FURTHER DECLINE IN NEST-BOX USE BY VAUX'S SWIFTS IN NORTHEASTERN OREGON

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ABSTRACT: Populations of the Vaux's Swift (*Chaetura vauxi*), a species of conservation concern, are declining in the Pacific Northwest. We compared the number of swifts nesting in boxes 2007–2008 to those nesting in the same boxes 1999–2002 to determine if numbers had changed. There were 51 nest attempts in the earlier 4-year period but only two to five nest attempts in the later 2-year period, an average decline of 72% in nest-box use. The cause of the decline is unknown. Northern Flying Squirrels (*Glaucomys sabrina*), Bushy-tailed Woodrats (*Neotoma cinerea*), and Red Squirrels (*Tamiasciurus hudsonicus*) usurped some of the nest boxes. Seven of seven swifts tested negative for the antibodies of West Nile virus. Conservation measures that protect existing nest and roost sites and create additional nesting sites (nest boxes and chimneys) would help ensure that habitat is not limiting Vaux's Swift populations.

From 1980 to 1999, on the basis of Breeding Bird Surveys, numbers of Vaux's Swifts (*Chaetura vauxi*) declined across their breeding range in the United States with a significant and steep decline in Washington (Bull and Collins 2007). Although the Vaux's Swift has no official status as threatened or endangered in any state within its breeding range, it is listed as a species of greatest conservation need in Washington's Comprehensive Wildlife Conservation Strategy (Washington Department of Fish and Wildlife 2005) and as a species of special concern in California (Hunter 2008). In 2003 in northeastern Oregon, Bull (2003a) recorded the swifts in only 46% of the forest stands they occupied in 1991 and significantly fewer swifts on survey transects. The cause for the decline in numbers of Vaux's Swifts in the Pacific Northwest is unknown, although loss of forest habitat, weather patterns, and disease are all potential factors. In addition, modification of their forest habitat, in the form of the harvest of large-diameter hollow trees and snags, eliminates the swifts' potential nest and roost sites. Other forest management that decreases the incidence of heartrot and reduces aerial insects could also reduce the number of the swifts' nesting and roosting sites as well as their prey (Bull 2003a). Currently, there is no quantitative information about the effect of adverse conditions, including weather and pesticide use, during migration or in wintering areas.

West Nile virus (*Flavivirus*) has spread rapidly across North America, causing deaths in humans, birds, mammals, and reptiles. Tens of thousands of birds have died, and local declines have been documented (McLean 2006, Clark et al. 2006), although it is difficult to attribute region-wide declines to West Nile virus specifically (Marra et al. 2004). In New York, 33% of the birds tested in 2000 were positive for West Nile virus (Kramer and Bernard 2001). In Ohio, Marshall et al. (2006) found 33% of Northern Cardinals (*Cardinalis cardinalis*) to be seropositive. Migratory birds are likely agents of the rapid spread of the disease (Rappole et al. 2000, McLean 2006).

Populations of the Chimney Swift (*Chaetura pelagica*), closely related to the Vaux's Swift, have been adversely affected by West Nile virus (Komar 2003). The arrival of West Nile virus in the Pacific Northwest may be yet another factor increasing mortality and depressing Vaux's Swift populations.

The 103 nest boxes erected for swifts in northeastern Oregon in 1998 (Figure 1; Bull 2003b) provide a unique opportunity for the breeding activities of Vaux's Swifts to be quantified and for adults and nestlings to be captured and tested for the virus (Bull 2003a). In addition, these boxes provided us the opportunity to compare numbers of swifts using them at different times. The objectives of this study were to compare the numbers of swifts nesting in boxes 1999–2002 and 2007–2008 and to determine if West Nile virus antibodies are present in nesting Vaux's Swifts.

METHODS

We monitored 103 nest boxes erected for Vaux's Swifts at 12 localities in the Wallowa-Whitman and Umatilla national forests within 50 km of La

Figure 1. Nest box designed for Vaux's Swift, installed near La Grande, Oregon, in 1998.

Photo by Evelyn L. Bull

Grande in northeastern Oregon. All boxes within a 5.4-km radius were considered to be at a single locality because 5.4 km was the maximum distance Bull and Beckwith (1993) found that radio-tagged swifts traveled from the nest while rearing young in northeastern Oregon. Nest boxes were 3.5 m deep and 30 cm square and put in trees 10–15 m above the ground. Approximately one-third of the boxes were installed in each of three habitat types: late-seral stands of Grand Fir (*Abies grandis*), harvested stands of Grand Fir, and stands of Ponderosa Pine (*Pinus ponderosa*).

We determined use of the boxes by climbing to them 1999–2002 during an earlier study (Bull 2003b) and again in 2007 and 2008 for this study. In late June or early July we inspected the walls of each box with a flashlight for stick nests (Figure 2) or swifts and collected its contents, which we inspected for eggshell fragments, sticks, and the swifts' fecal material. The presence of small white eggshell fragments indicated that eggs had been laid in the box. The presence of more than 300 cm^3 of the swifts' distinctive fecal material, containing lots of insect chitin, was a good indication that young had fledged successfully (Bull 2003b). The presence of only small sticks suggested that a nest had been started, but we did not consider these boxes to have been active if they contained no eggshell fragments. Some of the original 103 boxes had fallen or the trees to which they were attached had died and were unsafe to climb; only 92 and 86 boxes were checked in 2007 and 2008, respectively.

We netted swifts at active nests in early August 2007 and 2008 to collect a blood sample (<0.2 ml) from either the brachial vein or a toe nail.

Figure 2. Nest of Vaux's Swift in a box mounted on a tree near La Grande, Oregon.

Photo by Evelyn L. Bull

The blood sample was put on filter paper containing preservative and dried and sent to Orange County Vector Control (Orange County, California) for testing for West Nile virus antibodies by the blocking ELISA technique (Jozan et al. 2003).

RESULTS

We found substantially fewer swift nests in 2007 (2 active nests) and 2008 (5 active nests) than during the earlier study (Bull 2003b) (Table 1). In the earlier 4-year period, 1999–2002, there were 51 nest attempts (in 30 different boxes). From 1999 to 2002 there were 12.75 nest attempts per year and a mean of 13.1% of the boxes were used each year. In 2007 and 2008 these figures were 3.2 and 4.0%, respectively.

In 2007, one box contained six live young swifts and a second box contained three dead nestlings; on the basis of the amount of fecal material in the box we presumed some additional nestlings had fledged. In 2008, the five active nest boxes contained (1) at least four nestlings, (2) one nestling (accumulated fecal material indicated that other young had already fledged); (3) eggshells and a detached wing; (4) four whole eggs on the box's floor; and (5) eggshells and a destroyed nest. These findings suggest that both nest attempts in 2007 and two of the five in 2008 were successful in hatching and probably fledging young.

We made no direct observations of Vaux's Swifts using nest boxes from 2003 to 2007. Ten additional boxes, however, had fecal material and/or egg shell fragments implying that swifts had nested in them sometime between 2003 and 2006. Nine of these contained >300 cm^3 of fecal material, suggesting that young could have fledged from them (Bull 2003b). The one box with only eggshell fragments did not contain any fecal material, indicating this attempt failed. There were two boxes with 2000 and 2400 cm^3 of the swifts' fecal material that we assumed represented at least 2 years of successful nesting.

Table 1 Variation by Year in Vaux's Swift Use of Nest Boxes in Northeastern Oregon

	Year(s)		
	1999–2002	2007	2008
Swift nests			
Boxes with swift eggs or nestlings	30	2	5
Nest attempts (boxes used)	51	2	5
Active nests each year	10–15	2	5
Nest attempts per year (mean)	12.75	2	5
Percent of active nests that fledged young	53%	100%	40%
Squirrel nests			
Boxes with lichen or grass nests	58	73[a]	49
Years of monitoring	4	1	1
Boxes checked	103	92	86

[a]Accumulated from 2003 to 2007.

Two adult swifts and four nestlings in one nest box in 2007 and one nestling in 2008 were tested for WNV antibodies; all tests proved to be negative. While checking the nest boxes, we saw or heard free-flying swifts at only 4 of the 12 localities in 2007 and at 3 of the 12 localities in 2008.

A variety of other birds and mammals also used the nest boxes, making some of them unavailable to swifts. Northern Flickers (*Colaptes auratus*) and Pileated Woodpeckers (*Dryocopus pileatus*) roosted in the boxes regularly, leaving fecal material and wood chips. Pileated Woodpeckers had excavated additional entrance holes in five boxes by 2002 and in 19 boxes by 2008 (53% in stands of pine, 31% in harvested stands of fir, and 16% in late-seral stands of fir). We consider nest boxes with additional holes excavated in them unsuitable for swift nesting.

In 2007, seven boxes contained live Northern Flying Squirrels (*Glaucomys sabrinus*), and three boxes contained Bushy-tailed Woodrats (*Neotoma cinerea*). In 2008, Northern Flying Squirrels again occupied seven boxes, and unweaned Red Squirrels (*Tamiasciurus hudsonicus*) occupied one box. Nests of lichen or grass, presumably constructed by squirrels or woodrats, were found in 73 boxes (79%) in 2007. In 2008, rodents had built new nests in 49 of the boxes (56%). This one-year accumulation is greater than the total of 58 boxes with squirrel nests during the longer 1999–2002 study period. During that time, the percentage of the 58 swift nests that fledged young was 63% in boxes without a squirrel nest (n = 46) and 17% in boxes with a squirrel nest (n = 12).

The use of boxes in the various forest types changed over time. The swifts' use of late-seral stands of Grand Fir decreased but their use of stands of harvested Grand Fir and Ponderosa Pine increased. In all three forest types squirrels' use of boxes increased (Bull pers. obs.). Unfortunately, there are no data on squirrel population sizes during the study period.

DISCUSSION

The number of swifts nesting in boxes in northeastern Oregon decreased by 72% since the previous 1999–2002 study. In addition, in 2007 and 2008 Vaux's Swifts were seen or heard in only 4 and 3 of the 12 localities, respectively, whereas from 1997 to 2002 they were seen or heard in 11 of the 12 localities.

Numerous factors could influence Vaux's Swifts' use of nest boxes in northeastern Oregon. Some of these would include the size of the swift population in the area, the presence of squirrels in the boxes, and the condition of the boxes. Although all seven of the swifts captured tested negative for antibodies to West Nile virus, it might be argued that swifts that contacted the virus might have already succumbed to the disease, thus reducing the overall swift population in the study area. A wider program of West Nile virus testing in Vaux's Swifts would be informative. Squirrels occupying a box may make it less attractive, as evidenced by the success rate in boxes with squirrel nests being lower than in those without squirrel nests. As the number of squirrel nests in the boxes increased, the number of swift nests decreased. In addition to just appropriating the nest boxes, squirrels and woodrats could also be predators of eggs and hatchlings.

Among the 92 and 86 boxes that could be checked in 2007 and 2008, respectively, some were not suitable for swift nesting for several reasons. In 58 hollow trees used by Vaux's Swifts the average depth of natural cavities was 4.1 m (Bull and Collins 2007), and the nest was attached to the chamber wall 2.3 m below the entrance hole. When given a choice of nest boxes 1.2 m, 2.4 m, and 3.5 m deep, swifts frequently nested in the boxes 3.5 m deep, nested only once in a box 2.4 m deep, and never nested in the boxes 1.2 m deep (Bull 2003b). In the earlier study period (1999–2002), nest boxes were cleaned annually, so the accumulation of lichen and grass that squirrels brought in as nest material was minimal—usually less than 0.3 m deep on the bottom of the box. In 2007, after 5 years with no box maintenance, squirrel-nest material was more than 1.3 m deep in some of the boxes. By 2007 the accumulation of such large amounts of nest material may have made these boxes less attractive to the swifts by concealing their depth. The cleaning of the boxes in 2007 could have been partially responsible for the increase in nesting pairs in 2008; two of the swift nests that year were in boxes that had accumulated squirrel-nest material in them in 2007 and were thus not suitable.

Another explanation for some of the reduction in the swifts' use of the boxes is the higher incidence of Pileated Woodpecker entrance holes: in 19 boxes in 2008, in only five boxes 1999–2002. Additional entrance holes may make the box less attractive to swifts, perhaps because it is less secure from predators and the increased light may be undesirable. We had not anticipated that Pileated Woodpeckers would use these nest boxes for roosting. The excavation of additional holes in the boxes provides the woodpeckers with multiple avenues of escape should a predator enter the box. Multiple holes are also characteristic of Pileated Woodpecker roosts in hollow trees (Bull and Jackson 1995).

Only one stand of forest, containing four boxes, had been altered by fuel reduction since 2002, so it is unlikely that habitat alteration since 2002 significantly influenced the swift's population.

Conservation measures to prevent further declines of the Vaux's Swift population could include increasing opportunities for breeding by putting up nest boxes (Bull 2003b) or building mock chimneys as nest sites, as has been done for the Chimney Swift (Kyle and Kyle 2005). Cleaning of nest boxes just prior to nesting may also increase their use. It is also important to protect existing nest and roost sites (hollow trees and chimneys) in both the breeding range and at migration stop-over locations; their loss might be yet another factor contributing to the apparent decline of Vaux's Swift we have documented.

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