

## Ground-nesting great horned owl in Suisun Marsh, California

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Great horned owls (*Bubo virginianus*) are widespread throughout North, Central, and parts of South America (Artuso et al. 2013). Across this range, great horned owls are generalists, occupying a diverse range of habitats including deciduous and coniferous forests, wetlands, and agricultural landscapes. Within these habitats, great horned owls are generally found near upland or short-vegetation habitat suitable for locating prey (Artuso et al. 2013). In Suisun Marsh, California, great horned owls primarily occupy stands of non-native eucalyptus (*Eucalyptus* spp.), as well as man-made structures like waterfowl-nesting platforms (Figure 1) and on dock pilings over water (Figure 2), and they forage in nearby upland fields and seasonally flooded, diked wetlands managed primarily for waterfowl (USGS unpublished data).

Similar to other owl species, great horned owls do not construct their own nests; instead, they utilize unoccupied nests constructed by other birds, usually raptors or corvids, or arboreal squirrels (e.g., Baumgartner 1938, Errington 1932, Franks and Warnock 1969). However, their nest sites are described as “extraordinarily variable” and have been found in the crooks of large tree limbs, inside tree cavities, on cliffs, on and in man-made structures, and occasionally on the ground (e.g., Artuso et al. 2013, Bendire 1982, Bent 1938, Bohm 1977, Bohm 1980, Dixon 1914, Errington 1932, Fitch 1940, Fitch 1947, Kirkwood 1925, Murie 1922, Seidensticker and Reynolds 1971, Van Damme 2013). Though their nest sites are known to be diverse, little documentation exists to support some of these observations, especially the use of ground nests. For example, Artuso et al. (2013) mention two observations of ground-nesting, one nest in a log on the ground, and one nest in a waterfowl nest on the ground (Bendire 1892). Indeed, a literature search of ground-nesting specifically



FIGURE 1.—Great horned owl nesting in an elevated waterfowl-nesting platform on Grizzly Island Wildlife Area, California in 2016. Photo credit: Michael Casazza/USGS.

yielded no results aside from cliff nesting, where nests are elevated above ground level (see references above). In California, variability in nest sites occurs within pairs of owls across seasons (Dixon 1914) and among pairs and seasons (Fitch 1947), with nests occurring in stick nests in trees, on tree limbs, and on cliffs and ledges of steep slopes. Here, we document the first recorded evidence for ground-nesting in a great horned owl pair during three consecutive breeding seasons (2016-2018) on the Grizzly Island Wildlife Area, Suisun Marsh, California (38°08' N, 121°59' W). Grizzly Island Wildlife Area consists of ~5,200 ha of tidal and diked marshes, and upland habitat managed primarily for waterfowl, and is located within Suisun Marsh, which is a large (~46,900 ha) brackish water estuary in the San Francisco Bay Delta Watershed. The dominant vegetation across the wildlife area includes bulrushes (*Schoenoplectus* spp.), cattails (*Typha* spp.), rushes (*Juncus* spp.), pickleweed (*Salicornia virginica*), and various forbs (e.g., *Atriplex patula*, *Lotus corniculatus*) and grasses (e.g., *Distichlis spicata*, *Frankenia salina*, *Bromus* spp., *Elymus* spp., *Hordeum* spp.).

During waterfowl nest searches in 2016, U.S. Geological Survey (USGS) researchers discovered an active great horned owl ground-nest with 2-3 eggs (exact number not documented) in a small eucalyptus stand (~50 trees). The nest was located at the base



**FIGURE 2.**—Great horned owl nestling in a nest on a dock piling over water near Wheeler Island in Suisun Marsh, California in 2016. Photo credit: Sarah Peterson/USGS.

of a eucalyptus tree with Grizzly Island Road along the southern edge, and a dry, diked marsh along the northern edge. This nest was found on 4 April 2016, but was observed as completely depredated due to the presence of crushed eggshells during the next visit on 25 April 2016. At this time, at least one adult owl was still present in nearby trees after the nest was depredated. Because this nest was found incidentally to the primary research goals of 2016, no nest characteristics were recorded and no further monitoring occurred.

After the initial discovery of a ground-nest in 2016, we made a concerted effort to document ground-nesting behavior for this pair of owls in 2017 and 2018. On 30 March 2017, while conducting a survey for raptor nests along Grizzly Island Road, we discovered a female great horned owl incubating one egg (Figures 3 and 4) on the ground at the southeast base of a large eucalyptus tree (~ 23 m tall and 0.71 m DBH) in the same stand of trees where the ground-nest was previously found in 2016 by flushing the female from the nest after approaching on foot. The nest substrate consisted of loose eucalyptus sticks, bark and leaf litter. After briefly inspecting the nest and taking pictures, we immediately left so as not to cause prolonged disturbance or nest abandonment. The pair of adult owls was observed in a nearby (15-20 m away) tree while we inspected the nest.



**FIGURE 3.**—Initial great horned owl ground nest with one intact egg at the base of a eucalyptus tree on Grizzly Island Wildlife Area, California on 30 March 2017. Photo credit: Shannon Skalos/USGS.

A few hours after discovering the nest, we returned with a camera to document the female at the nest (Figure 5). We remained in our vehicle on Grizzly Island Road approximately 20 m away from the nest. The female incubated while we took pictures, she did not appear to show signs of stress, and she remained at the nest as we drove away.

During the second nest visit on 5 April 2017, the female was not on the nest so we approached on foot and the egg was cold, indicating that the female had likely abandoned the nest. During this visit, both adults were still present in a nearby tree, therefore we then searched the surrounding trees and ground for a possible second nesting attempt. After careful searching, we discovered two additional nest locations that appeared to be earlier nesting attempts from the 2017 season. A second nest was located on the ground at the southeast base of another eucalyptus tree (~18 m tall and 0.27 m DBH) with eggshell fragments and several adult great horned owl feathers present (Figure 6). A third nest with eggshell fragments was located in the crook of two limbs of a large eu-



**FIGURE 4.**—Placement and size of initial great horned owl ground nest with one intact egg at the base of a eucalyptus tree on Grizzly Island Wildlife Area, California on 30 March 2017. Photo credit: Shannon Skalos/USGS.

calyptus tree (~29 m tall and 1.67 m DBH) a few meters away from the second nest and approximately 2.5 m above the ground (Figure 7). The substrate of both nests consisted of loose eucalyptus sticks, bark and leaf litter. The two additional nests were approximately 50 m from the first discovered ground-nest in the same stand of eucalyptus trees.

We checked this stand of eucalyptus trees weekly, noting if the adults were present and if any additional nesting activity occurred. One or both adults were observed on subsequent visits in nearby trees, but we never discovered an additional nest or observed any nesting behavior. The egg was present in the initial nest through at least 5 May 2017, after which on 12 May 2017 the egg was gone without any signs of eggshells, suggesting a predator may have removed the whole egg. We stopped weekly nest checks after 19 May 2017.

In 2018, on 4 April we observed a female great horned owl incubating two eggs on the ground at the southeast base of a large eucalyptus tree (~16 m tall and 0.44 m DBH) in the same stand of trees as the ground-nests from the previous two years (Figure 8). We discovered the



**FIGURE 5.**—Female great horned owl incubating one egg within a ground nest on Grizzly Island Wildlife Area, California on 30 March 2017. Photo credit: Andrea Mott/USGS.



**FIGURE 6.**—Second great horned owl ground nest discovered with eggshell fragments and several adult owl feathers at the base of a eucalyptus tree on Grizzly Island Wildlife Area, California on 5 April 2017. Photo credit: Shannon Skalos/USGS.



**FIGURE 7.**—Third great horned owl nests discovered in the crook of two limbs of a eucalyptus tree approximately 2.5 meters off of the ground on Grizzly Island Wildlife Area, California on 5 April 2017. Photo credit: Shannon Skalos/USGS.

nest by flushing the female from the ground while searching on foot for evidence of ground-nesting. A second ground-nest was discovered and believed to be a nest attempt from earlier in 2018 because it was in the same location as the second ground-nest from 2017 and contained fresh eggshell fragments. Similar to 2017, the substrate of both nests was loose eucalyptus sticks, bark and leaf litter. The female returned to the ground-nest to resume incubation from a nearby tree as we were walking away. After initial discovery, we monitored the nest from a vehicle on Grizzly Island Road on a weekly basis. On 25 April 2018 the female was no longer seen incubating eggs so the nest was approached on foot and there were no eggs or eggshells present. We did not see any owls or nesting behavior in this tree stand after 25 April 2018.

Of 14 raptor or raven stick nests found in trees in 2017, and 11 nests found in trees in 2018 on Grizzly Island Wildlife Area, only two were unoccupied in 2017 and none were unoccupied in 2018. Because all or nearly every stick nest was occupied, this may suggest a potential saturation of nesting locations for great horned owls. A stick nest was present in 2015 within the same tree stand where the ground-nests were found, potentially indicating that the absence of an alternate nesting substrate led this pair of great horned owls to



**FIGURE 8.**— Female great horned owl incubating two eggs within a ground nest on Grizzly Island Wildlife Area, California on 4 April 2018. Photo credit: William Thein/USGS.

establish nests on the ground in 2016-2018. Indeed, the next closest eucalyptus trees are >1 km away (straight-line distance) and were occupied by other great horned owls during the 2017 and 2018 nesting seasons (USGS unpublished data). Additionally, strong nest site fidelity and territoriality despite nest failure has been documented in great horned owls (Bendire 1892, Baumgartner 1939), and may also explain why this pair remained in this territory and nested on the ground instead of relocating to a territory with a more suitable nest location. Regardless of the mechanisms for ground-nesting in this pair, this observation is the first documented case in California. Additional research to establish the range-wide rate of ground nesting in great horned owls and the underlying mechanisms resulting in this behavior could elucidate how this life history trait affects nest success and fitness.

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