

# Environmental Issues

**Glenn Cada**

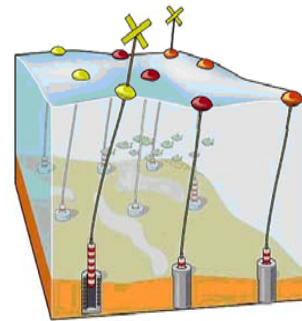
**Oak Ridge National Laboratory**

**R&D Needs for Waterpower Development: A  
Workshop**

**October 29-30, 2008**

# Environmental Issues Common to Conventional Hydropower and Marine/Hydrokinetic Technologies

- **Alteration of currents/river flows/waves**
- **Alteration of bottom substrates, sediment transport, deposition**
- **Alteration of bottom habitats**
- **Alteration of open water (pelagic) habitats**
- **Toxicity of chemicals**
- **Interference with animal movements/migrations**
- **Strike/Impingement/Collision**



# Unique Issues

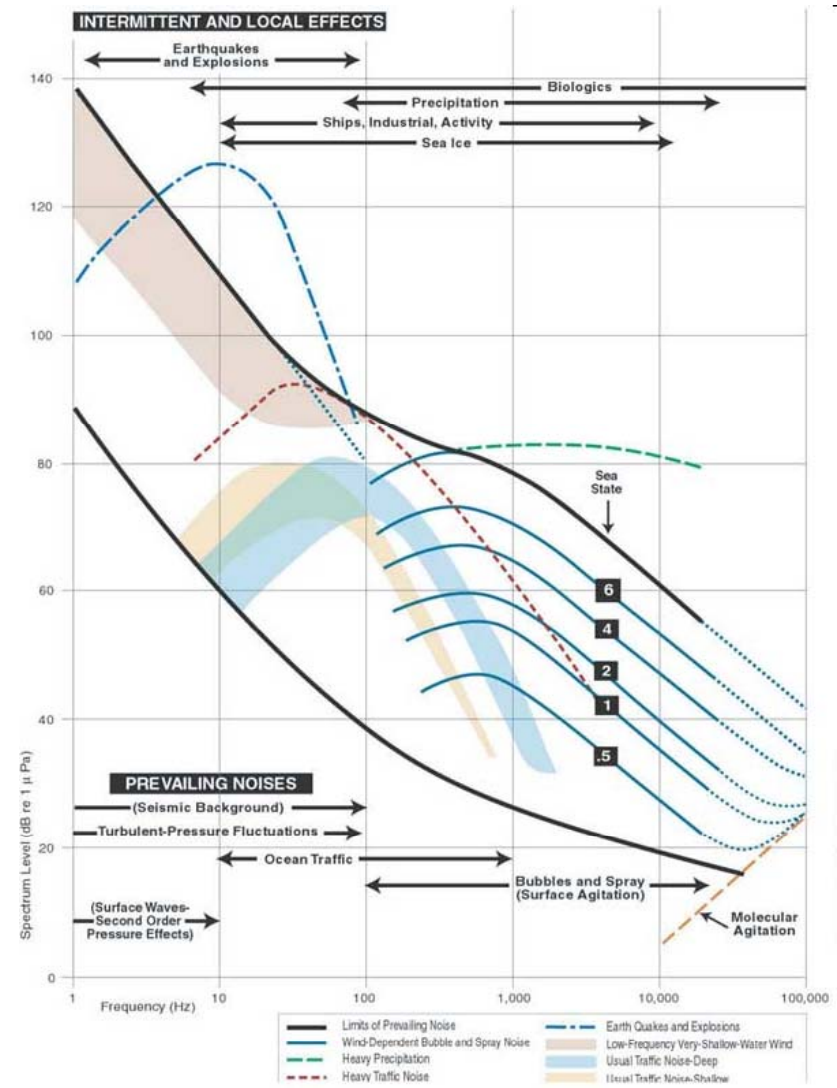
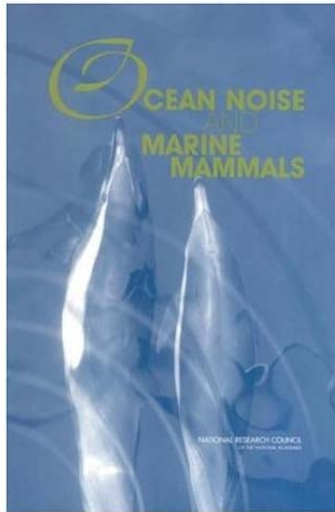
## Hydrokinetic and Ocean Energy Projects

- Noise
- Electromagnetic fields

## Conventional Hydropower

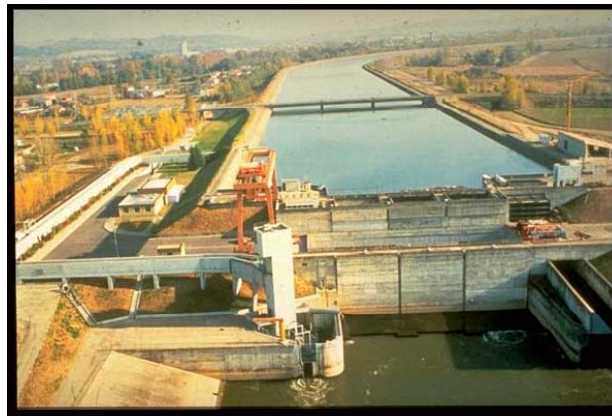
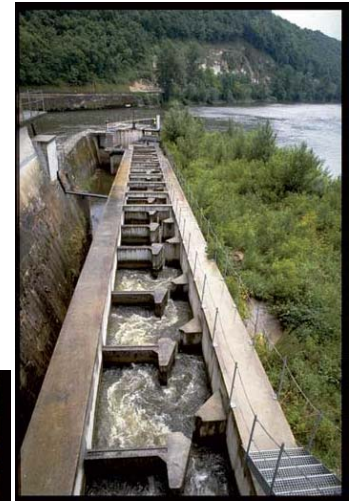
- Water quality (dissolved oxygen, temperature, gas supersaturation)
- Greenhouse gas emissions
- Environmental flow releases
- Flooding terrestrial habitats

# Noise



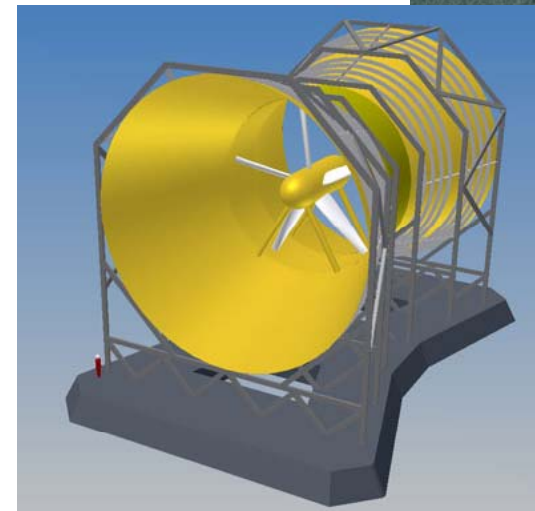
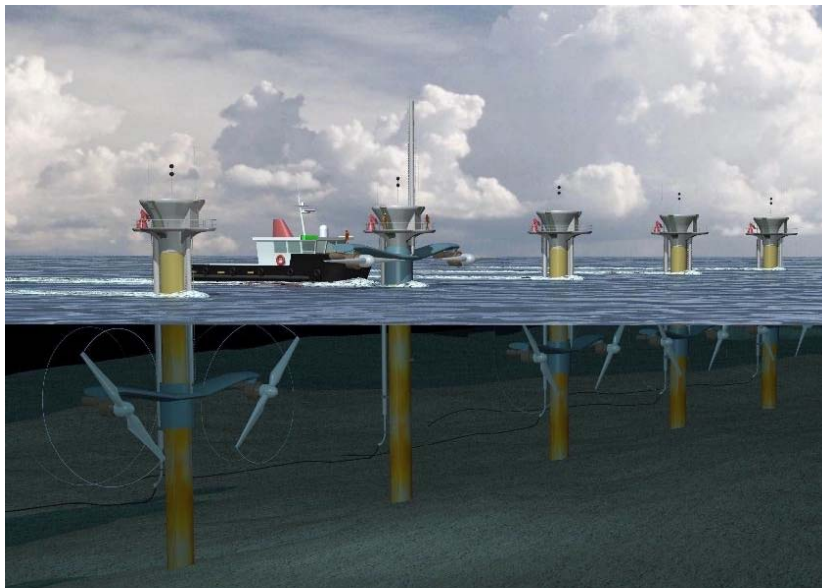
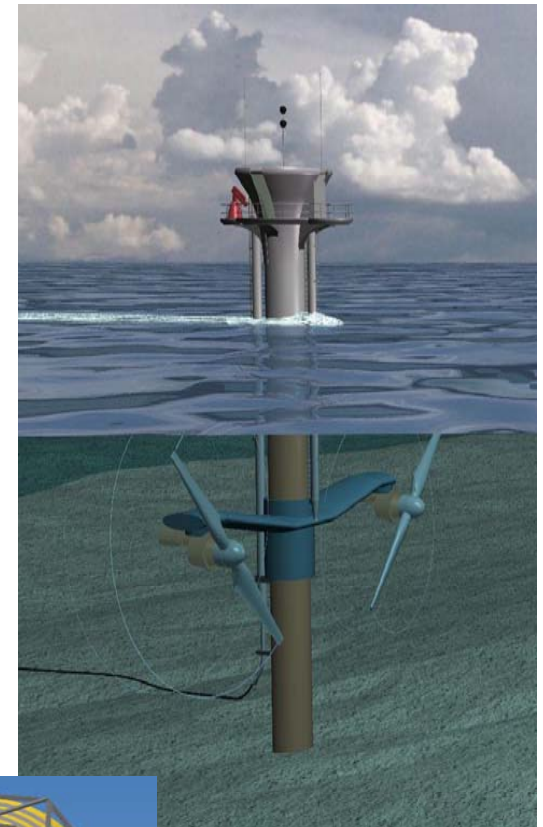
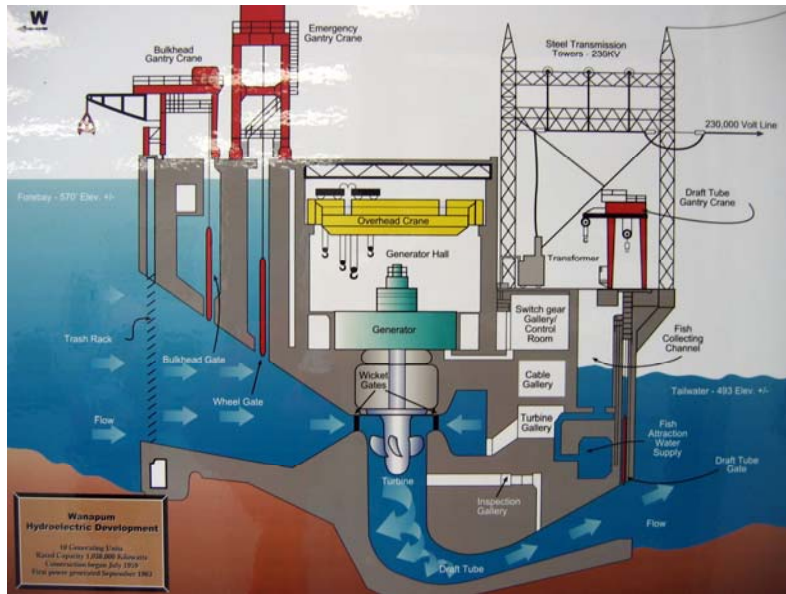
# Passage of Fish and Other Organisms

- **Interference with local movements or migrations**
- **Upstream Passage**
  - Need to know more about the effectiveness of fish ladders, lifts, and nature-like bypasses
  - Fish behavior, swim speeds, abundance
- **Downstream Passage**
  - Effectiveness of fish screens
  - Survival through reservoirs and dam passage routes
  - Overall survival

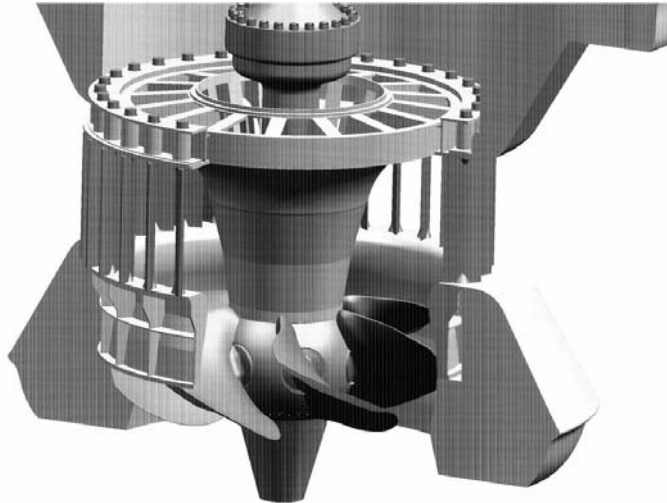




# Strike/Collisions

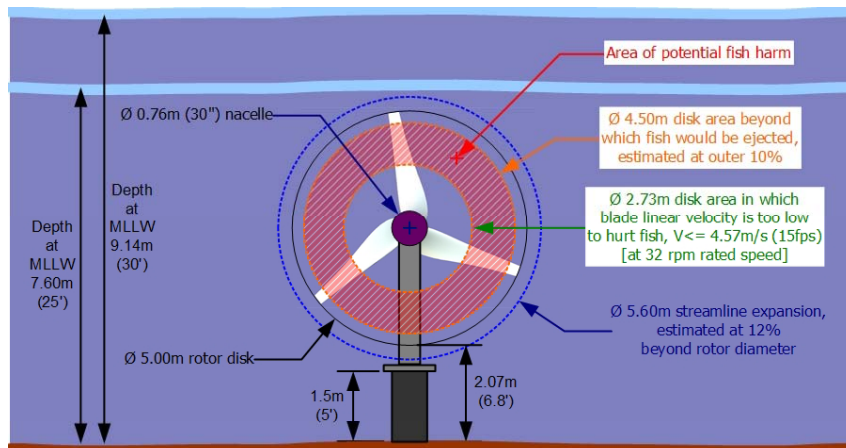


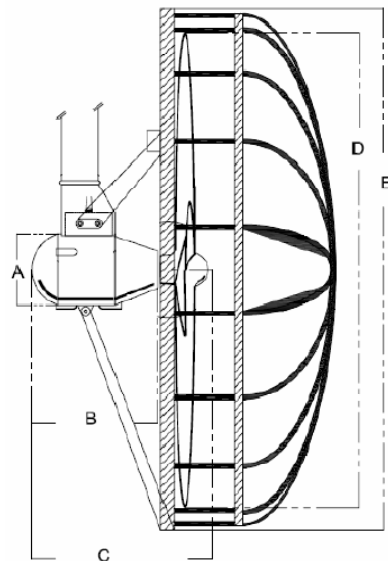
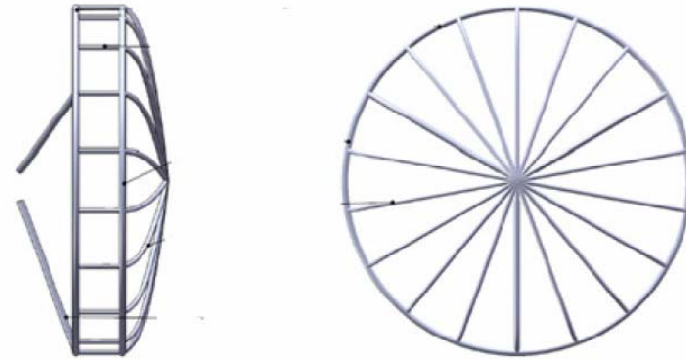
# Blade Strike



- **Important factors affecting blade strike:**

- Number of blades
- Blade design
- Rotation rate
- Water velocity
- Strike location
- Approach angle
- Swim speed
- Size of the animal





From Previsic (2008) – EPRI RP 006 Alaska



# Environmental Research Needs

- **Both Conventional and Ocean / Hydrokinetic**
  - Fish passage
  - Strike/Impingement
  - Cumulative effects of multiple units
  - Minimization and mitigation measures
- **Conventional**
  - Greenhouse gas emissions
  - Dissolved oxygen enhancement
  - Environmental flow releases
- **Ocean / Hydrokinetic**
  - Noise
  - Electromagnetic fields

# Adaptive Management

- **Adaptive management is a system of management practices based on clearly identified outcomes, monitoring to determine if management actions are meeting those outcomes, and, if not, facilitating management changes that will best ensure that outcomes are met or re-evaluated (U.S. Department of the Interior, January 2008)**
  - **CEQ recommended incorporating adaptive management concepts into the NEPA process and Environmental Management Systems**
  - **Many regulatory and resource agencies are adopting an adaptive management approach**
  - **Particularly useful for a new technology that will be developed in steps**
  - **Likely to be a part of license conditions**

# Take Home Messages

- **Conventional hydropower and ocean/hydrokinetic energy systems have several environmental issues in common, and generalized research could be designed to provide answers for both**
- **Environmental issues that are minor for a single unit may become serious as a result of cumulative impacts from multiple units**
- **Adaptive management can be a valuable monitoring approach**