Columbia River Project Water Use Plan

Kinbasket and Arrow Reservoirs Revegetation Management Plan

Effectiveness Monitoring of Wildlife Enhancement Structures in Arrow Lakes Reservoir

Implementation Year 5

Reference: CLBMON-11B5

Monitoring of Waterfowl Nest boxes in Revelstoke Reach

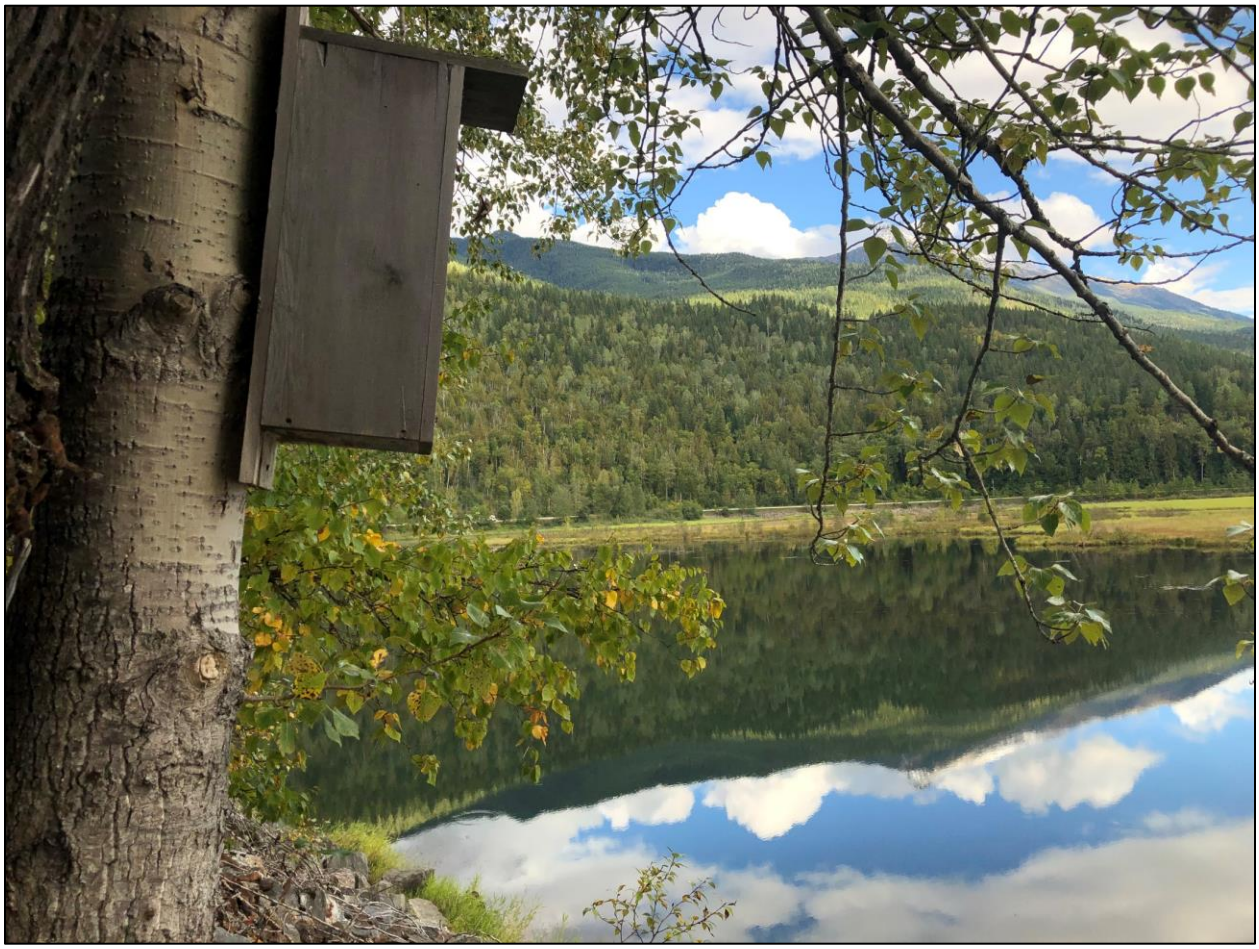
Study Period: 2022

Kingbird Biological Consultants

November 4, 2022

Monitoring of Waterfowl Nest Boxes in Revelstoke (CLBMON-11B5),

2022 Nesting Season



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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 (Arrow Lakes Reservoir Wildlife Enhancement Program (CLBWORKS-30A) focuses on wetland enhancement in Revelstoke Reach area. As part of that program, 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). A monitoring program to document use by waterfowl or other animals began in February 2015, after the boxes had been available for one breeding season (spring/summer 2014). As part of this ongoing monitoring program, boxes were again checked in September 2022.

Methods

Assessing use by waterfowl / other wildlife

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, eggs, eggshell fragments, membranes, other nesting material, or presence of a nest cup (Figure 1). 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. 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 and ensured door latches were secure and doors could be firmly closed.

Timeline of monitoring trips

Nest box monitoring was not done regularly during the beginning of the monitoring program (Table 1). The timing of several nest box inspections meant that findings could not be assigned to an exact year; use may have occurred in one or more of the nesting seasons assessed during that visit. A revised monitoring plan in 2021 will ensure that monitoring occurs yearly up to and including 2024.

Table 1. Timing of nest box inspections and the nesting seasons that use of the box may have occurred in.

Month and year of inspection	Nesting season(s) assessed
Feb 2015	2014
Nov 2016	2015-2016[1]
Apr 2018	2017
Apr 2021	2018-2020[1]
Sep 2021	2021
Sep 2022	2022

[1] Use of boxes could not be attributed to a specific nesting season so a range of seasons are given.

Availability of nest boxes

Although 26 boxes were originally installed, from 2018-2020 two boxes were destroyed when the trees they were attached to were felled by beaver. In 2022, two additional boxes were inspected that were not considered available for waterfowl in 2022. These boxes had the side doors open, and all the wood chip bedding was on the ground. This brought the number of boxes available for nesting in 2022 down to 22 boxes. Additional hardware was used to ensure these doors stayed securely latched and bring the number of boxes back to 24 available for 2023.

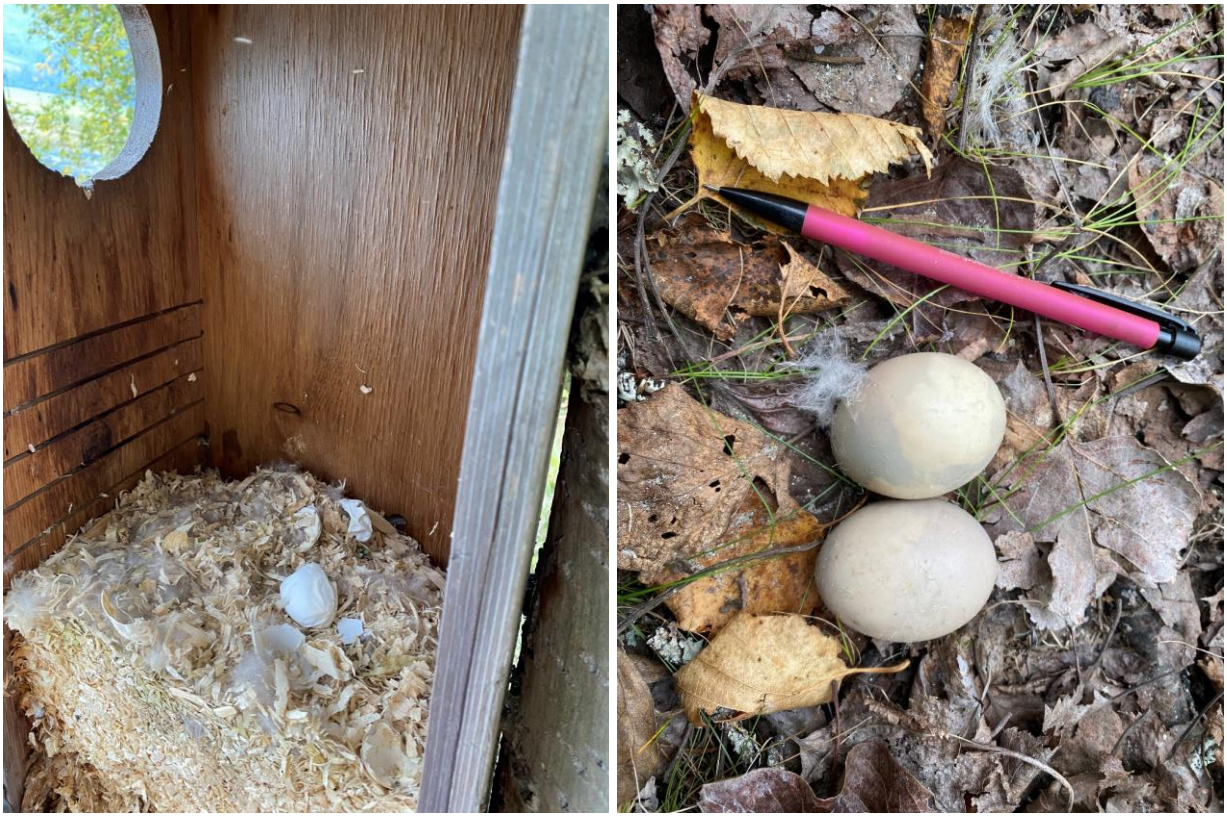


Figure 1. Used nest boxes contain nesting materials, eggshells, membranes (left), and unhatched eggs (right).

Results

2022 nesting season

In the 2022 nesting season, there were 11 confirmed duck nests in the 22 boxes available for use by wildlife (50% occupancy, Appendix 2). Confirmed waterfowl nests had down, shell fragments, membrane pieces, entire eggs, or in one case, a dead chick. All the eggs found appeared similar – round, cream coloured, and ~48-50 mm (Figure 1) – likely Wood Duck (*Aix*

sponsa), or possibly Bufflehead (*Bucephala albeola*). The chick was black and white but unfortunately too decomposed to identify as Wood Duck or Bufflehead (Figure 2).

Four boxes had signs of use by wildlife other than waterfowl in 2022. One box had a depression and fluffy fine cedar strips and is suspected to have been a roost of a Northern Flicker (*Colaptes auratus*), including nesting or roosting material of moss, lichen, and cedar bark strips. Three other boxes had no obvious depression but contained various bedding materials including moss and lichen (1 box, Figure 2), cottonwood leaves (1 box) and cedar bark threads and synthetic fluff (1 box). These materials may have been brought in by squirrels for bedding, although there were no additional clues to support identification.

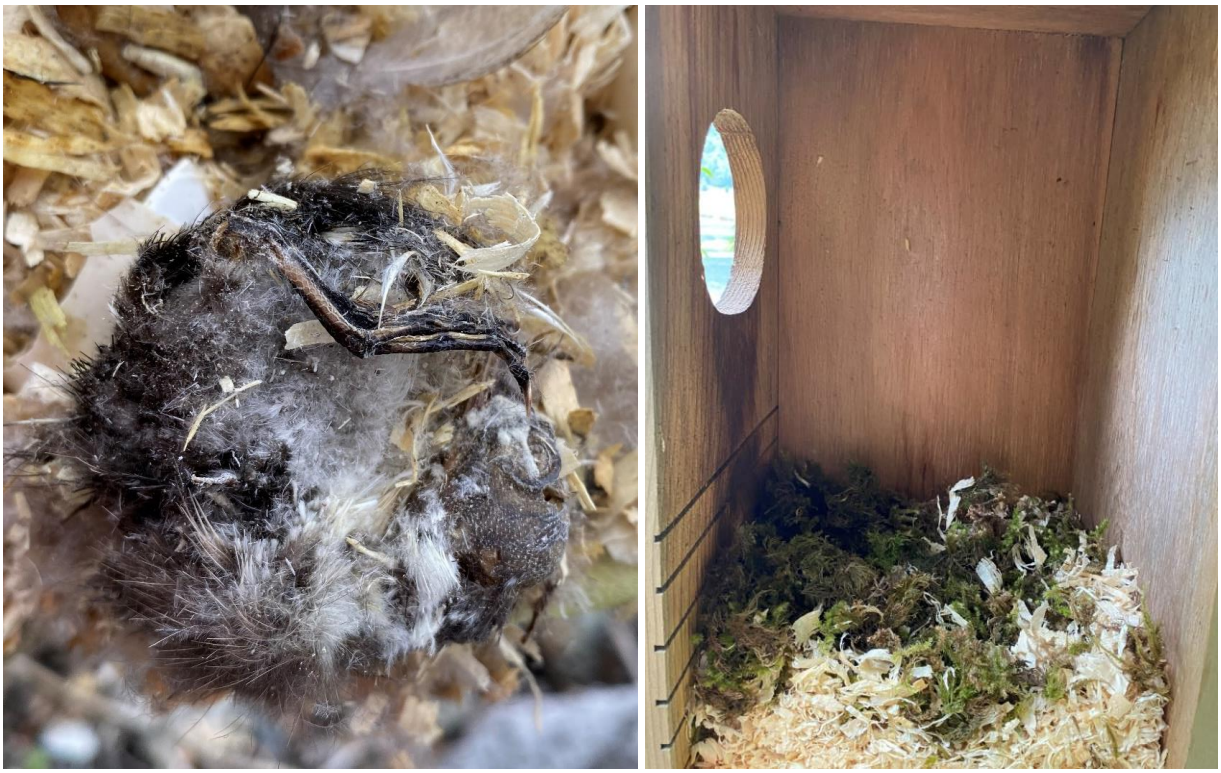


Figure 2. The remains of a dead chick at a Montana Bay nest box in September 2022 (left), and moss brought in by other wildlife (right).

Nest boxes over time

Species present

Across all years, three species of waterfowl have been confirmed using the boxes – these are Wood Duck, Bufflehead (both confirmed by finding chicks after 2018/19/20), and Merganser (*Mergus 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. The boxes are also frequently used by wildlife other that waterfowl, mostly Northern Flicker and squirrels (Table 2).

Table 2. Non-waterfowl species found inside nest boxes from 20214-2022, 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.

Use of nest boxes over time

Use of boxes increased over the first few years that boxes were available (Table 3). From 2014 through 2022, 22 of 26 boxes have been used by waterfowl at least once (Figure 3) and 21 of the 26 boxes were used by other wildlife at least once (Table 4). While most boxes are consistently re-used after being used once, there are eight boxes that were used intermittently or used and then not re-used by waterfowl. Four nest boxes have never been used by waterfowl; however, three of these have been used by other wildlife, leaving only one box where there has been no documented evidence of use by animals.

Table 3. Use of nest boxes by waterfowl from 2014 – 2022.

Site	Box ID	Breeding season(s)						Confirmed use from 2014 - 2022
		2014	2015, 2016	2017	2018-2020	2021	2022	
Downie Marsh	1			1	1	1	1	1
Downie Marsh	2				1	1	1	1
Downie Marsh	3		1	1	1	1	1	1
Downie Marsh	4		1	1	1	1		1
Downie Marsh	5			1	1	1	1	1
Downie Marsh	6		1				1	1
Downie Marsh	7				1	1	1	1
Montana	9	1	1	1	n/a	n/a	n/a	1
Montana	10	1	1	1			1	1
Montana	11	1	1	1	n/a	n/a	n/a	1
Montana	12	1	1	1	1	1	n/a *	1
Cartier Bay	13		1	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	n/a*	1
Cartier Bay	18						1	1
Cartier Bay	19				1		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	1
Big Eddy	40							0
Number boxes used		4	9	10	15	13	11	22

n/a* = box door open, no nesting material remaining inside

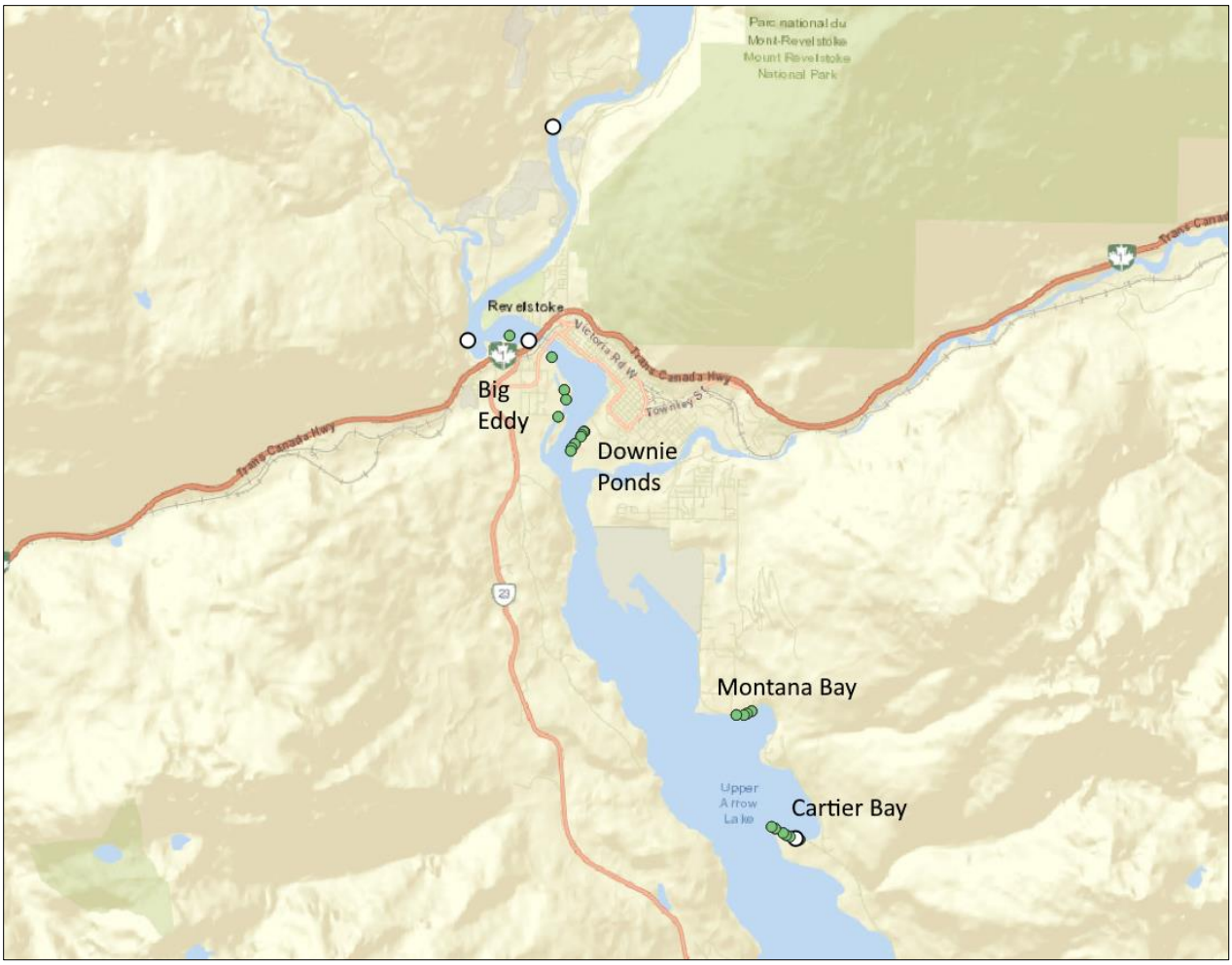


Figure 3. Location of the 26 nest boxes installed in the Revelstoke reservoir drawdown zone and assessed for use. Green markers indicate 22 boxes that were used by waterfowl at any time from 2014 through 2022. White markers indicate the four boxes that have never been used by waterfowl for nesting.

Table 4. Use of nest boxes by wildlife other than waterfowl, from 2014 – 2022.

Site	Box ID	Breeding season (s)						Confirmed use from 2014 - 2022
		2014	2015, *2016*	2017	2018-2020	2021	2022	
Downie Marsh	*1*		1	1				*1*
Downie Marsh	2							0
Downie Marsh	3			1				1
Downie Marsh	4			1				1
Downie Marsh	5			1	1			1
Downie Marsh	6			1		1		1
Downie Marsh	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	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	1
Big Eddy	32							0
Big Eddy	35	1			1	1	1	1
Big Eddy	36		1	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	4	22

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, as indicated by hatching of eggs, appears excellent, with the majority of birds in nests successfully hatching most of the eggs in them each year. There are no data on pre-enhancement nesting success of cavity-nesting ducks for comparison.

Nesting success was 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 in the laying period (perhaps by a different hen). However, after the 2021 breeding season there were 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).

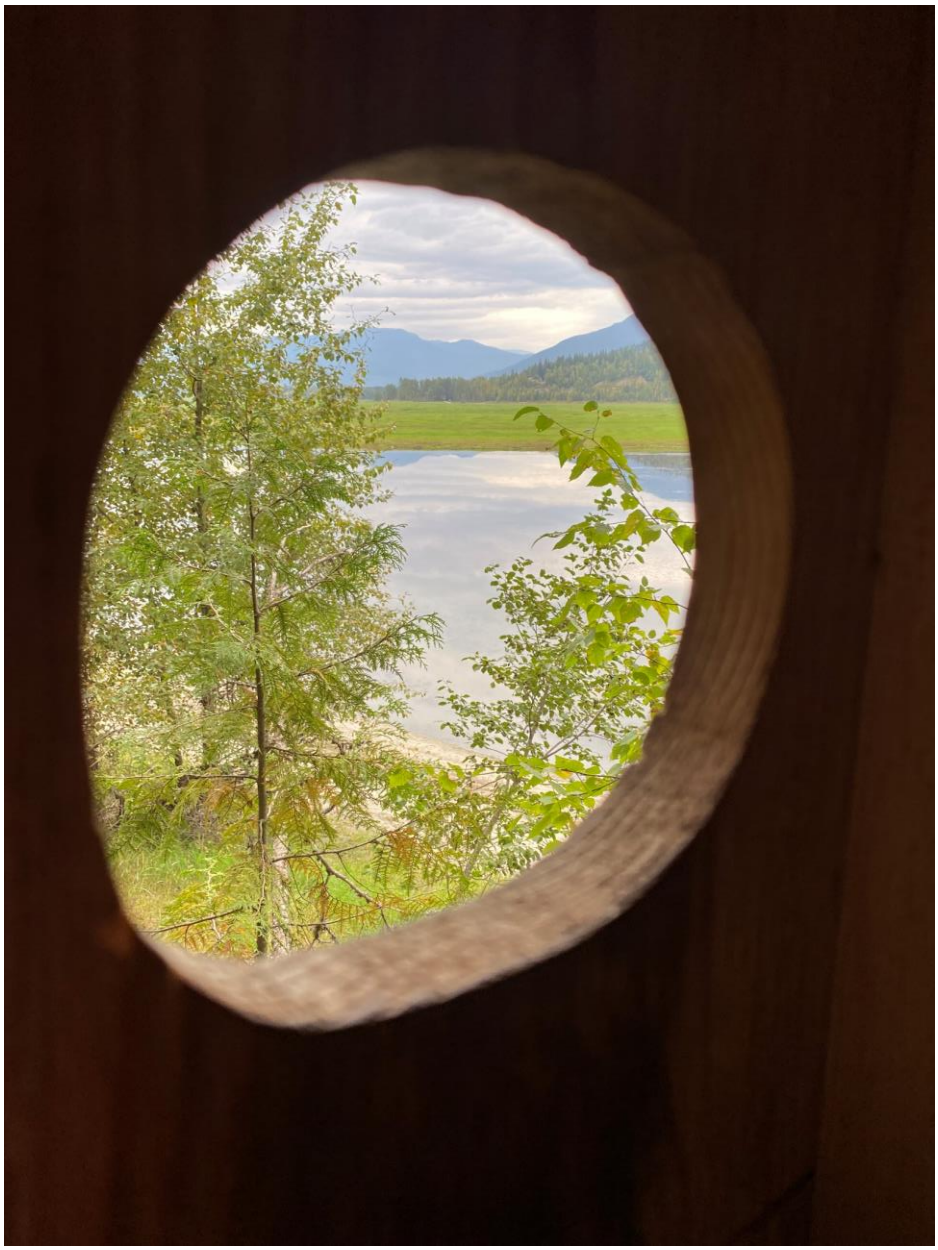
In 2022, in spite of a record-breaking cold and wet June, nesting success appeared to return to pre-2021 levels, with few nests containing unhatched eggs.

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 and provided nest sites immediate upon installation. However, boxes are showing signs of aging and will require more maintenance or replacement as time goes on to ensure the boxes continue to provide quality nesting habitat.

Recruitment of large-diameter trees and natural cavities over the longer term will help reduce

the long-term need for artificial nest boxes. Potential other actions to ensure a supply of large trees and cavities int eh future 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. Investigating options to increase the longer-term supply of natural cavities in the region is recommended, but in the immediate- and short-term, nest boxes continue to be an effective method for enhancing nesting habitat in the drawdown zone of Revelstoke Reach.



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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 the 2022 breeding season

Site	Box	Breeding season	Use by waterfowl	Use by other wildlife
Downie Marsh	1	2022	yes	no
Downie Marsh	2	2022	yes	no
Downie Marsh	3	2022	yes	
Downie Marsh	4	2022	no	no
Downie Marsh	5	2022	yes	no
Downie Marsh	6	2022	yes	no
Downie Marsh	7	2022	yes	no
Montana	10	2022	yes	no
Montana	12	2022	no	no
Cartier Bay	13	2022	yes	no
Cartier Bay	14	2022	no	lots of moss, tiny bit of lichen - squirrel?
Cartier Bay	15	2022	no	no
Cartier Bay	16	2022	no	no
Cartier Bay	17	2022	no	no
Cartier Bay	18	2022	yes	no
Cartier Bay	19	2022	yes	no
Big Eddy	27	2022	no	Flicker roost?
Big Eddy	32	2022	no	no
Big Eddy	35	2022	no	layers of cottonwood leaves - squirrel?
Big Eddy	36	2022	no	fine cedar strands and synthetic fill, no bird down - squirrel?
Big Eddy	37	2022	no	no
Big Eddy	38	2022	no	no
Big Eddy	39	2022	yes	no
Big Eddy	40	2022	no	no