

Use of Flooded Snags by Cavity-nesting Birds at Shasta Lake, California

Len Lindstrand III, North State Resources, Inc., 5000 Bechelli, Suite 203,
Redding, CA 96002. lindstrand@nsrnet.com

Information regarding nest site and habitat characteristics of cavity nesting birds is widely available in the literature (Raphael and White 1984, Laudenslayer et al. 1999) and from other sources. Limited information is available, however, documenting cavity nesting birds using flooded snags in reservoirs or other flooded habitats, partly because trees are often removed from reservoir sites, particularly in California. Lack of tree clearing in a portion of Shasta Lake, California, created extensive areas of flooded snags within the reservoir drawdown zone, providing an opportunity to document cavity nesting bird use of this uncommon habitat.

STUDY AREA

Shasta Lake is 16 km north of Redding, Shasta County, California (Figure 1). The lake consists of five primary arms including Big Backbone and Squaw Creeks, and the Sacramento, McCloud, and Pit Rivers. Completed in 1945, Shasta Lake is California's largest reservoir with a maximum surface area of 121 km² and 676 km of shoreline. The full-pool elevation is 326 m and the surrounding terrain is moderate to steep. The local climate is Mediterranean, with an average annual precipitation of approximately 155 cm occurring primarily as rainfall. Average annual temperatures range from 10°C in winter to 32°C in summer.

During construction of Shasta Dam, clearing crews removed trees and other vegetation within much of the future reservoir area, presumably for timber use and to remove future obstructions to boating and reservoir operations. Crews worked from the dam site upriver to the confluence of Squaw Creek and the Pit River before their activities ceased due to the onset of World War II. Subsequent inundation of the new reservoir flooded the remaining 2,104 ha of forest in portions of the Squaw Creek arm and the entire Pit River arm (Figure 1), resulting in extensive stands of snags within the reservoir. Although many of the snags have fallen over time, most persist today.

The flooded forests consist primarily of conifers dominated by Douglas-fir (*Pseudotsuga menziesii*), with ponderosa pine (*Pinus ponderosa*) and occasional knobcone pine (*Pinus attenuata*). Dominant hardwoods include canyon live oak (*Quercus chrysolepis*), with occasional California black oak

(*Quercus kelloggii*) and Pacific madrone (*Arbutus menziesii*), which occurs in the upper reaches of the Pit River arm. The number and vertical area of snags exposed above the reservoir's water surface varies depending on annual water levels and associated reservoir management. These flooded forests represent a unique situation where large areas of reservoir contain thousands of inundated snags, providing an uncommon combination of wildlife habitats.

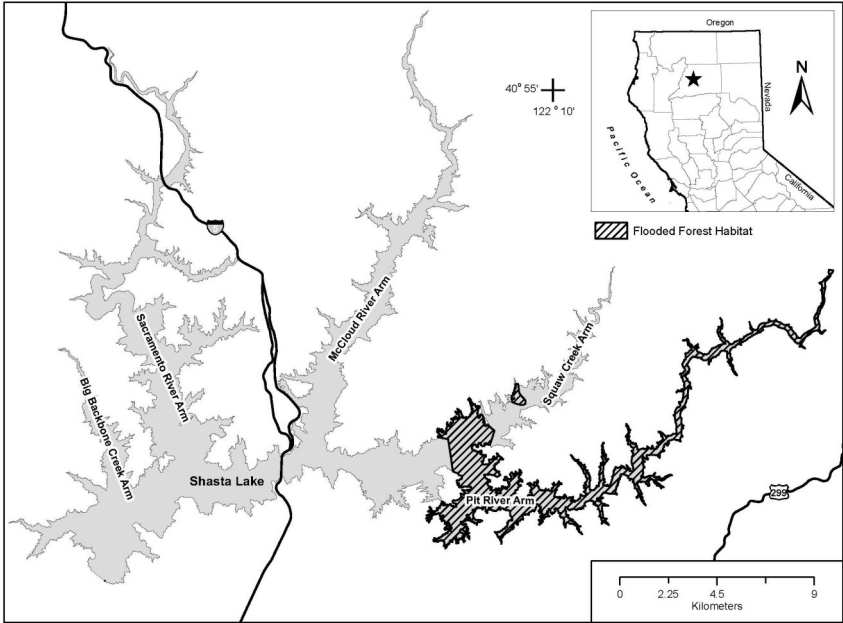


Figure 1. Shasta Lake with areas of that were not cleared of forest prior to original inundation, Shasta County, California.

METHODS

Over time, primary cavity-nesting birds led by a large Acorn Woodpecker (*Melanerpes formicivorus*) population excavated numerous cavities in the flooded snags, which have provided nest sites for other primary and secondary cavity-nesting birds. One notable secondary cavity nesting bird occurring in the flooded snag habitat at Shasta Lake is the Purple Martin (*Progne subis*). The martin, a California Species of Special Concern (Shuford and Gardali 2008) has been known to nest in the Pit River Arm since at least the 1970s (Airola and Williams 2008, Lindstrand 2008). I conducted annual surveys between 2007 and 2014 to determine the status and nesting ecology of this Purple Martin population. These surveys occurred from May through

August and consisted of documenting Purple Martin breeding pairs, nesting habitat, and nesting locations.

During the Purple Martin surveys, I made numerous incidental observations of seven other bird species using cavities in flooded snags for nesting. I made no efforts to quantify species abundance, nest success, or other nesting attributes. Here, I simply provide incidental observations of birds using cavities in flooded snags for nesting, which may be of general interest and of use in considering future reservoir planning and management.

RESULTS AND DISCUSSION

I documented eight species using cavities in flooded snags for nesting: American Kestrel (*Falco sparverius*), Acorn Woodpecker, Purple Martin, Tree Swallow (*Tachycineta bicolor*), Violet-green Swallow (*Tachycineta thalassina*), Northern Rough-winged Swallow (*Stelgidopteryx serripennis*), European Starling (*Sturnus vulgaris*), and Brewer's Blackbird (*Euphagus cyanocephalus*). The most commonly observed species were the Acorn Woodpecker, Tree Swallow, and Purple Martin, with an estimated 125 to 190 occupied cavities observed annually. Species that were less common but observed in most years include European Starling, Violet-green Swallow, and Northern Rough-winged Swallow. An estimated 2 to 6 European Starling nests have been observed annually since 2008. American Kestrel and Brewer's Blackbird were the least common species, as I observed each species nesting in flooded snags only once.

Other primary cavity nesting species that occurred and nested in intact forests adjacent to the reservoir but not in flooded snags included Nuttall's Woodpecker (*Picoides nuttallii*), Downy Woodpecker (*Picoides pubescens*), Hairy Woodpecker (*Picoides villosus*), Northern Flicker (*Colaptes auratus*), and (rarely) Pileated Woodpecker (*Dryocopus pileatus*). With the occasional exception of foraging and roosting by the Northern Flicker, none of these species were observed in the flooded snag habitats. Numerous other secondary cavity-nesting species such as Ash-throated Flycatcher (*Myiarchus cinerascens*), Oak Titmouse (*Baeolophus inornatus*), Red-breasted Nuthatch (*Sitta canadensis*), White-breasted Nuthatch (*Sitta carolinensis*), and House Wren (*Troglodytes aedon*) also occurred in the adjacent forests, but not in the flooded snag habitats.

The flooded snag forests appear to provide foraging and nesting habitat for aerial insectivore and ground-foraging insectivore and omnivore guilds (e.g., swallows, blackbirds, starlings), but not the foliage or bark gleaning guild (e.g., nuthatches, warblers), even though intact habitat for these species is immediately adjacent. When I surveyed them, the flooded snags were devoid of all but the largest branches and most have no bark due to years of flooding and weathering. Presumably the lack of stems, small branches, foliage, and

bark precludes use of these forests from all but the aerial insectivore, and the ground-foraging insectivore and omnivore guilds.

While these observations are unquantified, they nonetheless indicate that the flooded snag forest at Shasta Lake supports a diversity of cavity nesting bird species. An active proposal exists to raise Shasta Lake for increased survival of anadromous fish populations in the Sacramento River and increased water supply and reliability for agricultural, municipal, industrial, and environmental purposes (U. S. Bureau of Reclamation 2013). Current plans are to clear newly inundated areas around infrastructure and selected locations for public safety, and leave the remaining newly inundated areas uncleared. In total, overstory vegetation would be left uncleared in 80 to 91 percent of the newly inundated areas, thereby providing new recruitment of flooded snag forest habitat. Additional monitoring of this avian community and habitat to assess its importance to regional populations and to characterize habitat selection by the various species may be useful to assist planning and management of the future reservoir augmentation at Shasta Lake and other reservoir sites.

ACKNOWLEDGMENTS

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American Kestrel (*Falco sparverius*). 14 Dec 2013. Alpine County, California.
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