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# Glen Canyon Dam Fish Escapement Options

Glen Canyon Dam Adaptive Management Program  
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# Background

- At lower reservoir elevations, the epilimnion is near the penstock intake elevations.
- Risk of downstream fish entrainment has increased.
- Non-native game fish above Glen Canyon Dam (e.g., smallmouth bass, walleye, striped bass) threaten to compete with and/or predate the native fish community downstream including threatened and endangered species (humpback chub, razorback suckers).



# Project Goal

Explore exclusion options to prevent passage of non-native fish through Glen Canyon Dam.



# Project Approach

- Research technologies used to limit fish escapement from reservoirs
- Describe related examples
- Assess applicability to Glen Canyon Dam
  - Scalability
  - Effectiveness
  - Operational and power production impacts
  - Inspection and maintenance requirements
  - Recreational impact
- Document options for further consideration



# Summary

- There is no clear alternative that can fully eliminate fish escapement at Glen Canyon Dam.
- Preventing downstream movement of non-native fish from Lake Powell is a difficult problem without a definitive solution.
- Various needs and interests will need to be balanced.
- Preferred solutions will limit impacts to power production, operations, maintenance, and recreation while maintaining an acceptable level of entrainment protection.



# In-Reservoir Barrier Options

- Prevent fish from approaching or entering dam through exclusion
  - Physical barrier screens (vertical/horizontal flat plate, cylindrical, in-conduit)
  - Barrier nets
  - Air bubble curtains
  - Underwater acoustic barriers
  - Multi-stimulus barriers (bubble, light, sound)
  - Carbon dioxide barriers
  - Floating barriers (plates, flexible curtains)
  - Electric barriers
  - Other options (light, velocity, turbulence, seismic water guns, louvers)



# At-Dam Options

- Prevent fish from passing through the dam through exclusion or by reducing survival
  - Deeper water withdrawal through outlet works
  - Turbine mortality
  - Energy dissipating valve
  - Other options (lethal dose of carbon dioxide, electricity)



# Downstream Removal

- Collect and remove fish that have passed into the lower river
  - In-river barrier with sorting facility
  - Continuous electrofishing
  - Other options (tailrace nets, physical impact, drop structures)





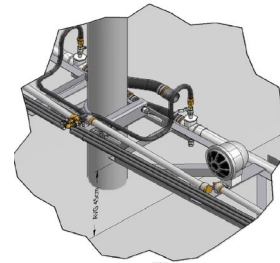
# Options Assessment

- In-reservoir barrier net
  - Possible installation: block net suspended from or near the buoy line in the forebay; installation at trashrack would increase fish impingement risk and headloss for power production
  - Precedent for fish exclusion nets at large widths and relevant depths due to modular layout
  - Similar installations reduce entrainment, but do not eliminate it
  - Little to no recreational impact
  - Key uncertainties: anchoring, dam safety concern if dislodged, inspection and maintenance related to biofouling and mussel attachment



# Options Assessment

- In-reservoir multi-stimulus barrier (bubble, sound, light)
  - Possible installation: suspended from or near the buoy line in the forebay; installation at trashrack would reduce effectiveness due to localized velocities
  - Precedent for multi-stimulus barriers at large widths and relevant depths due to modular layout
  - Similar installations have variable effectiveness by species and location; typically used for guidance, not to block movement.
  - Little to no recreational impact
  - Key uncertainties: effectiveness, anchoring, inspection and maintenance related to biofouling and mussel attachment, power requirements



# Options Assessment

- Deeper water withdrawal
  - Low-level outlet works are located 96 ft below the penstocks which allows for water to be released below epilimnion
  - No concern about new infrastructure and related maintenance
  - No recreational impact
  - Critical uncertainty: no hydropower generation possible, although planning activities are underway for future hydropower generation below minimum power pool



# Next Steps

- Submit final report to Reclamation's Upper Colorado Basin Region by mid-September 2022.
- Recommend convening a group of subject matter experts to:
  - Review options with greatest likelihood of success in more detail.
  - Identify installation layouts and design features, anchoring strategies, anticipated efficacy, timeframe for installation, and initial and ongoing costs.





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