

Evaluation of Mitigation Effectiveness at Hydropower Projects: Fish Passage

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Background

- **Evaluation of mitigation effectiveness was included in the FERC strategic plan for complying with the Government Performance and Results Act of 1993**
- **Present study is one of several FERC studies to evaluate the effectiveness of mitigation requirements included in FERC licenses**
 - **Shoreline management**
 - **Water quality**
 - **Fish passage**
 - **Recreation**

Purpose of Study

- **Assess the effectiveness of mitigation measures for upstream and downstream fish passage at projects licensed between 1987 and 2001**
- **Improve FERC internal practices by ensuring that mitigation measures are both necessary and effective**

Information Sources

Primary: FERC eLibrary database (formerly FERRIS)

- Effectiveness monitoring plans and reports submitted by licensees
- Orders issued by Commission
- Comment letters from resource agencies

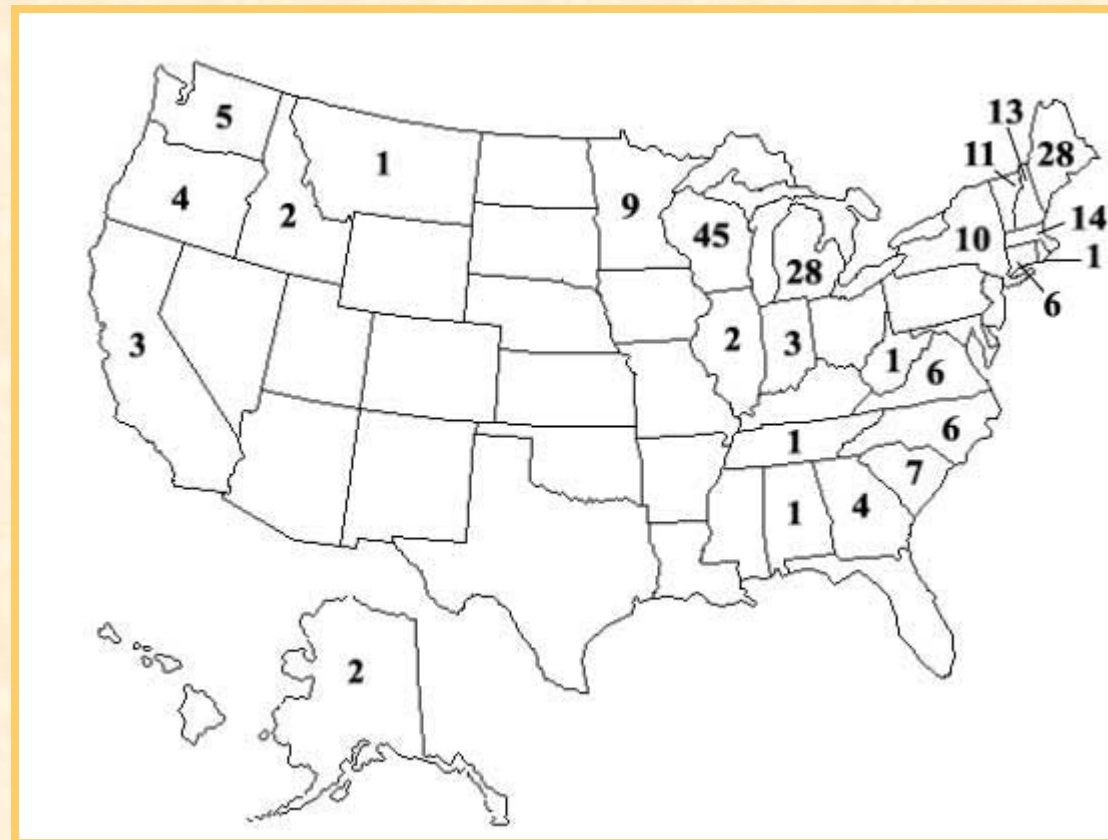
Secondary: Previous mitigation studies

- DOE (1991, 1994)
- Peer-reviewed journal articles

Description of Database: Number of Projects

- **213 projects with at least one fish passage requirement**
 - Comprised 66% of the 324 projects that were licensed during the period 1987-2001
 - 123 of the 213 projects had only the reservation of authority (Federal Power Act, Section 18)
- **90 projects consisting of 108 developments (=dams) constituted the actual database available for analysis**

Geographical distribution of 213 projects with at least one license article that addressed fish passage



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Regional summary of 108 hydropower developments with fish passage requirements in addition to Section 18 authority

Region	No. of Projects	No. of Projects with Settlement Agreements	FISH PASSAGE REQUIREMENTS			
			Upstream Only	Downstream Only	Upstream and Downstream	Effectiveness Monitoring
Northeast (CT, MA, ME, NH, NY, VT)	59	25	6	27	26	45
North Central (MI, WI)	30	25	--	6	24	17
Northwest (AK, CA, ID, OR, WA)	16	4	5	4	7	12
Southeast (GA,VA, WV)	3	1	1	--	2	2
Total	108	55	12	37	59	76

Measuring Effectiveness

- **Used proportion of fish passed upstream or downstream**
- **Requires an estimate of the population available for passage**
 - Number of radiotagged fish released
 - Number of fish passed at downstream dam
- **Radiotagging most commonly employed to assess effectiveness of downstream fish passage**

Characterization of Upstream Fish Passage Facilities

- Mitigation required at 71 of the 108 developments (66%)
- Only 40% of the fish passage facilities are installed (and 71% of these are located in the Northeast)
- Northeast and Northwest regions together account for 94% of the installed upstream fish passage facilities
- Most common installed facilities are lifts/locks and Denil fishways in the Northeast and pool-weir fishways in the Northwest

Effectiveness of Upstream Fish Passage

- **Adequate data to measure effectiveness were available for 3 of the 108 developments, all in the Northeast**
 - No facilities installed at 52% of the developments
 - No effectiveness monitoring required at another 19%
 - 5 of the 108 developments had fish counts but no estimate of the population available for passage
- **Effectiveness ranged from 45 to 67% for 3 anadromous species, based on counts at adjacent dams or mark-recapture study**
 - All three facilities were lifts or locks
 - Effectiveness values are within the range stipulated in the management plan for American shad in the Connecticut River basin

Characterization of Downstream Fish Passage Facilities

- Mitigation required at 96 of the 108 developments (89%)
- Only 41% of the fish passage facilities are installed (and 76% of these are located in the Northeast)
- Northeast and Northwest regions together account for 91% of the installed downstream fish passage facilities
- Most common type of facility (installed and uninstalled) in both the Northeast and Northwest is a sluiceway

Effectiveness of Downstream Fish Passage

- **Adequate data to measure effectiveness were available for 11 of the 108 developments**
 - Results available from 28 studies (93% in Northeast)
 - Radiotagging of Atlantic salmon smolts used to assess effectiveness at 7 of the 11 developments
- **Surface collection with conveyance below the dam was evaluated in 14 of the 28 tests (4 developments)**
 - Same species and similar methods used
 - Effectiveness ranged from 17 to 78% across projects
 - Effectiveness highly variable between years at same project (e.g., 17-59% over 6 years; 17-63% over 4 years)

Effectiveness of Downstream Fish Passage (cont'd)

- **Variability in river flow influenced results**
 - Studies scheduled to avoid periods of spill where possible
 - Bypass effectiveness increased with reduced generating flow (bypass:intake flow ratio important)
- **Other methods of downstream fish passage were evaluated, but data on effectiveness were limited**
 - Effectiveness of spill reached 100% following continuous design modifications over a 3-year period
 - Maximum effectiveness of sluices with louvers (72%) exceeded that of sluices without louvers (27%)
 - Effectiveness of angled bar racks not quantitatively assessed with anadromous species

Effectiveness Monitoring Plans

- Requirement for 76 of the 108 developments (70%)
- Emphasis on monitoring to determine mitigation effectiveness is relatively recent (past 10-15 years)
- Requirement has regional focus that reflects the importance of anadromous fish passage
 - 76% of developments in Northeast
 - 75% of developments in Northwest

Conclusions

- **Effectiveness has been quantitatively evaluated at relatively few projects**
 - Most (at least 70%) licenses require effectiveness monitoring
 - Technology advancement depends upon knowledge gained from monitoring effectiveness of existing facilities
- **Criteria to assess the success of fish passage mitigation were generally not available**
- **Greater variability in the effectiveness of downstream vs. upstream fish passage, reflecting the importance of flow (bypass, generation, spill) as a factor influencing downstream fish passage effectiveness**
- **Upstream fish passage is a mature, well developed technology, but downstream fish passage remains more experimental in approach**

Recommendations

Monitoring

- **Requirements for fish passage should include an effectiveness monitoring plan**
- **Duration of monitoring should be defined**
 - **Can use radiotagging to test effectiveness for 2-4 years, depending upon flow conditions**
 - **May want to continue counts of upstream fish passage (i.e., “monitoring only”) and report annually**

Recommendations

Mitigation

- **Additional information should be obtained on the most effective measures for downstream fish passage**
 - Field applications of new technologies
 - Passage of resident fishes
- **Need well-defined performance criteria to provide an unambiguous measure of the success of fish passage mitigation**