Columbia River Project Water Use Plan

Kinbasket and Arrow reservoirs Revegetation Management Plan

Effectiveness Monitoring of Wildlife Enhancement Structures in Arrow Lakes Reservoir (Waterfowl Nest Boxes)

Implementation Year 4

Reference: CLBMON-11B5

Annual Monitoring Report

Study Period: April 1, 2021- September 30, 2021

Kingbird Biological Consultants
Revelstoke, BC

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CLBWORKS-30

Monitoring of Waterfowl Nest Boxes in Revelstoke,

2018 - 2021 Nesting Seasons

Kingbird Biological Consultants

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Background

As part of the Water License Requirements (WLR) for the operation of Arrow Lakes Reservoir, Wildlife Physical Works projects were designed to enhance wildlife habitat. The CLBWORKS-30 project focuses on wetland enhancement in Revelstoke Reach area. As part of that project, nest boxes were built and installed in the study area to provide habitat for cavity-nesting ducks. Kingbird Biological Consultants Ltd. (KBC) installed 26 nest boxes in 2013 and 2014 at sites identified by BC Hydro (Appendix 1, Kellner 2013, Kellner 2014). Installation followed standard protocols (Ducks Unlimited 2008). Boxes were first monitored for use by waterfowl or other animals in February 2015, after the boxes had been available for one breeding season (spring/summer 2014). Since that time, monitoring was intermittent – boxes were revisited in fall 2016 for maintenance and assessment of use in the intervening two breeding seasons (2015 and 2016), and again in April 2018 for assessment of use in the 2017 breeding season. In April 2021, the boxes revisited to assess use over 2018, 2019, and 2020. A revised monitoring plan was developed, to check boxes yearly for use by ducks and other wildlife. As part of this program, boxes were again checked in September 2021 to document use in the 2021 breeding season.

Methods

As in previous years, we visited all nest boxes and assessed each box for signs of use by wildlife, including presence of down, feathers, feces, eggshell fragments, membranes, other nesting material, or presence of a nest cup. When boxes had been used by wildlife, any introduced nesting material or soiled wood chips were removed and replaced with ~10 – 15 cm of fresh wood chips to provide clean nesting material (Figure 1). If necessary, the nesting material in unused boxes was topped up. We also checked for and repaired any loose screws in the boxes themselves or loose nails where the boxes were attached to trees. Photos of boxes are available on request.

Figure 1. Used nest boxes contain nesting materials, eggshells, membranes, and unhatched eggs (left). Maintenance involves ensuring boxes are secure, removing soiled material, and replacing wood chips in preparation for the next breeding season (right).

Results

2018-2020

Over the 2018-2020 breeding seasons, there were 13 confirmed nests and 2 probable waterfowl nests in the 23 nest boxes that were available for use by wildlife (Appendix 2). Confirmed waterfowl nests had down, shell fragments, membrane pieces, or entire eggs. Probable nests had remnants of soiled down but confirmation of nesting was impossible because the box doors were open and all other contents had fallen out. One nest had one round, cream unhatched egg ~ 45 mm in length, likely a Wood Duck (*Aix sponsa*) (Figure 1). One dead chick was found in Box 1 along with cream eggshell fragments; this chick is suspected to be Bufflehead (*Bucephala albeola*) (Figure 2).

Figure 2. Single egg found in nest box at Cartier Bay in April 2021 (left); dead chick at Downie March nest box in April 2021 (right).

Eight boxes had signs of use by wildlife other than waterfowl. Two of the boxes had evidence of use by Northern Flickers (*Colaptes auratus*), including nesting or roosting material of moss, lichen, and cedar bark strips. We suspect that these boxes were being used as roosting sites by Northern Flickers, based on the lack of eggs, shells, or membranes. Two boxes had depressions in the shavings, like the start of a nest – these may have been Flicker roost sites as well. One box housed a Northern Flying Squirrel (*Glaucomys sabrinus*), which came bursting out when the box was opened for inspection. Two boxes contained cottonwood leaves, perhaps brought in by squirrels, and one box had a small tunnel in the shavings suggesting use by a mouse.

Although 26 boxes were originally installed, from 2018-2020 two boxes were destroyed when the trees they were attached to were felled by beaver. An additional box had fallen from its tree and was found propped in a nearby tree; it was successfully reattached in April 2021 and was available for use in the 2021 season, bringing the number of available boxes back up to 24.

2021

In the 2021 breeding season, there were 13 confirmed nest boxes used by waterfowl. Nest boxes were used by waterfowl at all sites in 2021 – the Big Eddy (3 boxes), Cartier Bay (3 boxes), Downie Marsh (6 boxes), and the north shore of Montana Bay (1 box). As in previous seasons, confirmed waterfowl nests had down, shell fragments, membrane pieces, or entire eggs. Most nests were assumed to be Wood Duck due to the size and colour of the eggs. One nest box had dark feathers in it and the skull of a chick; this was the same box that had the entire chick in the previous check and was presumed to be Bufflehead. Eight of the thirteen nests had unhatched

eggs, with nests of 1,2,3,7,7,8,9, and 9 eggs. In most cases, the eggs were covered with a layer of down (Figure 3).

Eight boxes had signs of use by wildlife other than waterfowl, including suspect Flicker roosts and feces from a flying squirrel.

Figure 3. Inside of a nest box in fall 2021, with a clutch of unhatched eggs covered in down (left); unhatched eggs and a membrane from a hatched egg in the same nest (right).

Box use by waterfowl over time

There was an increase in the number of boxes used by waterfowl from 2014 to 2021, after eight nesting seasons of the boxes being available (Figure 4, Table 1). In 2021 and over 2018-2020, 15 boxes were used, up from ten used in 2017, nine used in 2015/2016 and four used boxes in 2014, the first season they were available. While most boxes are consistently re-used after being used once, there are six boxes that were used intermittently or used and then not re-used.

Species of waterfowl using the boxes include Wood Ducks and Bufflehead (both confirmed by

finding chicks after 2018/19/20) and Merganser (confirmed at 1 box, 2015 or 2016). However, the majority of eggs are similar in size and colour and suggest that the primary users of the boxes are Wood Ducks.

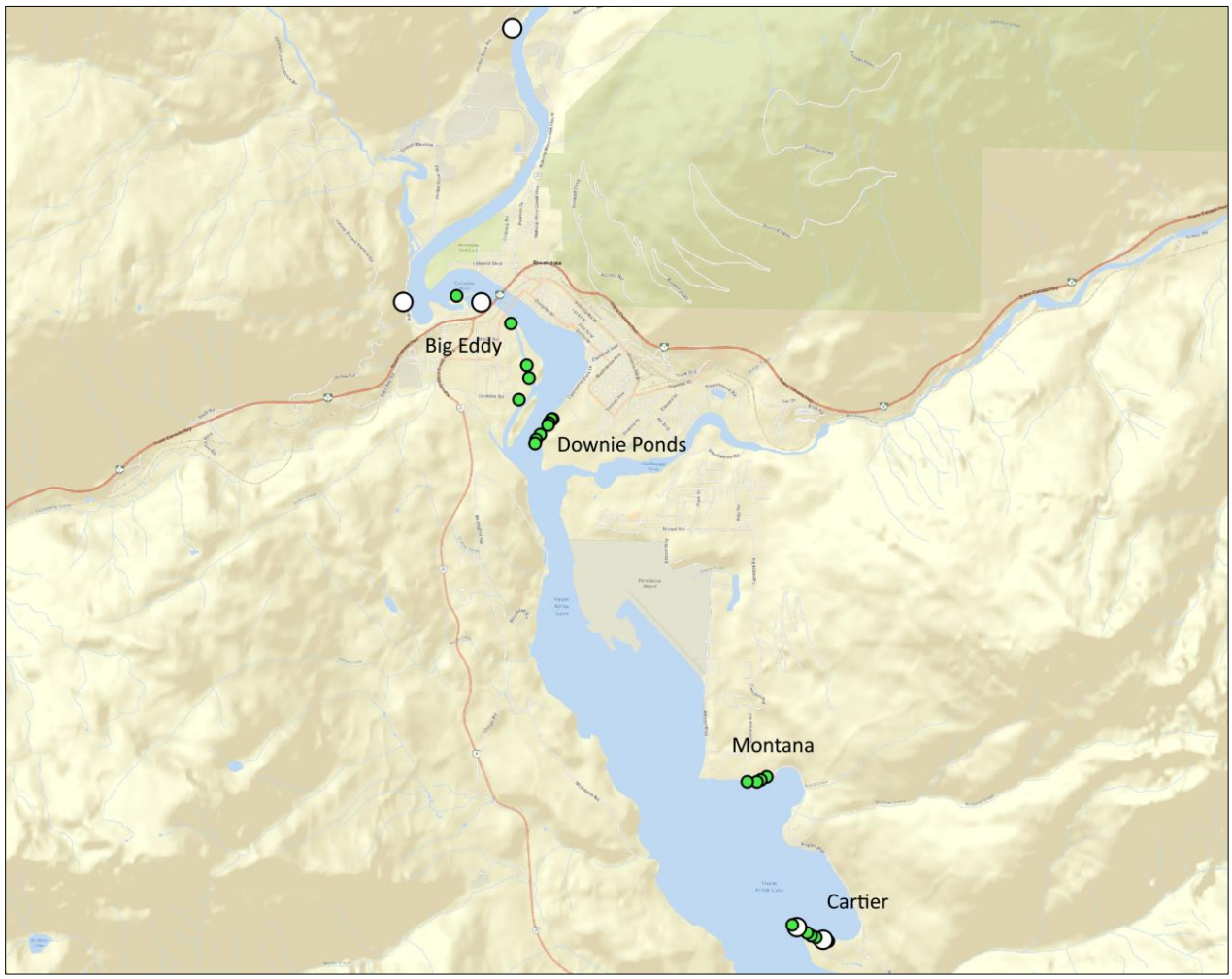

Figure 4. Location of the 26 nest boxes installed in the Revelstoke reservoir drawdown zone and assessed for use. Green markers indicate 21 boxes that were used by waterfowl at any time from 2014 through 2021. White markers indicate the five boxes not used by waterfowl for nesting.

Table 1. Use of nest boxes by waterfowl from 2014 – 2021.

Site	Box ID	Breeding season(s)					Confirmed use from 2014 - 2021
		2014	2015, 2016	2017	2018-2020	2021	
Downie Ponds	1			1	1	1	1
Downie Ponds	2				1	1	1
Downie Ponds	3		1	1	1	1	1
Downie Ponds	4		1	1	1	1	1
Downie Ponds	5			1	1	1	1
Downie Ponds	6		1				1
Downie Ponds	7				1	1	1
Montana	9	1	1	1	n/a	n/a	1
Montana	10	1	1	1			1
Montana	11	1	1	1	n/a	n/a	1
Montana	12	1	1	1	1	1	1
Cartier Bay	13		1	1	1	1	1
Cartier Bay	14						0
Cartier Bay	15				1	1	1
Cartier Bay	16				1		1
Cartier Bay	17				1	1	1
Cartier Bay	18						0
Cartier Bay	19				1		1
Big Eddy	27				1		1
Big Eddy	32						0
Big Eddy	35		1				1
Big Eddy	36						0
Big Eddy	37			1		1	1
Big Eddy	38				1	1	1
Big Eddy	39				1	1	1
Big Eddy	40						0
Number boxes used		4	9	10	15	13	21

Box use by wildlife other than waterfowl

The boxes are also frequently used by wildlife other that waterfowl. From 2014 through 2021, 21 of the 26 boxes were used by other wildlife (Table 2), mostly Northern Flicker and squirrels (Table 3).

Table 2. Use of nest boxes by wildlife other than waterfowl, from 2014 – 2021.

Site	Box ID	Breeding season (s)					Confirmed use from 2014 - 2021
		2014	2015, *2016*	2017	2018-2020	2021	
Downie Ponds	*1*		*1*	*1*			*1*
Downie Ponds	2						0
Downie Ponds	3			1			1
Downie Ponds	4			1			1
Downie Ponds	5			1	1		1
Downie Ponds	6			1		1	1
Downie Ponds	7			1			1
Montana Bay	9		1		n/a	n/a	1
Montana Bay	10				1	1	1
Montana Bay	11				n/a	n/a	0
Montana Bay	12						0
Cartier Bay	13	1	1			1	1
Cartier Bay	14	1			1	1	1
Cartier Bay	15	1	1				1
Cartier Bay	16	1				1	1
Cartier Bay	17	1	1	1			1
Cartier Bay	18	1	1	1	1	1	1
Cartier Bay	19	1	1				1
Big Eddy	27			1	1	1	1
Big Eddy	32						0
Big Eddy	35	1			1	1	1
Big Eddy	36		1	1		1	1
Big Eddy	37		1		1		1
Big Eddy	38	1	1	1			1
Big Eddy	39			1			1
Big Eddy	40		1	1	1		1
Number boxes used		9	11	13	8	9	22

Table 3. Non-waterfowl species found inside nest boxes from 20214-2021, including frequency of use.

Animal	Amount of use
Northern Flicker	frequent use, yearly use of numerous boxes
Flying squirrel	Confirmed in one box at least, used 2+ years
Squirrel – red or flying	Frequent - Multiple boxes, yearly use
Deer mice	Occasional - A few boxes, a few years
Mammalian predator	Occasional – a few boxes in a few years – based on evidence such as Swift wings, carp skull. Marten or weasel?
Vaux's Swift	Rare – Predated remains found in one box in 2017. Maybe predated by marten or weasel??
Owl	Rare - Pellets found in one box in 2017. Suspect Northern Saw-whet *Aegolius acadicus*
Black-capped Chickadee	Rare – possible feathers found in one box one year.

Discussion

CLBWORKS-30 aimed to enhance waterfowl nesting habitat in the Arrow Lakes Reservoir drawdown zone and answer the management questions put forth in the 2017 Terms of Reference (BC Hydro 2017):

MQ1. Are the wildlife enhancement structures (waterfowl nest boxes) effective at enhancing habitat quality and quantity for birds? How are the waterfowl nest boxes utilized by waterfowl in terms of species present and apparent nesting success?

The increasing use of nest boxes since deployment suggests that natural cavities may be limiting or the boxes are preferred by cavity-nesting ducks, and that the boxes are effective at enhancing the habitat quantity and quality. Wood Ducks, Bufflehead, and Mergansers have now been documented as using the nest boxes. Prior to finding a Bufflehead chick in a box used in the 2018, 2019, and/or 2020, Bufflehead had not been confirmed as reproducing around Revelstoke Reach (van Oort and Cooper 2013, van Oort et al. 2014). The boxes are also providing habitat for several other species that are not waterfowl, suggesting that the enhancement project offers additional value to non-target animals in the ecosystem.

Nesting success appears excellent, with the majority of nests successfully hatching each year. There are no data on pre-enhancement nesting success of cavity-nesting ducks for comparison.

Nesting success may have been lower in 2021.The presence of unhatched eggs in the nest boxes is not unusual for wood ducks (www.woodducksociety.com), and could be due to infertile eggs, death during development, or being laid later (perhaps by a different hen). However, in 2021 there eight nest boxes with unhatched eggs; five of these boxes contained seven or more eggs, with a total count of 46 unhatched eggs for the season. The cause of this large number of unhatched eggs is unknown but the 'heat dome' of late June – mid-July is suspect, when temperatures were regularly 30 C and peaked at 35 C in late June. Heat waves may 'bake' eggs, leading to low hatching success (McCowan and Griffith 2021). Alternatively, the cool wet May in 2021 could have impacted the brooding females. Low spring temperature between April 1 and 30 June have been linked to lower nesting success for prairie ducks (Drever and Clark 2007). Whether cool or hot temperatures affected nesting success in 2021, the effects of extreme climatic events on bird reproduction can be expected to increase with ongoing climate change (e.g., Bolger et al 2003, DuRant et al. 2019).

MQ2: Which wildlife enhancement structure methods or techniques (including those not yet implemented) are likely to be most effective at enhancing the productivity and suitability of wildlife habitat in the drawdown zone at Revelstoke Reach?

Nest boxes are an established method for enhancing habitat suitability and availability for cavity-nesting ducks in the absence of old forests and natural cavities (Belrose et al. 1964, Ducks Unlimited 2008). The boxes deployed in this study are proving effective at local enhancement. Potential other actions include protection of old trees, experimental cavity creation (Griffiths et al. 2018), or wildlife tree creation (Todd Manning, pers comm) to encourage woodpecker activity and cavity development; however, given the success of the nest boxes, other actions are not warranted at this time.

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Appendix 1. Location coordinates (Zone 11 UTM and Lat/Long) for 26 duck nest boxes installed in 2013 and 2014 near Revelstoke, BC.

Site	UTM X	UTM Y	Latitude	Longitude
1	415244	5649434	50.99025032	-118.20766082
2	415225	5649433	50.99023414	-118.20792426
3	415188	5649377	50.98972988	-118.20843581
4	415174	5649343	50.98941766	-118.20862642
5	415061	5649206	50.98817588	-118.21020900
6	415000	5649131	50.98749300	-118.21105801
7	414985	5649077	50.98700006	-118.21126521
~~9[a]~~	~~418376~~	~~5644202~~	~~50.94366278~~	~~-118.16186336~~
10	418290	5644157	50.94324997	-118.16307815
~~11~~	~~418233~~	~~5644129~~	~~50.94298954~~	~~-118.16388432~~
12	418091	5644130	50.94297202	-118.16591006
13	419277	5641797	50.92216554	-118.14850353
14	419202	5641818	50.92234072	-118.14958513
15	419096	5641852	50.92263459	-118.15109840
16	419026	5641878	50.92286417	-118.15210280
17	418968	5641919	50.92322275	-118.15293655
18	418818	5642002	50.92394988	-118.15508793
19	418751	5642036	50.92423931	-118.15603978
27	414748	5649715	50.99270110	-118.21479030
32	413053	5651144	51.00529457	-118.23927602
35	413836	5651233	51.00621658	-118.22813102
36	414197	5651138	51.00541729	-118.22297120
37	414630	5650831	51.00271588	-118.21673440
38	414864	5650217	50.99723613	-118.21325172
39	414896	5650035	50.99560216	-118.21274721
40	414650	5655144	51.04149953	-118.21745574

[a] Boxes 9 and 11 were destroyed when the trees were felled by beaver.

Appendix 2. Details on use of nest boxes by waterfowl and other wildlife, in 2018-2020 and 2021 breeding seasons

Site	Box	Breeding season	Use by waterfowl	Use by other wildlife
Downie Marsh	1	2018-2020	yes[1]	no
Downie Marsh	1	2021	yes	no
Downie Marsh	2	2018-2020	probable	
Downie Marsh	2	2021	yes	no
Downie Marsh	3	2018-2020	yes	
Downie Marsh	3	2021	yes	no
Downie Marsh	4	2018-2020	yes	
Downie Marsh	4	2021	yes	no
Downie Marsh	5	2018-2020	yes	Flicker roost - flicker feather inside

Site	Box	Breeding season	Use by waterfowl	Use by other wildlife
Downie Marsh	5	2021	yes	no
Downie Marsh	6	2018-2020	unknown	box down, reinstalled for 2021
Downie Marsh	6	2021	no	Flicker roost?
Downie Marsh	7	2018-2020	yes	no
Downie Marsh	7	2021	yes	no
Montana	9	2018-2020	unknown	box destroyed
Montana	10	2018-2020	no	mouse? - hole in shavings
Montana	10	2021	no	Flicker roost?
Montana	11	2018-2020	unknown	box destroyed
Montana	12	2018-2020	probable	
Montana	12	2021	yes	no
Cartier Bay	13	2018-2020	yes	no
Cartier Bay	13	2021	yes	Flicker? Squirrel? Moss
Cartier Bay	14	2018-2020	no	Flicker roost - moss
Cartier Bay	14	2021	no	Flicker? Squirrel? Moss
Cartier Bay	15	2018-2020	yes	no
Cartier Bay	15	2021	yes	no
Cartier Bay	16	2018-2020	yes	no
Cartier Bay	16	2021	no	Flicker roost?
Cartier Bay	17	2018-2020	yes	no
Cartier Bay	17	2021	yes	no
Cartier Bay	18	2018-2020	no	flying squirrel - inside
Cartier Bay	18	2021	no	flying squirrel - feces
Cartier Bay	19	2018-2020	yes	no
Cartier Bay	19	2021	no	no
Big Eddy	27	2018-2020	yes	squirrel? Dry leaves
Big Eddy	27	2021	no	Flicker roost?
Big Eddy	32	2018-2020	no	no
Big Eddy	32	2021	no	no
Big Eddy	35	2018-2020	no	squirrel?
Big Eddy	35	2021	no	Flicker roost?
Big Eddy	36	2018-2020	no	no
Big Eddy	36	2021	no	Flicker roost?
Big Eddy	37	2018-2020	no	squirrel? Dry leaves, cottonwood fluff inside
Big Eddy	37	2021	yes	
Big Eddy	38	2018-2020	yes	no
Big Eddy	38	2021	yes	no
Big Eddy	39	2018-2020	yes	
Big Eddy	39	2021	yes	no
Big Eddy	40	2018-2020	no	Flicker roost?
Big Eddy	40	2021	no	no

[1] Species is unconfirmed; the buff-coloured eggs and medium size suggest Wood Duck EXCEPT for Box 1, which had a dead chick, identified as bufflehead.