, A. V., McGregor, C., Bretzel, J., Mallen-Cooper, M., Robinson, W., Thew, P., Senevirathna, L., & Baumgartner, L. J. (2022). *Snowy Hydro secondary controls: Research commissioned by Snowy Hydro Limited*. Charles Sturt University.



Options for Fish Screens in Hydropower

Option 1. No screen; design turbines to pass all fish safely

Option 2. Screen and divert **larger fish**; design turbines to pass smaller fish safely

- % passage to **sustain** population, e.g. **<u>60-95%</u>**
- Large mesh (30 150 mm)



Larger (adult) fish

- Large aperture (mesh size)
- Easy to clean
- Lower cost

Option 3. Screen and divert all fish

- % passage to <u>prevent</u> population, <u>close</u>
 <u>to 100%</u>
- Small mesh (<0.5 mm)





- Small aperture
- Difficult to clean
- Extremely high cost



Considerations

- Not all screens are the same; some are better than others.
- Cost: Installation and maintenance expenses.
- Species-Specific Design: Not all fish respond the same way to screens.
- Testing of more fish species around screens is required, especially in SE Asia.





Summary and Opportunities for the Mekong

- Fish screens offer a tool to guide fish away from hydropower and water infrastructure (irrigation) structures.
- Fish screens must be designed appropriately to reduce damage to fish but to still effectively deliver water.
- Choosing a screen and mesh size depends on the specific objective:
 - 1) Protect and divert fish away from structures
 - 2) Prevent access of non-native fish
 - 3) Live stages of fish (eggs, larvae, juveniles, adults)



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