Wood duck use of Nesting Boxes along Rock Island Reservoir in 2017

ANNUAL REPORT

Photo by Matt Phillips

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Introduction

The Public Utility District No. 1 of Chelan County (Chelan PUD) provides, maintains, and monitors wood duck (Aix sponsa) nest boxes along Rock Island Reservoir in the vicinity of Wenatchee, Washington. This was the 35th year of the program that Chelan PUD began in 1983.

In January 1989, the Federal Energy Regulatory Commission issued a new license for the Rock Island Hydroelectric Project. Article 407 of that license required Chelan PUD to monitor the use of wood duck nest boxes along Rock Island Reservoir for two years. In that two-year study (Fielder 1991), Chelan PUD recommended actions for future wood duck management along the reservoir. Those actions included maintaining a minimum of 60 nest boxes annually, continuing to monitor wood duck nesting efforts in the boxes, and reporting annual nesting results to the U.S. Fish and Wildlife Service (USFWS) and Washington Department of Fish and Wildlife (WDFW).

This annual report summarizes wood duck nesting along Rock Island Reservoir during the 2017 nesting season. It also compares wood duck nesting in 2017 to previous years.

Study Area

Present

The project area is located in north-central Washington near the cities of Wenatchee and East Wenatchee. Wood duck nest boxes have been erected along shores of Rock Island Reservoir on the Columbia River between river miles 459 and 471 and at the confluence of the Columbia and Wenatchee Rivers. These areas include the optimal wood duck nesting and brooding habitat along the reservoir, based upon a mature tree overstory and shallow backwater areas with abundant shoreline vegetation. Chelan and Douglas counties border the west and east shores of the reservoir, respectively. Wood ducks are sparse breeders in Washington State (Bellrose and Holm 1994). In fact, Bellrose (1976) separated breeding and non-breeding wood duck areas in central Washington along the Columbia River, through the middle of our nest box area.

Steep cobble or dirt banks comprise much of the reservoir shoreline. At the mouth of the Wenatchee River several backwater channels, man-made ponds, and interconnecting channels provide higher quality habitat than along much of the main reservoir. Areas along the reservoir where wood ducks are generally seen are dominated by black cottonwood (Populus balsamifera ssp. trichocarpa), maple (Acer spp.), willow (Salix spp.), and mulberry (Moras alba). In addition to the overstory species, emergent and overhanging vegetation lines the quiet, shallow backwater areas that are suitable for duck brooding.

Shrub steppe vegetation, fruit orchards, residential, recreation, and industrial areas occupy areas up-slope from the riparian edge of the river. Shrub steppe habitat of central Washington is dominated by big sagebrush (Artemisia tridentata), rabbitbrush (Chrysothamnus spp.), and bluebunch wheatgrass (Agropyron spicatum).

Historically

Historically, few wood ducks probably nested along the Columbia River in central Washington. Aerial photos of the Columbia River, taken in 1930 (prior to construction of hydroelectric dams), indicated
minimal riparian vegetation (in the form of a deciduous overstory) along the mid-Columbia. Runoff from snow melt caused large seasonal fluctuations in the river level. The high water levels seemed to have scoured away most shoreline vegetation within the high water zone. As river flow decreased after the spring run-offs, the river level receded and a wide barren cobble zone was left between the summer river level and the native shrub-steppe vegetation above the high water mark. Fast flowing water with ranging seasonal variations made it impossible for vegetation to establish below the high water line during spring runoff. Lush riparian vegetation (e.g., cottonwoods, willows, maples) did not persist along the high water line because of a lack of moisture during the summer. Therefore, the Columbia River shoreline prior to the Rock Island Reservoir did not historically provide wood duck nesting and brooding habitat.

Hydroelectric and water storage dams built on the Columbia River between 1930 and 1970 controlled river flow and reduced seasonal river fluctuations. Relatively consistent reservoir levels allowed woody riparian vegetation to establish at many areas along the river. As riparian vegetation became established, habitat for wood ducks improved in some areas compared to the habitat that existed prior to construction of the dams. The mid-Columbia River is now capable of supporting, and probably does support, a higher wood duck nesting population now than it did historically. Rock Island Dam was the first dam on the Columbia River and the reservoir behind it supports older and more developed woody riparian habitat than most other segments of the mid-Columbia.

Methods

**Nest Box Maintenance**

Wood duck nest boxes placed along the Rock Island Project were constructed and installed following the guidelines suggested by Fielder (2000). Nest boxes were installed either on large diameter trees or on posts with predator guards placed near backwater habitats. In late winter of each year, nest boxes are inspected, repaired or replaced as necessary, and prepared for the spring wood duck nesting season. During 2013, rotting wood on some wooden posts created a safety hazard. To address the safety concern, all wooden posts (n = 25) in the Horan Natural Area were replaced with new 4” pressure treated posts following conclusion of the nesting season in 2013.

During 2017, Chelan PUD monitored 65 wood duck nest boxes along Rock Island Reservoir. The nest boxes were cleaned, repaired, and made ready for use by adding wood shavings to a depth of 4 inches in early April. At the beginning of the season, 1 nest box was occupied by an active bee hive, rendering it unavailable for wood ducks. An additional 3 boxes were lost due to falling trees. Of 65 boxes maintained in the program, 61 were available for wood ducks throughout the entirety of the nesting season.

Elliptical entrance holes 3” high and 4” wide prevent most raccoons (*Procyon lotor*) from entering nest boxes (Bellrose and Holm 1994). Although entrance openings to our nest boxes are no larger than 4” x 3”, the edges to several of the entrance holes had been rounded to allow easier access for the hens. These rounded edges may allow raccoons to squeeze into the boxes. To reduce predation by raccoons, extensions (face plates) are fastened over the existing openings on some nest boxes. The face plates were cut from 5/8” plywood and have 4” x 3” elliptical openings which do not have rounded edges. This 5/8” extension made the entrance holes a longer, deeper, and tighter fit that might further reduce entry by raccoons (Fielder 2000). Forty-three nest boxes are outfitted with the face plate device. Nine of those boxes were protected with the addition of a second face plate to make the box protected by “double face
plates.” These “double face plates” consist of two separate face plates placed over the box entrance to provide an even deeper tunnel opening to further reduce raccoon problems.

Other predator deterrents include wrapping wide bands of sheet metal around the trunks of trees that have nest boxes or adding PVC sleeves to posts supporting the nest boxes. Originally, about 15 boxes located on trees were protected by wrapping the tree trunks with bands of sheet metal. Over the years, the effectiveness of these sheets has been limited as trees have been felled by beaver or the sheet metal bands became unattached. Additionally, large tree diameters and inter-connecting limbs make it difficult to completely exclude predator access to most trees.

All support posts for nest boxes in the Confluence area are guarded by 4-foot lengths of PVC pipe encasing the support posts. This casing prevents predators from gaining access to the box by climbing the posts. The PVC casing makes the pole too smooth and slippery for animals (primarily raccoons) to grip. In 2015, 17 boxes mounted on posts had a combination of PVC in conjunction with a face plate. Fifty-nine of the wood duck nest boxes have predator deterrents (face plates, metal wrap, or PVC) in addition to the standard 4” x 3” elliptical entrance hole.

Surveys

Nest boxes were surveyed 3 to 4 times during the nesting season, depending on the nesting activity in the boxes. During our surveys, we determined the number of nests initiated, number of eggs laid, and the fate of each nest (including causes of predation and other unsuccessful nesting attempts). We also removed and destroyed any starling (Sturnus vulgarus) nests, eggs, or young found in the nest boxes during surveys.

Nest boxes were classified as initiated by wood ducks if one or more wood duck eggs were deposited in the box. Successful nests were classified as nests from which at least one egg hatched and at least one duckling left the nest box (Mayfield 1975). The average clutch sizes (# eggs laid) and fledge rates (# ducklings that left nest box) are calculated only from successful, non-dump nests (dump nests and unsuccessful nests were excluded when calculating average clutch size/fledge rate). Nest initiation dates were determined using an egg laying rate of 1 egg per day (Leopold 1951). Nest initiation dates were not determined for dump nests.

Beginning in 1999, nests with clutches exceeding 12 eggs were regarded as dump nests (nests in which more than one hen laid eggs). This dump nest criteria is based upon recent agreement with work conducted by Semel and Sherman (1992). Prior to 1999, we had used the criteria established by Morse and Wight (1969) that considered wood duck nests to be dump nests if they contained 16 or more eggs. The change in dump nest criteria means that earlier survey reports (1983 - 1998) underestimated the amount of dump nesting that occurred and overestimated average clutch sizes. Clutch size and fledge rates specific to dump nests are calculated from only successful dump nests (nests containing 13 or more eggs).
Results and Discussion

Wood duck production

The earliest a wood duck nest was initiated during 2017 was on or before 1 April. The earliest nest initiated since we began our nest box program in 1983 was on 23 March 1998. The latest wood duck nest in 2017 hatched in mid-June. It is not unusual to find 1 - 2 nests initiated late in the season; hatching in late June or early July.

In total, wood ducks laid 112 eggs in 11 nest boxes from the 61 available nest boxes (18% occupancy) in 2017 (Table 1). Seven of the 11 nests (64%) were successful, producing 73 ducklings. The average clutch size (calculated from successful, non-dump nests) was 10.6 eggs per successful nest.

Three dump nests (nest with 13 or more eggs) had a total of 40 eggs, of which 25 ducklings fledged from the nest boxes. During 2017, these 3 dump nests accounted for 34% of all fledged ducklings. The fledge rate of wood duck eggs from the dump nests (63%) was slightly lower than that of non-dump nests (67%). During the last decade (2007 – 2016), the average fledge rate of dump nests (44.4%) was lower than that of non-dump nests (58.6%) within our study area. However, the number of ducklings that fledged per dump nest during 2017 (12.5) was higher than the average number that fledged per non-dump nest (9.6). Numbers of ducklings fledging per dump nest are generally higher. During the last decade, an average of 10.5 ducklings fledged per dump nest compared to an average of 7.8 ducklings per non-dump nest.

Dump nesting has generally been beneficial to our nesting population; adding to the total number of eggs laid, the proportion of those eggs that fledge are somewhat similar to non-dump nests, and a greater number of ducklings overall are produced. Detrimental effects of dump nesting often become evident in areas where nest programs build up large breeding populations, where large numbers of eggs are laid, but proportionally fewer young are produced (Bellrose and Holm 1994). The dump nests monitored during 2017 occurred in three separate areas along the Reservoir, miles apart from each other.

Dump nesting could be diminished if nest boxes were moved so they would be less visible to wood ducks (Semel and Sherman 1995). However, a narrow riparian corridor and low availability of shallow backwater areas in our study area restrict our placement of nest boxes.

Duckling production was at its highest from 1993 - 2000 (Table 1). A low number of initiated nests, low clutch size, and a high predation rate combined to result in a major reduction in duckling production in 2001 and 2002. However, the lowest number of ducklings produced per box was observed during 2015, a drought year (Table 1). The number of ducklings produced per box in 2017 was 1.2, below the long term average of 1.9 ducklings per box.

Duckling production seemed to increase in 2003 and 2004 but decreased again during the 2005 - 2011 nesting seasons. Prior to the 2008 nesting season, new boxes were placed along the Rock Island Reservoir and historically unproductive boxes were moved to new locations. However, moving unproductive boxes to new locations did not have an immediate effect on nest occupancy or success from 2008 - 2012. During 2015, historic drought conditions occurred and affected availability of water in the shallow back channels of the South Confluence. The Columbia River was less affected, but was running well below average spring flows for the duration of nesting season. Many of the nest boxes were no longer isolated by water, allowing predators such as raccoons easy access to disturb the hens. Additionally, extended periods of unseasonably hot weather may have affected nesting hens.
Starlings attempted nests in the boxes during 2017. Generally, removal and destruction of starling nests in early to mid-May seems to disrupt their use of the nest boxes. Starlings laid eggs or started nests in 7 of the wood duck boxes. Following repeated removal of starling nests, wood ducks subsequently initiated nests in 2 separate nest boxes. Continued vigilance to manage starling nest starts is beneficial for use of the nest boxes by wood ducks.

The Wenatchee Confluence State Park Horan Nature Area historically has the highest wood duck production along Rock Island Reservoir. The Nature Area surrounds the confluence of the Wenatchee and Columbia Rivers; with the Wenatchee River bisecting the park. A maze of wetlands, channels, and islands were created in the southern portion of the Nature Area, known as the South Confluence. The northern section of the park also contains channels and ponds. The man-made waterways of the South Confluence of the park are shallow and provide an early and abundant protein source of aquatic invertebrates in the quiet backwater brooding habitat. Generally, boxes in this area receive a high percentage of use by wood ducks and account for many of the ducklings produced. Of the 33 nest boxes in the Nature Area, 7 wood duck nests were initiated in boxes (64% of all nests) and comprised 66% of all fledged ducklings (n = 48).

**Unsuccessful nests**

Nest abandonment and high water resulted in 4 nest failures which represented 29% of eggs laid during 2017. One nest was flooded by high water in late May. This box is located high in a tree, but the Reservoir was higher than the historical average during all of April and May, resulting in flooded conditions for many areas. Outflows from Rocky Reach Dam were 163% and 153% of the 10-year average for April and May, respectively (DART 2017). Three other nests were abandoned for unknown reasons following initiation of the clutch. No evidence was found at the nest box indicating mortality of the hen. However, it possible the hen was predated away from the nest box. Generally, the raccoons kill the hen and feed on the carcass, scattering feathers on nearby tree limbs and trunks and in or near the nest box. Blood splotches are often visible on the nest box lid and sometimes on the sides and near the box opening. If the raccoon can enter the box, it breaks and feeds on the eggs.

Predation on incubating wood duck hens by raccoons and mink has been a problem along Rock Island Reservoir during many recent years compared to the earlier years of the nest box program. Between 1983 and 1995, only 2 wood duck hens were killed by mink in our nest boxes. Since then, mink have killed at least one incubating wood duck hen in a nest box during each of the 1996 - 2001 seasons, and also during the 2006 and 2010 seasons. Predation events attributed to mink peaked during 1996 - 1998 seasons, where 3, 3, and 4 wood duck hens were killed, respectively. Typically, mink decapitate the hen, do not feed on the carcass (but may return in following days and feed on the carcass), and do not break or bother the eggs. Generally, few feathers are scattered and most of the carcass appears untouched.

No nets were destroyed by Northern flickers (*Colaptes auratus*) during 2017. Flickers will peck holes in the eggs to destroy them, and may remove destroyed eggs and shell fragments. No wood duck nests were abandoned as a result of starlings building nests on top of wood duck eggs. In previous years, starling nest attempts on top of wood duck eggs have led to failed wood duck nests.

Reservoir elevations were higher than average, with high flows experienced throughout April and May compared with levels experienced during recent years. During both 2011 and 2012, reservoir elevations were higher than average during late June, although not as high as elevations experienced during the 1997 season. After unusually high water levels during 1997 flooded 25% of the wood duck
nests, the affected boxes were moved to higher elevations. Water levels have since remained below the 1997 maximum flow.

**Other species use of nest boxes**

Over the past few years, we have seen an increase in the number of boxes occupied by bees. Prior to the beginning of the 2017 season, 1 wood duck box was occupied by honeybees. This box was left on-site with the active bee hive because it could not be safely removed. The nest box containing the bee hive was located in the general vicinity of the confluence of the Wenatchee and Columbia rivers. No additional boxes were overtaken by bees during 2017.

During 2017, we removed starling eggs and or nesting material from 7 nest boxes. Eventually two of these boxes were used by wood ducks. Nest box programs in which boxes are not regularly checked to remove starling nests may produce many starlings rather than wood ducks or other native species. There has been a severe reduction in starling nest attempts in our boxes since we began removing all starling nests, eggs, and young encountered in our boxes during each survey.

Northern flickers occupied a total of 4 wood duck nest boxes and Eastern gray squirrels nested in two additional nest boxes along the Douglas County shoreline. The introduced squirrels are becoming more common along the Reservoir and are likely to exclude wood ducks from nesting in the boxes. The boxes in these areas may benefit from having the entry holes covered during the off-season, and opened during the beginning of the wood duck nesting period in order to prevent or reduce use by the squirrels. Chelan PUD will experiment with methods to reduce Eastern gray squirrel use of wood duck nest boxes.

Each year tree swallows attempt to nest in our wood duck nest boxes. Tree swallows (*Tachycineta bicolor*) generally initiate nests in late May and early June, near the end of the wood duck nest initiation period. It is doubtful if the tiny tree swallow nests would preclude a wood duck from nesting in a box.

**Nest box program summary**

The wood duck nest box program along Rock Island Reservoir has produced an average of 121 ducklings annually. This year, the program produced 73 ducklings. The peak production of 258 ducklings from the Chelan PUD nest box program occurred in 2000. Eleven nests were initiated this season with 65% being successful in fledging young. This nest success rate is near the 35-year average (63%). Average clutch sizes remained relatively high this year (10.6 eggs/successful nest) as they had during the past few seasons. One hundred twelve wood duck eggs were laid in our boxes this year, lower than the 35-year average of 215 eggs (Table 1).

Evidence of raccoon and mink activity near our nest boxes (tracks in the mud along the shorelines), was relatively high again this year compared to early in the nest box program's history. During 2000, Washington state voters passed a law that restricted conventional trapping with leg hold and body gripping traps. The absence of trapping will likely lead to further increases in raccoons and mink along the river and predation problems similar to those we have experienced from 2001 through this season. The spring of our highest wood duck production (258 ducklings) followed a winter during which a local trapper harvested a good number of raccoon and mink within or near our nest box project area.

Most of our nest boxes (90%) have 1 or more of 3 different types of predator deterrents. Nest boxes mounted on poles have PVC pipe sleeves to deter predators from climbing up to the nest box. Some trees where boxes are mounted to have metal wrap to deter mammalian predators from climbing up to the boxes. Face plates help to exclude predators from the boxes by maintaining the 4” x 3” entrance hole.
Face plates also reduce the effective reach of a predator trying to access the nest box. Predator deterrents may not be enough to adequately prevent growing populations of mink and raccoons from being serious wood duck nest predators because of their persistent nature.

Checking nest boxes regularly during the nesting season greatly enhances a nest box program's production (Utsey and Hepp, 1997). We reduced starling competition for nest boxes by frequently checking the boxes and removing starling nests so that the boxes were available for wood duck use. The frequent nest box checks also allow us to better identify predation, nesting problems, and to monitor success.

Conclusion

Duckling production during the 2017 nesting season was lower than the 35-year average for Rock Island Reservoir. Duckling production was similar to numbers observed in 2016 and 2009. 2017 was a normal water year, but Reservoir levels were higher than average throughout both April and May.

High levels of predation by raccoons and mink during recent years appear to be taking a toll on nesting hens, reducing nest success and therefore, the overall number of ducklings hatched. In northern latitudes, many hen wood ducks may not nest until their second year. Yearling hens of many duck species are known to lay smaller clutches than adult hens (Mendall 1958, Dane 1965, Coulter and Miller 1968, Morse et. al. 1969, Krapu and Doty 1979). Predation on older hens may be reducing the reproductive potential of the nesting wood duck population in the Wenatchee area. As that reproductive potential is reduced, fewer young hens are recruited into the nesting population in future years.

From 2008 - 2010, Chelan PUD Wildlife staff noticed a decrease in the water elevation in the ponds at the South Confluence Nature Area. This became very apparent in 2010, when canoeing the channels within the wetland became much more difficult due to lower water levels. Some nest boxes were impossible to check or maintain until mid-June, when late run-off in the Columbia River increased water levels within the ponds in this area. Low water levels promoted an increase in emergent vegetation in the back channels and reduced the amount of available early-season back-channel open water foraging areas for wood ducks. However, high water levels in 2011, 2012 (near record Columbia River flows), and 2017 inundated much of the South Confluence Nature Area for most of the season. Water was flowing and pooling in areas where typically none is found. Water levels during 2014 in the South Confluence Nature Area were average, but during 2015 water levels were greatly reduced, rendering some channels and a pond dry. Water levels during 2016 were reduced, but similar to levels observed during 2010 and 2013. The number of nests initiated in the South Confluence Nature Area during 2017 (n = 7) was similar to both the 5-year average of 7.2 nests and the long-term average of 7.9 nests.

The number of abandoned nests for the nest box program in 2017 (n = 3) was similar to the long-term average of 3.7. Nest abandonments occurred during 83% of all nesting seasons from 1983 to present. Nests might be abandoned for a number of reasons. Faulty nest boxes, disturbance, harassment, or predation could cause a hen to abandon a nest. Another potential cause for nest abandonment is intraspecific competition, in which altercations between females occur at nest boxes.

It is possible that the wood duck nest box program has built up wood duck numbers such that local breeding densities are much higher than previously thought. Even as suitable nest sites are available it is thought that the greater the concentration of breeders, the more likely certain females will follow another
female to a nest site for the purpose of depositing an egg, resulting in higher numbers of dump nests (Bellrose and Holm 1994).

Bellrose and Holm (1994) found that as nest density increased, the number of injured females and deserted nests increased as a result of increasing intraspecific strife. Often, a yearling female was found to be the intruder, and the surviving female an adult. With the number of boxes occupied by bees in the South Confluence Horan Nature area increasing in recent years (despite removal efforts), fewer boxes are available for wood ducks.

Wood duck hens return to the same nest boxes year after year. With fewer boxes available in prime habitat, the younger hens may be competing with older hens at established nest sites in the Horan, leading to clashes between females and possible abandonment of initiated nests. Nest boxes occupied by bees will continue be evaluated for removal and replacement within the South Confluence Horan Nature Area in 2017 - 2018. Additionally, a feasibility study is underway to examine options for maintaining water levels in the man-made ponds and ditches in the South Confluence Nature Area.

**Acknowledgements**

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Literature Cited


Table 1. Wood ducks produced from nest boxes along Rock Island Reservoir, Columbia River, Washington, 1983 - 2017.

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35-Year Total 2,278 739 469 7,536 4,219
Average 65 21 32% 13 63% 213 121 56% 1.9