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Case Study

Peregrine falcons nest successfully during reconstruction of bridge over Ohio River

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Abstract: Peregrine falcons (*Falco peregrinus*) often nest on bridges over rivers and other waterways, resulting in the need for mitigation planning for bridge maintenance and reconstruction. However, mitigation guidelines for peregrine falcon nests during bridge reconstruction are lacking in the literature. In this paper, we describe the monitoring, spatial, and temporal buffers, nest box installation, and other methods that allowed peregrine falcons to nest successfully on the Milton-Madison (US-421) Bridge during demolition and reconstruction. Construction activities occurred over a 4-year period (2011–2014), and coordination with local road departments and contracted engineers was necessary to accommodate the falcon nest. Nonetheless, construction activities were able to progress without causing major construction expense or delays, and the nesting falcons were able to fledge 14 young during the project.

Key words: bridge construction, bridge maintenance, demolition, deterrence, disturbance buffer, *Falco peregrinus*, mitigation, nest box, peregrine falcon, temporal buffer

Peregrine falcons (*Falco peregrinus*) frequently nest on bridges over rivers and other waterways (Watts and Watts 2017, Redig et al. 2018). Although bridges can offer suitable nesting locations for the species, this results in the need for mitigation during bridge maintenance or reconstruction. Peregrine falcons were formerly listed as endangered under the Federal List of Threatened and Endangered Wildlife, but the species was removed from the list in 1999 (U.S. Fish and Wildlife Service [USFWS] 2003). They are still protected by the Migratory Bird Treaty Act and listed as a species of greatest conservation need in Kentucky, USA and many other states (Kentucky Department of Fish and Wildlife Resources [KDFWR] 2013). For species of special concern, management for a single nest can be important to local populations, and thus, falcon nests are often considered during environmental planning for bridge maintenance and reconstruction.

Federal funding initiatives (e.g., Transportation Investment Generating Economic Recovery Discretionary Grants Program) and aging infrastructure have spurred the reconstruction of many bridges over large rivers in the recent past and near future (U.S. Department of Transportation 2018). Often in these circumstances, road departments and contractors consult with federal and state wildlife agencies for mitigation procedures for species of concern. However, detailed guidance on how to minimize effects on raptors during construction is lacking for many species. Spatial buffers of restricted activities are often suggested to minimize disturbance, but the appropriate distance for each species is seldom known or recommendations vary greatly (Richardson and Miller 1997, Whitfield et al. 2008). Disturbance buffers for bald eagles (*Haliaeetus leucocephalus*) are widely used throughout the United States (USFWS 2007), and a few states have guidelines available on disturbance buffers for other raptors (Colorado Division of Wildlife 2008). However, some of this information might be outdated or may present significant challenges for projects by suggesting large buffers. Information is further lacking for additional mitigation actions outside of spatial buffers.

Peregrine falcons regularly occupy manmade structures, sometimes nesting in inherently disturbing situations. For example, in Victoria, Australia, peregrine falcons nested just 50 m from rock-crushing equipment (White et al. 1988). Past research indicates individual raptors may develop tolerance to human disturbance (Holthuijzen et al. 1990). Even so, concerns arise when imposing a substantial new disturbance on a long-standing eyrie that has not been previously exposed to human disturbance.

In this paper, we describe the mitigative measures that allowed peregrine falcons to nest successfully during the demolition and reconstruction of a bridge over the Ohio River. Construction activities occurred over a 4-year period, and coordination with the road department and contracted engineers was necessary to accommodate the falcon nest. Nonetheless, construction activities were able to progress without causing major construction expense or delays. Below, we describe the monitoring, spatial and temporal buffers, nest box installation, and other methods that contributed to this project being a success.

Study area

The Milton-Madison Bridge (US-421) was originally built in 1929 across the Ohio River connecting Madison, Indiana with Milton, Kentucky. Due to structural deficiencies, the superstructure of this bridge required replacement, and the existing piers were reinforced and used to support the new bridge. In order to accomplish this, construction crews built the new bridge superstructure on temporary piers next to the old bridge and then laterally slid it onto the reinforced piers after removal of the old superstructure. Construction activities began in 2011 and reconstruction was fully complete in 2014. The new structure includes 6.1 m of additional width, shoulders for safety, and a pedestrian walkway (Walsh Group 2015).

Methods

Planning and coordination

Planning for the reconstruction of and environmental mitigation for the Milton-Madison Bridge began in 2008. Discussions between the Kentucky Transportation Cabinet (KTC) and KDFWR prompted a special provision for the peregrine falcon nest in the contract between KTC and Walsh Construction, the contractor awarded the project in 2010. Walsh Construction, KDFWR, and relevant consulting firms met once or twice annually to discuss plans for falcon nest mitigation. These meetings, along with falcon behavioral monitoring, promoted adaptive management of the falcon nest over the course of the project. We also provided informational flyers explaining falcon-related restrictions to construction personnel.

Monitoring

We monitored falcon behavior to determine fledging success every 2 weeks starting in February until approximately 3 weeks after the young left the nest. We also monitored falcon behavior during major construction events such as blasting and the lateral bridge slide. Egg laying occurred during mid-late March, and the young fledged during the last week of May or first week of June. We used binoculars, a spotting scope (20–60x), and a camera with a telephoto lens to view the falcons' behavior from shore or from a boat. We interpreted behavioral observations according to the methods detailed in Cade et al. (1996) and generally spent at least 2 hours for each monitoring visit, or as many as 12 hours in the case of monitoring during major construction events.

We banded young with U.S. Geological Survey (USGS) and colored, unique, alphanumeric leg bands between the ages of 21–28 days to distinguish individuals during observations (USGS banding permit #23400). Due to long-term, statewide monitoring efforts, the adults were previously banded. We considered young successfully fledged if we observed them flying outside of the nest box at 47–60 days of age. On 3 instances, we found fledglings on the shore, incapable of sustained flight. We captured these individuals and either brought them to a wildlife rehabilitator or placed them back on the pier that supported the nest box.

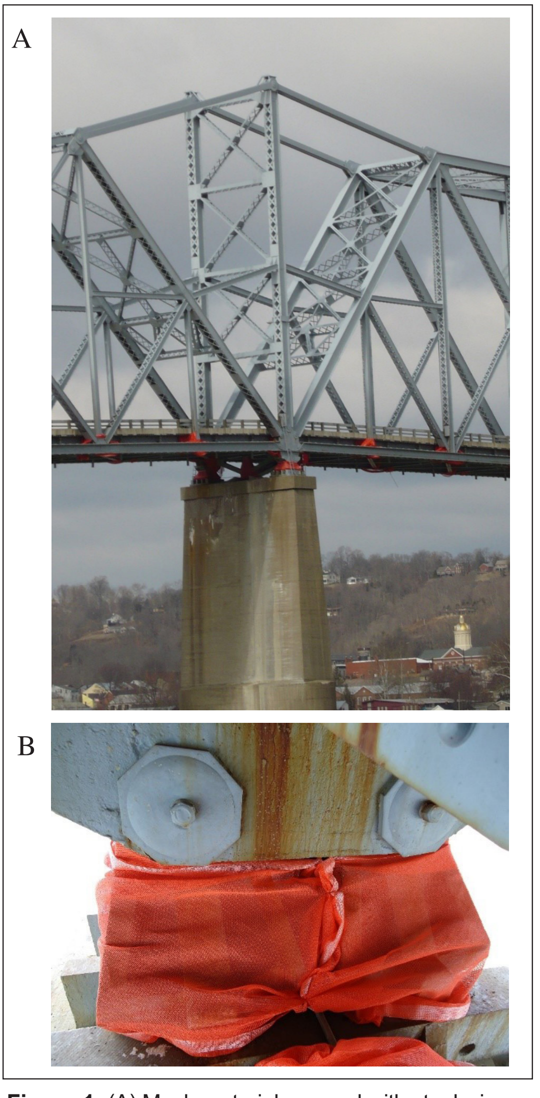

Figure 1. (A) Mesh material secured with steel wire was wrapped around potential nesting locations on the bridge to encourage peregrine falcons (*Falco peregrinus*) to nest in the nest box instead of an unpredictable location on the structure. (B) A zoomed-in view of a wrapped potential nesting location (*photos by K. Slankard*).

Nest box management

Peregrine falcons first nested on the Milton-Madison Bridge in 2002. From 2002 to 2008, the birds nested in a beam underneath the bridge. The KDFWR installed a nest box on a bridge pier cap in 2007, and the pair began using it in 2009. In January 2011, we relocated the nest box to a pier cap on the Indiana side to encourage the falcons to nest away from pending construction activities. That nest box stayed at that location during 2012 and 2013. In December 2012, we installed an additional nest box on the new bridge for the 2013 nesting season. By 2014, we removed the nest box on the old bridge, and the nest box on the new bridge remained available.

Deterrence

Peregrine falcons are often attracted to areas on bridges where beams meet and create a hollow or form a shelf for nesting. Walsh Construction covered potential nesting sites on the old bridge in 2011 with mesh material (Boen Orange Fire Resistant SafetyShield Safety Netting, Jaydee Group, New Windsor, New York, USA), secured with steel wire (Figure 1). The intent was to encourage the falcons to nest in the nest box instead of an unmanageable location on the structure. Much of this material remained on the bridge until demolition.

Temporal buffer (construction schedule)

We imposed spatial buffers (detailed below) during the nesting season (February 1 to June 30) and scaled them back for the rest of the year. We attempted to schedule all demolition outside the nesting season. However, we could not avoid the demolition of 1 bridge span during the nesting season due to major flooding in spring 2011 and other unforeseen events. In general, we made some minor adjustments to the construction schedule to accommodate the nesting falcons. For example, in 2011, Walsh Construction postponed work on the piers closer to the nest box until after the nesting season, while conducting work at further piers during the nesting season. Even so, the falcon nesting season did not drive the overall schedule of the project.

Spatial disturbance buffers

We initially utilized a 91-m spatial buffer to minimize disturbance to the nesting falcons. However, as construction progressed, the falcon pair demonstrated resilience to human disturbance and we adjusted the spatial buffer based on behavioral observations. In general, we employed a wide buffer (69–91 m) for repetitive loud activities and bridge climbing or foot traffic, while occasionally reducing the buffer to 46 m for less frequent activities. We often determined the exact buffer distance using the architecture of the bridge. For instance, in 2013 we had noted during behavioral observations that falcons tolerated personnel access as close as the adjacent pier of the bridge, which was 77 m away from the nest box. Thus, we adjusted the spatial buffer accordingly for that nesting season.

Observations

2011

Prior to the 2011 nesting season, a barge loading dock for the project was constructed on shore at a distance of about 46 m from the nest box. That spring, the falcons nested in the recently relocated nest box and produced 4 young. A 91-m spatial buffer around the nest box was imposed for activities during the 2011 nesting season. Construction personnel made an effort to avoid loud activities or access to the underside of the bridge within the buffer. In early June, we found 1 fledgling male falcon on the shore incapable of sustained flight, apparently having been blown from the nest perch during a storm. We placed the uninjured fledgling back on the nest pier and it later fledged successfully, along with the other 3 young. The pier supporting the nest box was off limits to construction personnel, even for most of the non-nesting season. Loud work to reinforce an adjacent pier 77 m from the nest box occurred after the 2011 nesting season.

2012

In 2012, the same falcon pair used the provided nest box and produced 3 young. We reinitiated the 91-m buffer at the start of the 2012 nesting season, until the demolition of a bridge span 46 m from the nest box occurred on April 25, 2012. The nest box faced away from the demolition, and the span was removed with 1 blast via explosive charges that were directed away from the nest. The blast occurred during the afternoon when the nest contained chicks <1 week old. Monitoring occurred for 4 hours prior to and 2 hours after demolition, and normal brooding behavior was not disrupted by the blast. After the demolition, pile-driving occurred at a distance of 69 m throughout May and June 2012, during the late nestling and fledging period. In late May, we found 1 fledgling female falcon on the shore incapable of sustained flight, presumably having left the nest early. We placed the uninjured fledgling back on the nest pier and it later fledged successfully, along with the other 2 young. After the nesting season, Walsh Construction erected temporary piers and the new superstructure parallel to the old bridge at a distance of 4.6 m.

2013

In December 2012, we installed a new nest box on the new bridge for the 2013 nesting season. The same falcon pair then nested in the nest box on the old bridge and 4 young fledged successfully. Deck removal on the old bridge occurred in preparation to demolish the rest of the old superstructure. Much of this occurred during the nesting season, except for a span within 77 m of the nest box, which was delayed until 3 weeks after the young fledged in June 2013. After the 2013 nesting season, demolition of the remaining old bridge trusses occurred in August. Minimal blasting occurred since each of 4 bridge spans was removed with a single blast. No more than 2 blasts occurred in a single day. We observed falcon behavior during these demolition events. The young were fully flighted by this time and exhibited no negative effects from this demolition.

2014

In 2014, the same falcon pair nested in the new nest box on the new bridge. The new bridge superstructure was slid from the temporary piers 17 m onto the old (reinforced) bridge piers, during the incubation phase of the nesting season on April 10, 2014. We observed the falcons throughout this process (12 hours), and normal incubation occurred undisrupted. Once the bridge was in its final position after the slide, the bulk of construction activity nearest to the nest box occurred at reinforced piers, 107 m and 76 m away. Noisy activity at the piers included welding, removal of the sliding harnesses, and final painting. Construction crews also removed the temporary piers using non-explosive means. These were adjacent to the existing piers at 107 m and 76 m. For the most part, the structure of the bridge provided a visual barrier, and these activities were out of view from the nest box. The bay (15 m in length, including a catwalk) between the nearest floor beams to the nest box was off-limits to all personnel during the nesting season and otherwise accessed only when necessary. Therefore, the falcons did not see personnel directly approaching them on the bridge and could only see construction personnel working at a distance at the piers.

In late May, we found 1 fledgling female falcon on the shore, incapable of sustained flight, presumably having fledged prematurely. This fledgling had a wing injury, and we transferred it to a permitted wildlife rehabilitator. The other 3 young fledged successfully, and the injured female was successfully rehabilitated and later released. After the nesting season, painters performed touch up work in the bay where the nest box was located. Peregrine falcons continued to nest in this nest box from 2015 to 2019.

Discussion

The same adult falcons were present at this site during 2011 to 2014. Replacement of one of the adults during the project may present a challenge as nest sites will sometimes change if a new adult takes over a territory (Cade et al. 1996). Adequate disturbance buffers may also differ between individual raptors, with some individuals being more susceptible to disturbance than others (Stalmaster and Newman 1978). We recommend that spatial buffers be adapted using behavioral monitoring results whenever possible. Site-specific characteristics, such as the visibility of disturbing activities from the nest, as well as the history of human disturbance at the site should also be considered (Stalmaster and Newman 1978, Richardson and Miller 1997).

First flights can be challenging for peregrines, and it is not unusual for a bridge-reared fledgling to fall into the water or end up on shore, especially if high winds occur during the fledging window (Cade et al. 1996). In the years prior to this project (2007–2010), we rescued 3 fledglings from the shore. Thus, we assume the rate of fledging success, which occurred during bridge reconstruction, was comparable to what it had been in the past and attribute early fledging events to windy weather more so than construction-related disturbance. Given the extent of our monitoring, we were able to intervene and assist a few grounded fledglings during our project. We realize this might not always be possible, but even without the rescues, 12 young fledged, unassisted, from the bridge during reconstruction.

Management implications

The alternative to working around an active nest for a species of concern is to attempt to deter the birds from nesting during construction. This is often done by blocking access to the nest location or removing nesting substrate prior to egg laying (USFWS 2002). Deterrence efforts are not always successful and can be more burdensome than working around a nest. Once peregrine falcons establish a nest on a structure, they do not dissuade easily from nesting there in future years (Cade et al. 1996). In our case, we opted to work around the falcon nest and avoid disturbance as much as possible. Avoiding disturbance can be difficult to define, as biologists have long argued about what constitutes disturbance (Grubb and King 1991). In our case, our goal was to prevent the disruption of normal nesting behaviors, especially to the point of decreasing normal productivity.

Previous recommendations for spatial buffers to prevent disturbance of nesting falcons varied between 800 and 1600 m (Richardson and Miller 1997). However, a buffer this wide would have precluded the falcons nesting on the bridge during reconstruction, as the total length of the bridge was 970 m. In this scenario, nest deterrence would have been the only option, resulting in 4 lost years of productivity. In the case of a recovering but still rare species like the peregrine falcon, the productivity of a single nest can be important to local populations. To that point, 14 young fledged successfully from this nest during the reconstruction process, and we later confirmed 2 of those individuals (one had been assisted when fledging) as breeding adults at other nesting sites in Kentucky.

In our case, a 46–91-m buffer was sufficient to avoid disturbance to the nesting falcons, and the falcons were much more resilient to construction activities than anticipated. Installing deterrents at the old nest site on the old bridge probably encouraged the falcons to nest in the provided nest box. This allowed us to locate the disturbance buffer where it would not majorly hinder construction progress. In similar circumstances, we highly recommend encouraging falcons to nest in a nest box prior to the start of construction. A pair that is already accustomed to a nest box is much more likely to follow the nest box, when moved, and installation of deterrents may not be necessary for pairs with a longstanding history of nesting in a nest box.

In 2012, we felt fortunate that blasting occurred after the eggs hatched because we were concerned about egg breakage if blasting were to occur earlier. Blasting 100 m from a peregrine falcon nest at a quarry near Canberra, Australia did not break the eggs or prevent them from hatching (Olsen and Allen 1997), but demolition at our site occurred closer to the nest (46 m). Although our observations demonstrate that nesting falcons can tolerate some demolition during the nesting season, it may be prudent to avoid blasting in the immediate vicinity of a nest during the incubation timeframe. Our observation of the demolition blast causing no disruption to brooding behavior was similar to the findings of Holthuijzen et al. (1990), who found prairie falcons (*F. mexicanus*) frequently continued brooding during nearby blasting or resumed brooding within a few minutes post-blast. This same study recommended a buffer of 125 m for blasting near prairie falcon nests, with no more than 3 blasts on any given day. Because a prolonged break in incubation or brooding may hinder hatching or survival of young nestlings (Sockman and Schwabl 1998), major disturbances such as demolition should occur on dry, warm days.

Although peregrine falcons often nest on bridges, not all bridge sites provide high-quality nesting areas. Watts and Watts (2017) noted low fledging success for falcon nests on bridges in Virginia, USA, particularly those without nest boxes. We surmise the placement of each nest on a bridge relative to prevailing winds, the road, and the topography probably results in some variation in fledging success for bridge nests. Our site was positioned under the bridge deck, in a nest box close to the shore. These attributes likely led to better fledging success than bridge sites that are over large expanses of water or above the roadway where young may be hit by cars when learning to fly. Watts and Watts (2017) noted that nest boxes boost reproductive success on bridges, and in our case, we think the placement of the nest box facing beams under the bridge also helped fledging success because young could use the nearby bridge structure for exercise in the days after fledging.

Due to long-term monitoring, we knew this nest had some fledging success, despite the occasional rescued fledgling. Thus, in this situation, we felt it was worthwhile to use the aforementioned mitigative tactics for continued productivity during construction. However, at less successful bridge sites, other tactics may warrant consideration during construction and maintenance if the necessary state and federal permits can be obtained. For instance, Watts et al. (2018) describe translocation efforts for nestling falcons from bridge sites with low fledging success to hacking areas in the mountains of Virginia. Fostering of nestling falcons from bridge nests with low fledging success to other nearby nests with known success may also be an option if no hacking efforts are taking place (Bildstein and Bird 2007).

It is important for biologists, road departments, and construction personnel to develop a good working relationship when carrying out mitigation for species of concern. Communication and collaboration between biologists and construction personnel was key to the success of this project and will be essential in similar endeavors. Creative solutions and compromise from both parties allowed for feasible mitigation and minimal interference with construction operations.

The recovery of several species of birds of prey that use manmade structures for nesting (e.g., osprey [*Pandion haliaetus*], peregrine falcon, and barn owl [*Tyto alba*]) has led to increased occurrence of human conflict with these species in regard to construction plans, utilities, and communications equipment maintenance (Washburn 2014). Management guidelines should allow for conflict mitigation that is mutually beneficial. Because opportunities for replicated experiments on spatial buffers and other mitigation practices are rare, more case studies on successful mitigation procedures should be shared to provide supportive information for similar situations.

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