Evaluation

Use of Green Laser to Deter Avian Predators at the McNary Dam Juvenile Fish Facility Outfall – 2019

Prepared by

C. Peery, Bobby Johnson and Denise Griffith

Walla Walla District, USACE

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Background

Multiple active and passive methods are used to reduce avian predation pressure on juvenile salmonid migrants at dams. At McNary Dam, sprinklers were used to deter birds from congregating near the juvenile fish facility outfall pipe (JFOF) where fish diverted from turbine intakes are returned to the river. Operation of the sprinkler system has been limited in recent years because of debris, damage from high water events and general poor design. In 2018, damage from high water again removed the sprinkler system from operation, prompting the project to consider alternate deterrent systems that could be more easily implemented and maintained. The project decided on a green laser designed to reduce bird damage to crops as a method to deter avian predators at the McNary Dam JFOF in 2019.

Methods

McNary Dam purchased an Autonomic 500 Agrilaser with solar panel power supply. This is a green beam Class 3B laser (<500 mW) with projected coverage of 4.6 square miles (12 km^2) and maximum range of 2.2 miles (3.5 km). The unit was mounted on the north shore navigation guidewall, across the river and approximately 880 ft (268 m) from the JFOF (Figure1). The laser was programmed to move in a random pattern through an area of approximately 10 x 20 yd (9 x 18 m) on the river in front of the end of the JFOF.

The goal of the evaluation was to compare numbers of birds present at and near the JFOF with the green laser on and off, focused during two periods of typical peak bird abundance, 15 April – 15 May and 15 June – 15 July. The study plan included operating the laser in blocks of three days with the laser on for two days and off one day. The off day was be selected at random within each block. However, there were technical difficulties with the original laser and for most of the season it was left on. The laser was replaced in mid-June and operated for a number on/off blocks until 3 July (Table 1). After this date the numbers of birds seen was relatively low and it was decided that there was little benefit to continuing the evaluation and the laser was again returned to continuous operation.

Data collected was the numbers of feeding birds of each species seen in the JFOF area. Point counts were made morning (0445-0630 hrs), noon (1130-1300 hrs) and in the evening (1900-2030 hrs). Numbers of non-feeding birds were not used in analyses because these were primarily birds that were perched on the outfall pipe outside the range of the laser. Observers also recorded the laser condition (on/off) and weather condition (sunny, partly cloudy, overcast and low visibility) as well as the normal variables of date, time and location and if hazing was occurring at time of counts. There were insufficient numbers of terns and cormorants counted during the study blocks to perform analyses. Hazing mostly occurred throughout the observation periods and so was dropped as a variable in the analyses. Sunny days was the only weather condition when feeding gulls and pelicans were fully crossed with laser operation (on/off). Those results will be summarized separately. We used univariate analysis of variance (ANOVA) for each bird species to assess effect of the laser. The final model provided approximately 9 replicate blocks with one response variable (mean bird counts per day), one fixed variable (laser condition) and one covariate (time). We also used figures to visually compare daily counts of gulls and terns for 2019 and the averages from 2014-2018.

Results

The number of feeding gulls and pelicans counted averaged 1.1 and 1.5 per day, respectively, during the study blocks. Gulls averaged 0.0 with the laser on versus 1.5 when off per day in the mornings, 1.3 when on vs. 1.8 when off at mid-day and 1.4 when on vs. 0.9 when off in the evenings. None of these

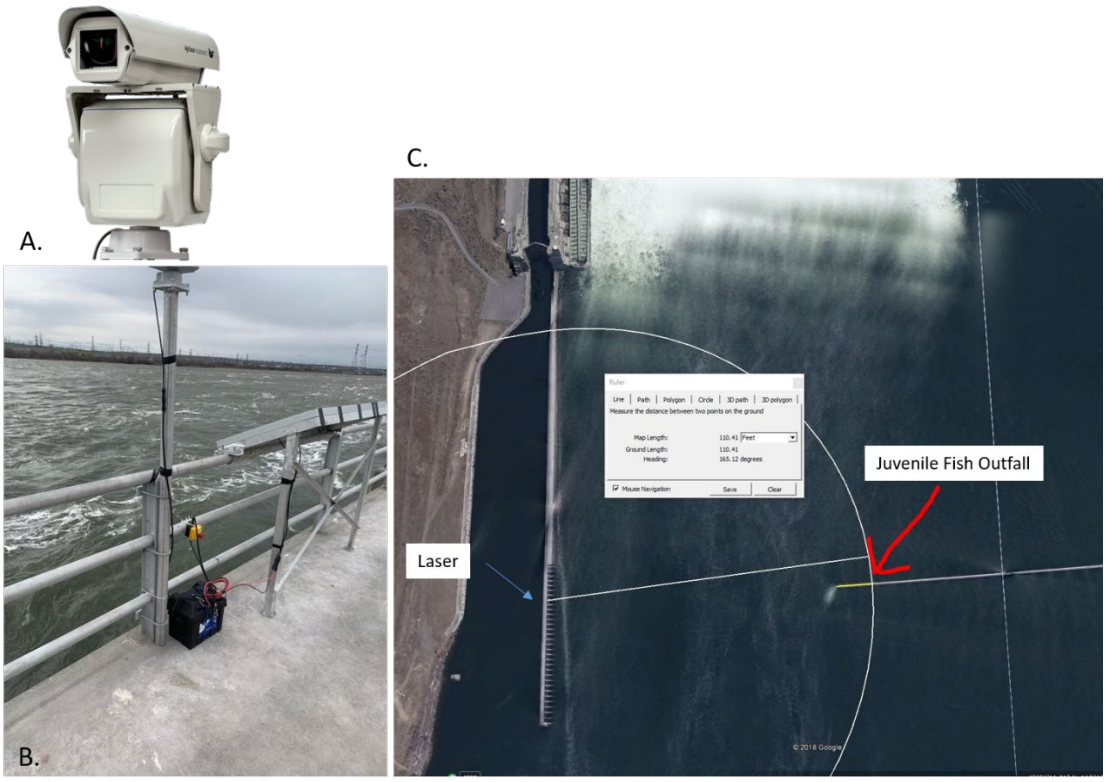

Figure 1. Green laser (A), laser mounting post and solar panel (B) and schematic showing relative positions of laser and JFOF at McNary Dam.

differences were statistically significant (Table 3). There was a significant interaction in numbers of pelicans seen with the laser on and off and time of day but the individual comparisons were significant for laser only in the morning. Pelicans averaged 0.1 with the laser on versus 7.3 with it off in the mornings ($P < 0.016$) and 1.3 when on versus 2.4 per day when off at mid-day ($P < 0.138$). No pelicans were seen at the JFOF in the evenings during the study blocks. On sunny days, there were significantly fewer feeding gulls counted at the JFOF in the mornings when the laser was on (0.0 vs. 4.0 per day; $P<0.017$). No other comparisons were significant (Table 4).

Discussion

Because of malfunctions with the original laser, which was replaced by the supplier mid-season, there were only a few study blocks completed, and those occurred when there were relatively few birds present at the project. During this limited trial, there was some evidence that the green laser reduced the numbers of gull and pelicans in the vicinity of the JFOF, although the effect was significant only for pelicans during the morning observations. Observations made by the project personnel provide insights into factors that influence the effectiveness of the laser. Comparisons between years are challenging because of the potential for confounding factors to influence observations. From a visual inspections of 2019 counts for gulls and terns we see that the days birds were present at McNary Dam were more temporally constrained in 2019 compared to the mean for 2014-2018 but abundances seen per day appeared comparable (Figure 2).

Table 1. Blocks of days with laser on and off used in analysis.

Block	Date	Laser	Block	Date	Laser
1	9-Apr	Off		17-Jun	On
	10-Apr	On	4	18-Jun	On
2	14-Apr	On		19-Jun	Off
	15-Apr	Off	5	20-Jun	Off
3	16-Apr	Off		21-Jun	On
	17-Apr	On		22-Jun	On
	18-Apr	On		23-Jun	On
	19-Apr	On		24-Jun	On
	20-Apr	On	6	25-Jun	On
	21-Apr	On		26-Jun	Off
	22-Apr	On	7	27-Jun	Off
	23-Apr	On		28-Jun	On
	24-Apr	On		29-Jun	On
	25-Apr	On	8	30-Jun	On
	26-Apr	On		1-Jul	Off
	27-Apr	On	9	2-Jul	Off
	28-Apr	On		3-Jul	On
	29-Apr	On		4-Jul	On
	30-Apr	On		5-Jul	On
	1-May	On		6-Jul	On
	2-May	On		7-Jul	On
	3-May	On		8-Jul	On
	4-May	On		9-Jul	On
	5-May	On		10-Jul	On
	6-May	On		11-Jul	On
	7-May	On		12-Jul	On
	8-May	On		13-Jul	On
	9-May	On		14-Jul	On
	10-May	On		15-Jul	On
	11-May	On		16-Jul	On
	12-May	On		17-Jul	On
	13-May	On		18-Jul	On

The original placement for the laser was facing the JFOF from about a quarter of a mile directly across the river. From this distance the laser was easily able to reach the area of the JFOF but, because of the narrow arc of movement, the laser beam appeared to move relatively quickly through the affected area. A laser located closer to the outfall may be more effective at deterring birds. There was also a blind spot directly behind the JFOF where the JFOF structure blocked the laser. This blind spot provides a way for birds to approach the outfall plume without being exposed to the laser. The limited results from this trial also suggests that the laser is less effective during mid-days on sunny days when background lighting is higher but there were insufficient observations across the different weather conditions to draw strong conclusions.

Recommendations

These results suggest that closer placement of the laser and/or use of multiple lasers may better deter birds from the JFOF by providing better coverage from varying angles of approach and by reducing blind spots. As a result, the project will be purchasing a second laser for use during the 2020 outmigration season. At this time the preferred placement for this second unit is on the JFOF facing north and down onto the end or the outfall pipe and in the vicinity of the outfall plume. The evaluation for 2020 with the second laser should be similar to that proposed for 2019 with days with the lasers off when bird counts would be compared to days with lasers operating. At least ten replicate blocks are needed with birds present, equally divided between early (April) and later (June) season for sufficient sample size for these analyses. Counts should again be made morning, noon and evenings to better evaluate light condition on laser effectiveness.

Table 2. Average (top) and standard deviations (bottom) for daily counts of feeding (GullsF) and non-feeding (GullsNF) gulls and feeding (PelF) and non-feeding (PelNF) pelicans observed in the area of the McNary Dam JFOF during the nine study blocks.

Average counts							
	Morning		Noon		Evening		
	Off	On	Off	On	Off	On	All
GullsF	1.5	0.0	1.8	1.3	0.9	1.4	1.1
GullsNF	1.5	0.3	4.3	8.4	7.2	7.2	5.3
PelF	7.3	0.1	2.4	1.3	0.0	0.0	1.5
PelNF	0.0	0.0	0.0	0.3	0.1	0.0	0.1
All	2.5	0.1	2.1	2.9	2.0	2.1	2.0
Standard deviation							
	Morning		Noon		Evening		
	Off	On	Off	On	Off	On	All
GullsF	3.0	0.0	5.0	2.2	2.7	2.3	2.8
GullsNF	2.8	0.7	7.6	9.2	10.6	11.3	8.8
PelF	8.4	0.4	2.4	1.5	0.0	0.0	4.0
PelNF	0.0	0.0	0.0	1.0	0.3	0.0	0.4
All	5.2	0.4	4.8	5.8	6.0	6.2	5.3

Table 3. Two-factor ANOVA results for feeding gulls (top) and pelicans (bottom).

Gulls	Df	Sum Sq	Mean Sq	F	Pr(>F)
Laser	1	1.3	1.306	0.163	0.688
Time	1	0.7	0.663	0.083	0.775
Laser*Time	1	10.31	0.323	1.286	0.261
Residuals	58	465.4	8.024		

Pelicans	Df	Sum Sq	Mean Sq	F	Pr(>F)
Laser	1	72.9	72.91	6.796	0.012
Time	1	137.8	137.83	12.847	0.001
Laser*Time	1	114.8	114.78	10.699	0.002
Residuals	53	568.6	10.7		

Table 4. Mean daily number of feeding gulls (top) and pelicans (bottom) observed during morning, noon and evening counts with the green laser on and off and weather conditions. Empty cells are when the combination of weather and laser operation did not occur during the nine study blocks.

Feeding gulls average counts							
	Morning		Noon		Evening		
Weather	Off	On	Off	On	Off	On	All
Low visibility	0.0						0.0
Overcast	0.0	0.0		0.0	0.0	0.0	0.0
Partly cloudy		0.0	3.8		0.5	4.5	2.4
Sunny	4.0	0.0	0.2	1.5	1.3	0.9	1.1
All	1.3	0.0	1.8	1.3	0.9	1.4	1.1
Feeding pelicans average counts							
	Morning		Noon		Evening		
Weather	Off	On	Off	On	Off	On	All
Low visibility	12.0						12.0
Overcast	11.3	0.0		0.0	0.0	0.0	5.0
Partly cloudy		0.0	2.5		0.0	0.0	0.8
Sunny	0.3	0.2	2.3	1.4	0.0	0.0	0.6
All	7.3	0.1	2.4	1.3	0.0	0.0	1.5

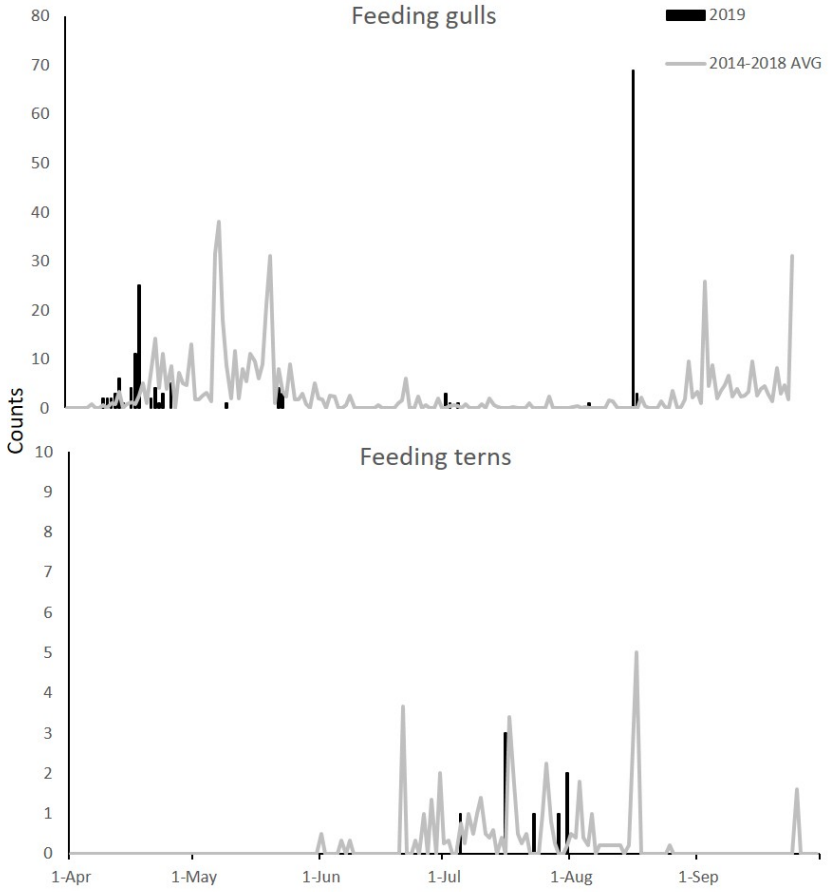

Figure 2. Feeding gulls (top) and feeding terns (bottom) observed at McNary Dam in 2019 (black bars) and mean count for 2014-2018. Similar data for pelicans were not available at this writing.