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Abstract: Predation by ring-billed gulls (*Larus delawarenis*) has been identified as a significant threat to migrant steelhead and salmon (*Oncorhynchus* spp.) smolt in the Columbia and Snake Rivers. Bird predation appears highest immediately below hydroelectric facilities. Installation of overhead wire/cable exclusion systems over the tailrace area of 12 dams has been completed to reduce gull predation. Data collected from 1 of the facilities as well as observations from other dams indicate that overhead wire/cable exclusion systems are effective in reducing predation by gulls.

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Key words: exclusion, gulls, *Larus delawarenis, Oncorhynchus,* Pacific Northwest, predation, salmon, Washington, wires.

The Snake River sockeye salmon (*Oncorhynchus nerka*) and the Snake River spring/summer and fall chinook salmon (*O. tshawytscha*) have been listed as endangered by the National Marine Fisheries Service (NMFS). NMFS has designated critical habitat for these species to include reaches of the Columbia and Snake Rivers. NMFS announced that systemic comprehensive status reviews on all species of salmon and anadromous trout species in Washington, Oregon, Idaho, and California were warranted because of the general decline in many West Coast salmonid stocks. Those status reviews will include coho salmon (*O. kisutch*), steelhead (*O. mykiss*), pink salmon (*O. gorbuscha*), chum salmon (*O. keta*), sockeye salmon, chinook salmon, and sea-run cutthroat trout (*O. clarki*). Increased awareness as to the plight of the salmon has led many private and governmental organizations in the Pacific Northwest to take significant steps to promote the preservation and conservation of the fish.

Predation by ring-billed gulls (*Larus delawarenis*) and other gull species has been identified as a significant threat to migrant salmon smolt and steelhead in both the Columbia and Snake rivers (Ruggerstone 1986). Other investigations have suggested that gulls may consume large numbers of salmonids (Mossman 1959, Alexander 1979, Mace 1983). United States Fish and Wildlife Service Breeding Bird Surveys from 1966 to 1991, (U.S. Fish and Wildl. Serv., Laurel, Md., unpubl. data) show ring-billed gull numbers increasing in the Pacific Northwest. Biologists from organizations involved in censusing nesting gull populations on islands in the Columbia River and other biologists involved in gull work believe that ring-billed gull populations are increasing dramatically (Blokpoel and Tessier 1992; D. Pock, Public Utility District No. 1 of Grant County, Ephrata, Wash., pers. commun.).

In the Snake and Columbia rivers, gulls gather below hydroelectric facilities in the spring to feed on downstream migrant juvenile salmonids. The disorienting and stunning effect of passing through turbines makes juvenile salmonids especially vulnerable below dams. The upwelling water carries the fish close to the surface where they are easily caught and consumed by the gulls. A portion of those salmonids consumed are probably killed or injured by the turbines prior to being consumed, however, many of the salmonids are otherwise healthy.

The United States Department of Agriculture, Animal and Plant Health Inspection Service, Animal Damage Control (ADC) was contacted by 12 hydroelectric facilities between 1988 and 1992. Biologists on the dams were concerned with gull predation and asked for assistance from ADC to devise some method of protecting juvenile salmonids from gulls in the high predation areas immediately below dams. The ADC collected data from previous research and experience including overhead monofilament exclusion systems at fish hatcheries and an overhead wire exclusion at a landfill, and then devised plans for overhead wire/cable exclusion systems that would cover the tailrace area of the hydroelectric facilities on the rivers (Ostergaard 1981). Stainless steel wire, because of its durability, was selected over monofilament line, which frequently had to be replaced. Stainless steel wires proved somewhat difficult to work with as they kinked easily. Therefore, stainless steel wire was replaced in later overhead exclusion system projects with 1.19-mm stainless steel cable, which was

much easier to work with and proved more durable.

Overhead wire/cable exclusion systems were constructed to protect salmonids from the turbine deck out as far as the system would allow. The maximum distance was determined by the height of the river bank/common anchor point above the high water level and the height of the anchor points on the dam above the high water level. In most cases, the sag in the wires became a limiting factor after 640 m. All dams required wires to be at least 4 m above the high water line. Ruggerstone (1986) found that most gulls foraged within 75 m of the turbine deck. It is believed that beyond that distance most of the healthy fish have regained their senses and the upwelling effects of the turbulent water have subsided allowing the fish to swim deeper.

Work plans were designed for each facility and varied considerably according to the design of the dam and the configuration of the river at each location. Most commonly an anchor point was established downriver from the dam and one at a time wires were attached to that anchor point and stretched to various locations on the turbine deck of the dam forming a design resembling a fan (Fig. 1). The distance between single wire anchor points on the turbine decks ranged from 11 m to 15 m.

General observations made by biologists associated with the hydroelectric facilities as well as ADC biologists indicated that the overhead wire/cable exclusion systems at the 12 hydroelectric facilities were effective in reducing gull predation on downstream migrating salmonids. However, no spe-

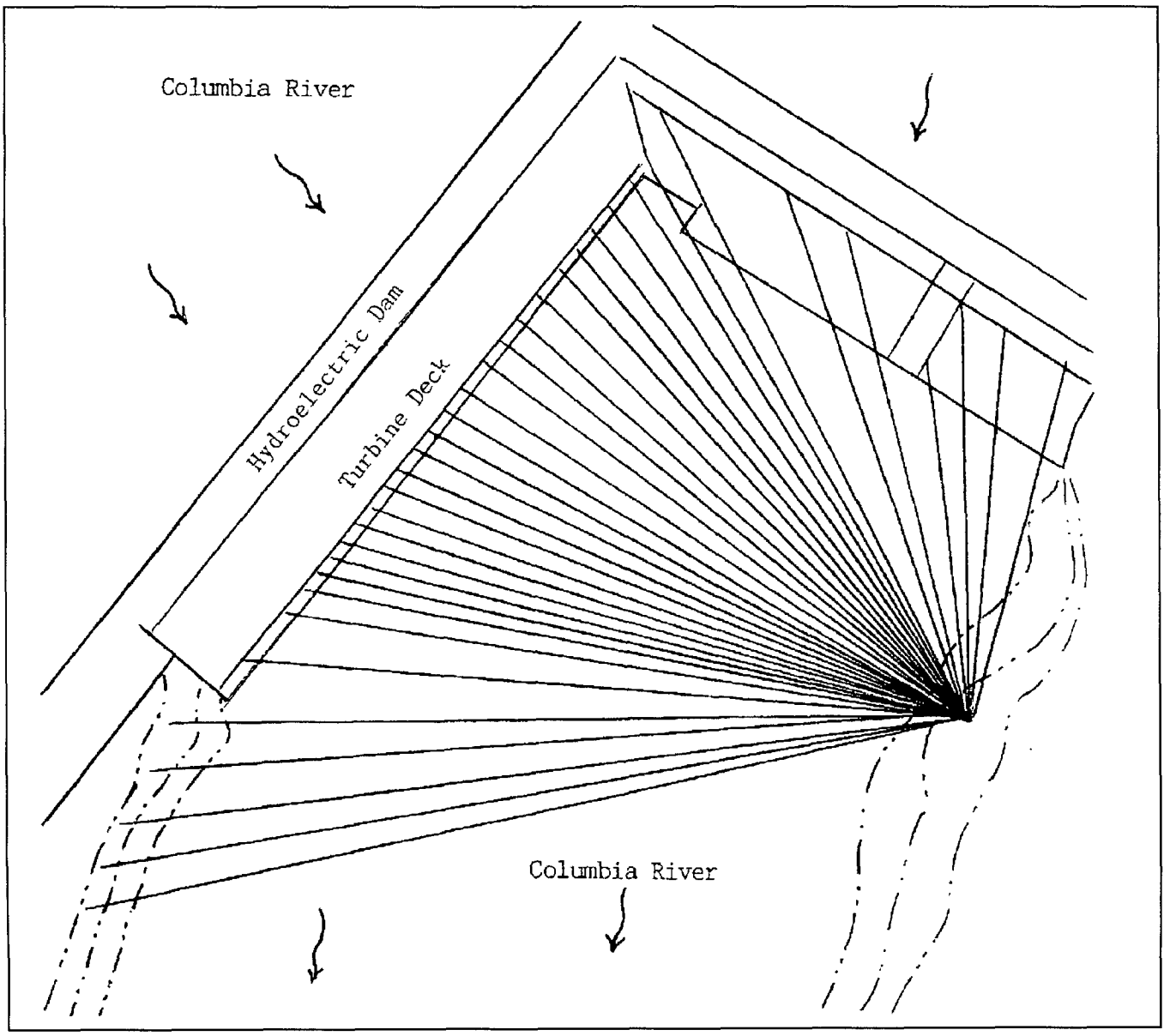

Fig. 1. Illustration of fan-shaped configuration of typical overhead wire exclusion system at hydroelectric facility.

cific data were collected to confirm those observations. The purpose of this investigation was to document the impact of the overhead wire/cable exclusion system at 1 hydroelectric facility (Wells Dam) as it related to gull predation on downstream migrant juvenile salmonids.

Special thanks go to Rick Klinge and Shane Bickford, Fisheries Biologists with Public Utility District (PUD) No. 1 of Douglas County. Both were instrumental in collecting data for this investigation.

STUDY AREA

Douglas County PUD personnel contacted ADC in early 1992 for assistance in alleviating a historical gull predation problem. Ring-billed gulls had previously caused significant predation on downstream migrant salmonids immediately below the Wells hydroelectric dam located on the Columbia River, 19.2 km (12 mi) north of Chelan, Washington. The dam is owned by Douglas County PUD.

METHODS

The observation area below the dam was divided into 4 sections (Fig. 2). Area A began from immediately below the dam to approximately 37.5 m down the river and spanned the entire width of the river. Area B and Area C began at 37.5 m below the dam and extended 60 m down the river. Area B reached from the East bank out to the middle of the river. Area C reached from the West bank to the middle of the river. The area covered by Area B and Area C was divided because of the difference in the number of gulls that had been observed feeding in those areas in the past. Historically, there had always been more gulls observed in the area now designated Area B. Area D began below Areas B and C (approximately 97.5 m from the dam) and included the area visible from that point on down the river. Area D spanned the width of the river.

The observation period began 1 April 1992 and continued through August 1992. It included the peak of downstream juvenile salmonid migration, which correlates directly with the highest number of gulls in the area of the dam. Observers made regularly scheduled observations (1 day/week) from the Operations Room located midway across the dam immediately above the tailrace area. Total numbers of gulls were recorded as well as the number actually feeding in each of the delineated areas.

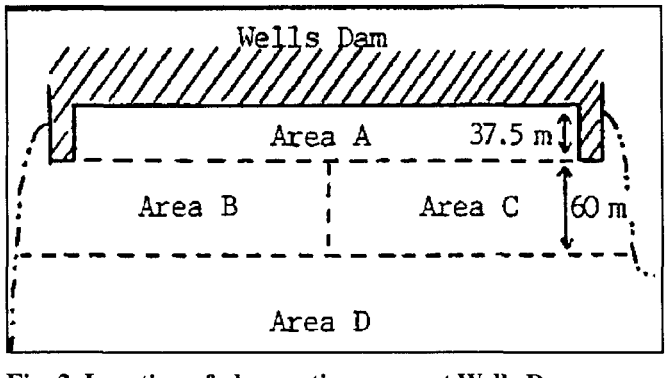

Fig. 2. Location of observation areas at Wells Dam, Washington.

In February 1993, ADC supervised Douglas County PUD personnel in the installation of 18 anchor points for an overhead wire exclusion system below Wells Dam. ADC then installed 9 overhead wires. The wires installed at Wells Dam were stretched straight across the river instead of in a fan-like configuration like many other dams. Five of the wires were placed at 7.5-m intervals and covered the area previously referred to as Area A. Four wires were placed at 15-m intervals over the areas previously referred to as Area B and Area C. There were no wires placed over Area D. The overhead wire exclusion system was in place, 1 April 1993; observations then began and continued through August 1993. Total number of gulls were recorded as well as the number of gulls observed feeding in each of the 4 areas.

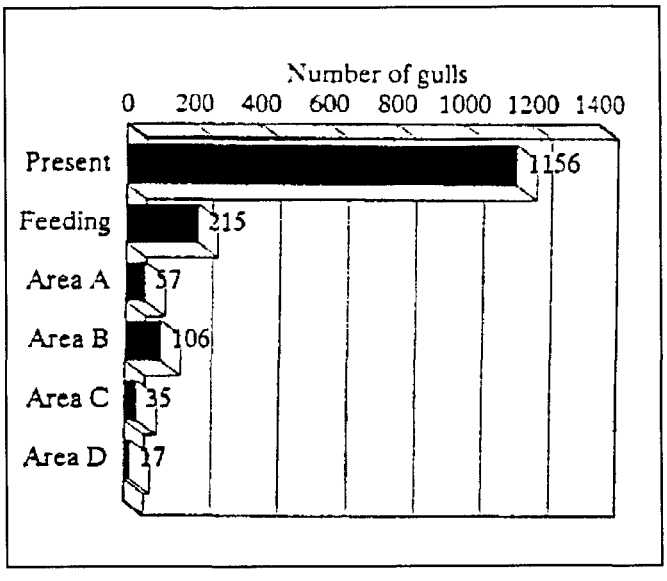

Fig. 3. The total number of gulls present and/or feeding in the tailrace of Wells Dam, Washington with the number of gulls feeding in each area prior to the placement of wires in 1992.

RESULTS

Results from observations in 1992, prior to the installation of the wires, are shown in Figure 3. A total of 1,156 gulls were observed; 215 of these were observed feeding. Of those gulls observed feeding, 27% (57) were in Area A, 49% (106) were in Area B, 16% (35) in Area C, and 8% (17) in Area D.

In 1993, after the installation of the overhead wire exclusion system, a total of 1,340 gulls were observed (Fig. 4) and 134 were observed feeding. Of those feeding gulls, none were observed feeding in Area A, 30% (40) in Area B, none in Area C, and 70% (94) in Area D.

DISCUSSION

Although there were more gulls observed in 1993, there were fewer gulls observed feeding. The results of the data collected show a dramatic decrease in the number of gulls

feeding in Area A, B, and C after installation of the wires. There were no gulls observed feeding in Area A after the 7.5-m wire grid was in place. The number of gulls feeding in Area B and C also decreased dramatically after the wires were in place. However, there were 40 gulls observed feeding in Area B where the wires were placed at 15-m intervals. In the future, it would be interesting to see if wires placed at 7.5-m intervals over Area B and C would further reduce the number of gulls feeding in those areas.

Of the 215 gulls observed feeding before the wires were in place, 92% were feeding in area A, B, or C. After placement of the overhead wires, 30% of the 134 gulls observed feeding were feeding in areas A, B, or C. It appears that the overhead wire/cable exclusion system forced most of the gulls to feed in less desirable Area D, which had comparatively fewer feeding gulls prior to installation of the overhead wires. It was likely that Area D was less desirable to the gulls because of the decrease in turbulence of the water (less upwelling) allowing the healthy fish to swim deeper and hence, become unavailable to the gulls. Overall, there may have been less fish available to gulls in Area D, and the majority of those fish that were still available were likely killed or injured in the turbines. Additional studies are needed to accurately measure the proportion of healthy vs. unhealthy juvenile salmonids consumed by gulls at various distances from the dams.

MANAGEMENT IMPLICATIONS

The cumulative effect of the gull predation at hydroelectric dams was substantial. The ADC has placed overhead wire/cable exclusion systems over the tailrace area of 11 dams on the Columbia and Snake Rivers in addition to Wells Dam. Although we only have documented observations on the Wells Dam Project, wire systems appear to successfully deter gulls from consuming salmonids equally well on all other Dam projects. The overhead wire/cable exclusion systems are a relatively inexpensive method of significantly reducing gull predation on juvenile salmonids. In addition to the application of overhead wire/cable exclusion systems at hydroelectric dam facilities, ADC has successfully adapted these systems to deter gulls from fish hatcheries and other aquaculture facilities as well as water treatment ponds, standing water close to airports, cattle feed storage pits, and roofs of buildings.

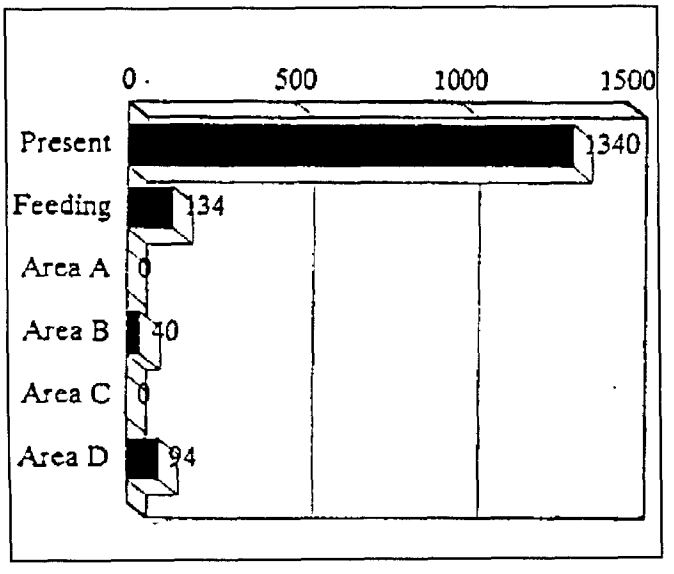

Fig. 4. The total number of gulls present and/or feeding in the tailrace of Wells Dam, Washington with the number of gulls feeding in each area after the placement of the wires in 1993.

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