PERFORMANCE MEASURE INFORMATION SHEET #13

ARROW LAKES RESERVOIR: WILDLIFE

Objective / Location	Performance Measure	Units	Description	MSIC
Wildlife/ Arrow Lakes Reservoir	Nesting Birds	% nesting habitat availability	A measure of the percent of habitat that is not inundated during the nesting season	3%
	Fall Migrating Birds	% migratory habitat availability	A measure of the percent of habitat that is not inundated during the fall migration season	4%

Description

The Revelstoke Wetlands is unique in that it comprises the largest known area of waterbird habitat within the impounded waters of the Columbia River. It provides important wetland habitat for 213 birds species (84 species of waterbirds, 21 birds of prey, and 108 species of land birds), as well as habitat for migratory, breeding and wintering birds, important breeding habitat for the painted turtle and short tailed weasels, and important wintering habitat for ungulates.

The spatial extent, timing and duration of flooding of the Revelstoke Reach of the Arrow Lakes Reservoir are important factors that determine habitat availability and nesting success for birds utilizing this reach. As part of the Columbia River Water Use Planning (WUP) process, a series of models were developed to determine how various operating strategies affect birds in the Revelstoke Reach. A simple metric was initially developed to track the frequency (number of days) at which an operating alternative met preferred conditions for Revelstoke Wetlands to function as a migratory bird stopover. More detailed bird habitat performance measures were subsequently developed to estimate available habitat for a range of migratory shorebirds and breeding birds in Revelstoke Reach.

Performance Measures

A set of parameters was used for modelling the impacts of nest inundation, and calculating habitat availability in the early fall. These were subsequently modified during the Revelstoke 5 and Mica 5/6 environmental assessment processes. These are summarized below.

Parameters for Nesting and Fall Migration Habitat Use

	Grassland Nesting Waterfowl	Late Nesting Waterfowl	Ground Nesting Landbirds	Shrub Nesting Landbirds	Short-Eared Owls	Land Bird Migration	Shorebird Fall Migration	Waterfowl Migration
Start Nest Date	15 Mar	14 May	14 May	14 May	30 Apr	25 Jul	Jul 20	Sep 1
End Nest Date	18 Jun	16 Jul	16 Jul	30 Jul	16 Jul	30 Sep	Sep 15	Nov 15
Peak Nest Date	5 Apr	1 Jun	4 Jun	10 Jun	28 May	28 Aug	Aug 15	Oct 15
Fledge Time (weeks)	9	9	6	6	11	n/a	n/a	n/a
Lower Elevation Range (metre)	434	435	434	436	437	432	434	432
Upper Elevation Range (metre)	440	439	439	440	439	440	439	440

Calculations

The most recent version of the HEC-RAS model for the mid Columbia River was used to estimate water surface elevations throughout the Revelstoke Reach. (Refer to the Mid Columbia River Fish Habitat PM Sheet for a description of the HEC-RAS model).The model is driven by Arrow Reservoir elevations (at Fauquier), discharge from Revelstoke Dam, and estimated local inflows. Water surface elevations are predicted for every week of the year from 1964 to 1973 based on the average local inflow by week, the average reservoir elevation by week, and the minimum or maximum hourly discharge from Revelstoke Dam by week. In this analysis, the maximum hourly discharge is used.

The effects of water surface elevation on bird populations in the Revelstoke Reach of Arrow Reservoir are modeled by predicting nesting success or useable habitat area. Model calculations can be summarized in the following five steps:

1) Nest and fledge parameters for specific groups of birds determine the fraction of nests created per week and the period when nests are vulnerable to flooding, respectively. In the case of migratory (non-nesting) bird groups, the parameters determine the timing of habitat use.
2) Nests are distributed over a defined elevation range, in proportion to the habitat area at each cross section – elevation category (in 0.25 m increments).
3) Average reservoir surface elevation and maximum weekly discharge are used in HEC-model to determine water surface elevation at each cross-section for each week of simulation.
4) Water surfaces are compared to elevation bands over which birds are distributed to determine which bands are flooded on each week.
5) Habitat availability or nest loss is computed from 4) and tallied by year. The model is run for eight different bird groups with different nest and fledge timing parameters and different elevation distributions. This statistic captures both nest loss due to flooding and overall loss of habitat (prior to nests being built).

The model also computes habitat availability for migratory birds that do not nest in the area (migratory landbirds, shorebirds, and waterfowl). The performance metric in these cases is driven only by the extent of unflooded area relative to the timing of migration, and not by loss of nests.

Key Assumptions and Uncertainties

- Each scenario is simulated using the same set of system constraints, input assumptions (e.g., load forecasts) and historic basin inflows (1964-1973).
- The seasons of use, preferred elevation bands are correct for each of the bird groups.
- Assumes that there is no plasticity in nest site selection. If an area is flooded when a breeding pair arrives, the simulation predicts that the birds do not successfully reproduce, rather than moving upslope to dry terrain. This dynamic results in very low survival rates relative to what likely occurs. However, the metric does provide an index of habitat loss, which could have population-level effects due to density dependent processes (e.g., poorer nesting sites are selected at higher densities leading to reduced reproductive success).

Results

The effects of Scenarios A-D on bird performance measures (nest survival or useable habitat) vary among the bird groups (Table 1, Figure 1). There is little difference among scenarios for grassland nesting waterfowl and ground nesting landbirds. However, Scenario D performs worse for land migration, late nesting waterfowls, shorebird fall migration, short-eared owls, and waterfowl migration due to higher reservoir elevations during the spring and summer. Scenario B (3.0 MAF) performs slightly better than A (4.5 MAF) and C (2.0 MAF) for ground nesting landbirds, late nesting waterfowl, short-eared owls, and shrub-nesting landbirds.

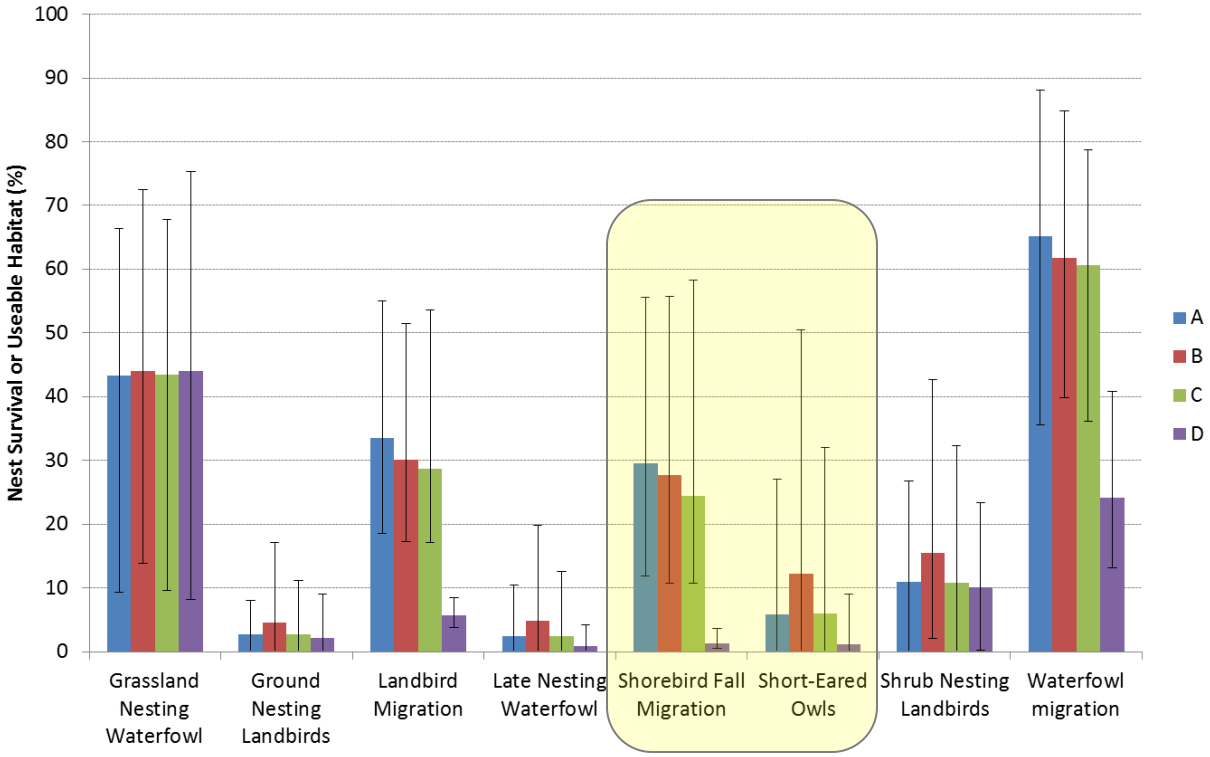

Figure 1. Average Nest Survival (% surviving) or Useable Habitat (% of total) for 8 Bird Groups between 1964 and 1973 across the Four NTSA Scenarios. Error bars show the minimum and maximum values over the 10 simulation years. Yellow-shaded results carried forward to the Consequence Table

Table 1. Statistics on Nest Survival or Useable Habitat (%) for 8 Bird Groups in the Revelstoke Reach of Arrow Reservoir across Four NTSA Scenarios

	Average				Minimum				Maximum			
Bird Group	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**
Grassland Nesting Waterfowl	43.4	44.0	43.5	44.0	9.3	13.8	9.5	8.2	66.3	72.5	67.8	75.3
Ground Nesting Landbirds	2.7	4.5	2.7	2.1	0.0	0.0	0.0	0.0	8.0	17.0	11.2	9.0
Landbird Migration	33.4	30.1	28.6	5.6	18.5	17.2	17.2	3.7	55.0	51.4	53.6	8.4
Late Nesting Waterfowl	2.4	4.8	2.4	0.8	0.0	0.0	0.0	0.0	10.5	19.8	12.6	4.1
Shorebird Fall Migration	29.5	27.7	24.4	1.3	11.9	10.7	10.7	0.5	55.6	55.8	58.3	3.6
Short-Eared Owls	5.8	12.2	5.9	1.2	0.0	0.0	0.0	0.0	27.1	50.5	32.0	9.1
Shrub Nesting Landbirds	11.0	15.5	10.8	10.1	0.1	2.1	0.1	0.2	26.8	42.6	32.3	23.3
Waterfowl migration	65.1	61.8	60.7	24.1	35.6	39.8	36.2	13.1	88.1	84.8	78.7	40.9

	Median				10th Percentile				90th Percentile			
Bird Group	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**
Grassland Nesting Waterfowl	40.1	40.2	40.1	39.2	28.8	29.2	28.8	29.3	65.4	65.8	65.3	68.7
Ground Nesting Landbirds	0.1	2.1	0.1	1.2	0.0	0.0	0.0	0.0	7.5	10.0	8.3	4.1
Landbird Migration	32.7	30.3	26.4	5.4	21.3	19.8	18.9	4.3	44.9	41.2	37.8	7.4
Late Nesting Waterfowl	0.0	0.6	0.0	0.2	0.0	0.0	0.0	0.0	7.6	12.8	10.7	1.9
Shorebird Fall Migration	27.8	25.2	21.5	0.9	13.2	15.9	12.1	0.5	43.3	41.3	35.3	2.6
Short-Eared Owls	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	18.9	33.2	27.6	3.2
Shrub Nesting Landbirds	4.3	12.3	4.3	9.6	1.9	2.3	2.0	1.1	25.8	30.3	27.4	19.4
Waterfowl migration	70.6	63.4	63.7	22.9	39.4	44.3	40.8	20.3	83.8	81.5	78.0	29.0