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Management Recommendations for Washington's Priority Species

Ferruginous Hawk

Buteo regalis

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General Range and Regional Distribution

The ferruginous hawk (Figure 1; *Buteo regalis*) occupies western North America from Canada through central Mexico (Ng et al. 2020). Washington is at the northwestern limit of the species' breeding range, which extends eastward to extreme southwestern Manitoba, and south to Texas (Figure 2). Although range-wide breeding distribution mirrors that in historical times, there was a documented contraction of range in Alberta, Saskatchewan, and Manitoba in the 1900s from agriculture conversion and aspen (*Populus* spp.) invasion (Ng. et al. 2020).

Figure 1. Adult ferruginous hawk in flight.

Most (98%) ferruginous hawks migrate from breeding territories after nesting (Watson et al. 2018*a*). Post-nesting migration begins in late summer for regional breeding populations, except those in Canadian grasslands, with hawks migrating eastward and northward to the northern grasslands and Great Plains (Watson et al. 2018*a*). Hawks migrate again in fall, with hawks from Washington wintering in central to southern California, and other populations wintering eastward through the southern grasslands (Figure 2).

Range-wide, ferruginous hawks spend most of the year away from their breeding territories in migration and on late-summer and winter ranges (Watson et al. 2018*a*). Because most ferruginous hawks do not spend the non-breeding period in Washington, and there is no wintering population of ferruginous hawks in the state, impacts from development and management recommendations in this document

Figure 2. (left) Distribution of ferruginous hawks in North America (allaboutbirds.org) and (right) Washington (WDSM Data System, WDFW).

are limited to the breeding population. However, many of the same threats and management recommendations presented here are also relevant to Washington's hawks on their non-breeding ranges in other regions.

Rationale

Range-wide population estimates of ferruginous hawks in the early 1990s, tallied on a state and provincial basis, were between 2,921 and 5,665 nesting pairs (Olendorff 1993). Owing to perceived population declines, the species was petitioned for federal listing under the Endangered Species act in 1983 and 1991, but a federal listing was not found to be warranted (USFWS 1992). Trend analysis of Breeding Bird Surveys indicate several states and regions have experienced downward trends since 1993 (Sauer et al. 2017). In Canada, the species was federally listed as Threatened in 1980, downlisted to Special Concern in 1995 and relisted to Threatened in 2008 (COSEWIC 2008). In Alberta, a breeding stronghold of the species range-wide, the species was designated as Endangered in 2006. The ferruginous hawk in 2005 was designated a Species of Greatest Conservation Need in 17 U.S. states and in several states is a state listed species (Ng et al. 2020). This species in Washington was listed as State Threatened in 1983 and owing to continued decline in nesting pairs was reclassified as State Endangered in 2021 (Hayes and Watson 2021).

Resource Requirements

The ferruginous hawk is an open country raptor that inhabits grasslands, shrubsteppe, and deserts of North America (Ng et al. 2020). These native habitats provide the critical resources that ferruginous hawks require for successful nesting: medium-sized mammal prey, low structure suitable for nest placement, and space that isolates it from disturbance. Their breeding habitat in Washington most often occurs in shrubsteppe and juniper savanna. These areas are especially important as ferruginous hawk habitat when occupied by native mammalian prey and when there is basalt rock outcrops or isolated trees, primarily juniper, to provide suitable nest sites (Bowles and Decker 1931, Bechard et al. 1990, WDFW 1996). Degradation or conversion of shrubsteppe and grassland often results in reduction or removal of the critical resources ferruginous hawks require for nesting.

Prey

Ferruginous hawks are dietary specialists that thrive on mammalian prey (Olendorff 1993), including ground squirrels and jackrabbits, often supplemented by pocket gophers (Figure 3). Ferruginous hawk nesting populations and breeding performance fluctuate in synchrony with populations of these prey. Hawks can lay more eggs per nesting attempt when their prey populations are high (Ng et al. 2020).

Figure 3. Washington ground squirrels like this one are preferred by ferruginous hawks as prey.

As many as six young can fledge from a nest in a year when prey populations are productive (Clarke and Houston 2008). Years of high prey productivity can buffer from years of poor hawk reproduction when prey populations are low. However, this points to the need for prey populations to recover to create a sufficient buffer.

Ferruginous hawk diets in Washington are comparatively diverse to elsewhere in their range. This is largely because of declines in their preferred prey of ground squirrels and jackrabbits in Washington. Their diets mainly consisted of insects (51%) and mammals (49%) based on the findings of a study of 67 nests in eastern Washington (Richardson et al. 2001). Mormon crickets (*Anabrus simplex*) were the main insect prey (92%) and northern pocket gophers (*Thomomys talpoides)* were the main mammalian prey (72%). Jackrabbits now contribute less in terms of prey, which is a major dietary shift noted since the 1920s. Other studies in Washington (Fitzner et al. 1977, Mazaika and Cadwell 1994, and Leary et al. 1996) have reported diets consisting of pocket gophers, Columbia Plateau pocket mice (*Perognathus parvus*), reptiles, and even gulls. These shifts are not without consequences as they can reduce nestling survival and can lead to declining hawk populations (Preston et al. 2017, Heath et al. 2021).

Figure 4. Ferruginous hawk nest in crook of a lone tree in grassland habitat.

Nests

Ferruginous hawks build their nests on natural and artificial objects that can be either on the ground or on low structures. Most nests are constructed away from human activity. Historically, ferruginous hawks may have built their nests on the ground due to fewer ground predators and less human disturbance. However, a summary of nest use in the 1970s and 1980s found that 49% of nests were in trees (Figure 4), 21% cliffs (Figure 5), 9% dirt outcrops, and only 6% on the ground (Olendorff 1993). Twenty-one percent of nests were built on human structures, including on utility infrastructure, buildings, and haystacks. This shows that they are adaptable to using elevated artificial structures.

Figure 5. Ferruginous hawk nesting on rocky outcrop.

Ferruginous hawks in Washington nested primarily on cliffs (62%), followed by trees (34%), and on artificial structures (4%) (Bechard et al. 1990). Early research in southeastern Washington found nests constructed of greasewood (*Sarcobatus vermiculatus*; Bowles and Decker 1931). Later research found nests constructed mainly of sagebrush and rabbitbrush sticks of at least 5 cm (2 inches) in diameter and lined with bunchgrass and peeled sagebrush bark (Fitzner et al. 1977).

Ferruginous hawk nests and nest structures may be lost to natural and human-caused disturbances. These can include fire, inclement weather, and the establishment of invasive trees in grasslands (Datta 2016, Parayko 2021). This resulting loss of nests can then reduce nesting opportunities for ferruginous hawks and can increase competition with other raptors, common ravens (*Corvus corax*), and great-horned owls (*Bubo virginianus*).

Space

Nesting ferruginous hawks have comparatively large breeding home ranges. They inhabit arid open country isolated from disturbance but that have limited nest structure and low densities of burrowing mammals. The breeding home range of a ferruginous hawk encompasses all resources necessary for a pair of hawks to nest successfully. The core of their home range requires the resources that breeding hawks most often use. The size of the home range and core area vary with the density and distribution of these local resources (Figure 6).

Seven hawks tracked with ground-based telemetry in Washington had breeding home ranges 10 times larger (78.6 km^2) than those in other regions (Leary 1996). Long flights (>15 km) taken to the nearest irrigated agricultural fields accounted for this large home range. These fields were harvested several times a year and thus had low canopy cover that likely enhanced the foraging opportunities for hawks.

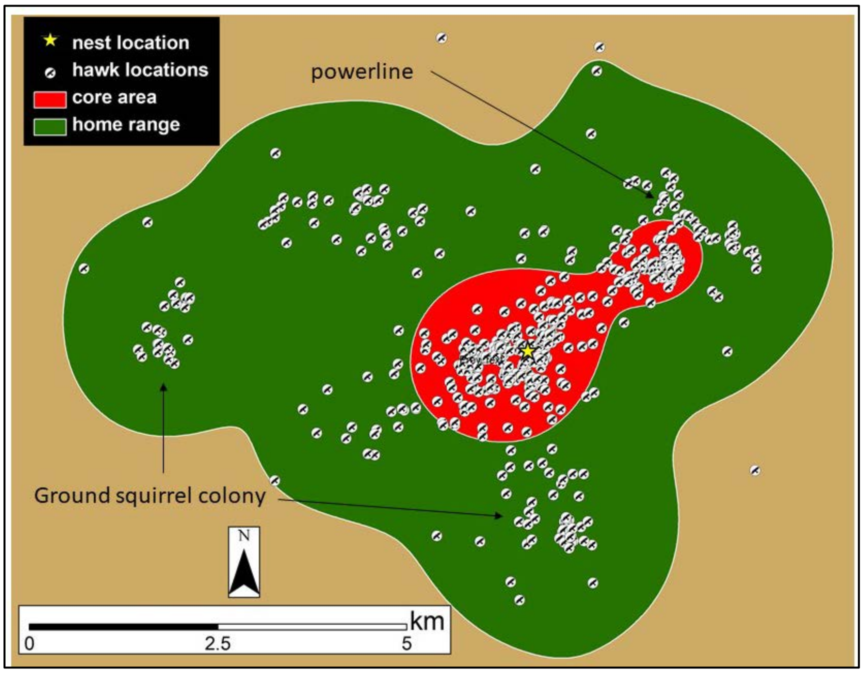

Figure 6. Stylized ferruginous hawk home range and core area.

More recent use of precise satellite telemetry found even larger ferruginous hawk home ranges in southern Washington and north-central Oregon (Watson et al. 2023). Home ranges in this study averaged 378 km^2, with core areas averaging 39.8 km^2 (17 hawks monitored for a total of 33 combined years). The comparatively large home ranges found in this study were attributed to the scattered distribution of prey in this region. These studies suggest ferruginous hawks travel further from their nests when prey availability is low. This ultimately influences a hawk's home range size.

Adult hawks in the Pacific Northwest are on their home ranges between 27 December and 17 October (Table 1; Watson et al. 2018*a*). The December arrival date is due to the small percent of adult male hawks (6%) that return to winter on their breeding ranges after late-summer migration. Most hawks arrive in early March. Fledglings typically migrate before, and independently from, adults (Watson et al. 2019). Although earlier studies suggested ferruginous hawks moved nomadically during prey declines (Schmutz and Hungle 1989, Woffinden and Murphy 1989) more recent evidence based on satellite telemetry find that ferruginous hawks have a high fidelity (83%) to their breeding home ranges throughout their breeding distribution, with most birds returning to the same ranges year after year (Watson and Keren 2019).

Table 1. Chronology of ferruginous hawk nesting in the Pacific Northwest (derived from 20 radio-monitored adults studied for 33 combined years, J. Watson, unpublished. data).

Behavior	**Date**		
	Begin	**Average**	**End**
Arrival of adults on home ranges	27 December	2 March	22 March
Incubation initiated	1 April	13 April	30 April
First eggs hatch	3 May	15 May	31 May
First young fledge	11 June	24 June	11 July
Late summer departure of adults from ranges	5 June	21 July	17 October

Limiting Factors

Human-caused or natural changes in ferruginous hawk habitats may reduce reproduction when either impacts the prey, nests, and space required for nesting. Direct mortality and disturbance of hawks from development may limit the size of breeding populations. A population viability analysis concluded the most important factors affecting ferruginous hawk population trends were adult survival and their ability to produce offspring (Collins and Reynolds 2005). Adult mortality is likely additive (Dwyer et al. 2018), effectively meaning there is no surplus of adults to replace those lost to cumulative sources. Disturbance of nesting hawks may alter their behavior potentially impacting their reproductive success, health, and survival of their young. Disturbance of nesting raptors may result in nest desertion, damage to eggs and young by frightened adults, cooling, overheating, and loss of moisture from eggs or young, premature fledging of young, or avian and mammalian predation (Rosenfield et al. 2007). For ferruginous hawks, disturbances may not only reduce productivity, but cause future nest desertion, and be exacerbated during periods of depressed prey populations (White and Thurow 1985).

Residential, recreational, and industrial development (e.g., renewable energy, surface mining, and road construction) may eliminate prey and nesting habitat during development of facilities, homes, solar arrays, roads, and other infrastructure. Hawks may respond by avoiding or by completely abandoning an area of disturbance (Dwyer et al. 2018). Hawks that continue to nest in these areas may be affected by disturbances associated with development (e.g., pedestrians, vehicles, machinery) both during and after construction. Disturbance is manifest as disruption of natural behaviors that may be subtle (e.g., flushing) or less obvious (e.g., displacement or abandonment) and may ultimately result in reduced reproduction. Direct, accidental mortality of ferruginous hawks is often due to vehicle collisions and more recently with wind energy development when they collide with rotating, elevated blades that reside in the flight space of their home range. Ferruginous hawks also collide with powerlines or may be electrocuted on distribution poles, both are increasingly recognized as threats to endangered bird populations (D'Amico et al. 2018). Solar energy development may also increase risk of electrocution and potential for fatal burns of hawks flying through solar flux fields (McCrary et al. 1986, Diehl et al. 2016). Recreational development and road construction that increase ORV access can increase disturbances, such as the illegal shooting of ferruginous hawks. Shooting was historically the highest assigned cause of mortality (15.8%) for ferruginous hawks banded and recovered between 1916 and 1992 (Gossett 1993).

Nesting of ferruginous hawks is potentially impacted by several other land management activities that primarily affect prey. Recreational shooting or poisoning to control or eliminate burrowing mammals may result in lead toxicosis or sub-lethal hemorrhage of hawks that consume mammal carcasses (Chesser 1979, Knopper et al. 2006, Murray 2017, Vyas et al. 2012). Effects of cultivation on ferruginous hawk nesting have been studied extensively in ground squirrel habitats in Alberta, with highest densities of hawks maintained at about 10% cultivation, declining at 30% (Schmutz 1999). Overgrazing and overstocking cattle in pastures can have negative consequences on vegetation and prey (Fleischner 1994, Wick et al. 2016) as well as increasing rubbing and trampling of nest trees (Houston 1982). Because ferruginous hawks avoid dense forests and use isolated trees or groves for nesting, intrusion of aspen or juniper into grassland and shrubland may inhibit nesting (Woffinden and Murphy 1983, Bartuszevige et al. 2012, Kennedy et al. 2014).

Management Recommendations

A goal of ferruginous hawk management in Washington is to protect all areas associated with their nesting. This corresponds to areas in close vicinity of recently used and unused nests (see the *Identification of Ferruginous Hawk Habitat* section below). Their endangered status is one reason why WDFW has taken a broad interpretation of the areas that should be protected, including unused nesting areas. A status of endangered means that the species is "seriously threatened with extinction throughout all or a significant portion of its range within the state" (see WAC 220-610-110). We also recommend protecting unused nesting areas because the species can re-occupy former nesting territories. Ferruginous hawks have been observed returning to unused nests after an absence of at least 20 years (Romin and Muck 2002, M. Vekasy, pers. comm., J. Fidorra, pers. comm.).

Proponents of land-use activities in areas associated with ferruginous hawk breeding should determine the potential project impacts. Proponents should devise appropriate management strategies for conserving ferruginous hawk habitats associated with proposed actions. What follows are the steps for project assessment and implementation.

Identification of Ferruginous Hawk Habitat

Ferruginous hawk nests are the focal point of breeding. From 1978 to 2020 WDFW identified and mapped 672 ferruginous hawk nest locations on 287 home ranges (WSDM database). Nest locations were used to identify areas associated with ferruginous hawk breeding habitat.

Areas "associated with" ferruginous hawk are lands that provide the space and prey needed for ferruginous hawks to successfully reproduce ("breeding habitat"). Breeding habitat consists of vegetation types listed in Table 2 provided the land is either (a) within 10 km of a ferruginous hawk nest site that has been identified at any time since September 1, 1991, or (b) within 20 km of a nest used by Ferruginous Hawks within the past five years. Breeding ferruginous hawks may use pastures, lands enrolled in the Conservation Reserve Program (CRP), or edges of irrigated agricultural land. We address management of agricultural practices and activities in areas "associated with" ferruginous hawk in the section below titled *Guidance for Voluntary Stewardship Planning*.

Table 2. Vegetation types associated with Ferruginous Hawk breeding habitat.

Vegetation Types
Columbia Plateau Scabland Shrubland
Inter-Mountain Basins Big Sagebrush Shrubland
Columbia Plateau Steppe and Grassland
Inter-Mountain Basins Big Sagebrush Steppe
Inter-Mountain Basins Semi-Desert Shrub-Steppe
Columbia Basin Foothill and Canyon Dry Grassland
Columbia Basin Palouse Prairie
Inter-Mountain Basins Active and Stabilized Dune
Inter-Mountain Basins Cliff and Canyon

When a proposal is first submitted for review, flag where the land use activity occurs relative to the nearest ferruginous hawk nest (Figure 7). This is usually done by the municipal or county authority in charge of planning and development. This step is carried out by overlaying the location of the proposed land use activity with WDFW's Priority Habitats and Species (PHS) data. The PHS data shows the location of ferruginous hawk habitat. The type of mitigation and appropriate management strategies will depend on the proximity of a given land use proposal to the nearest ferruginous hawk nest site (Table 3).

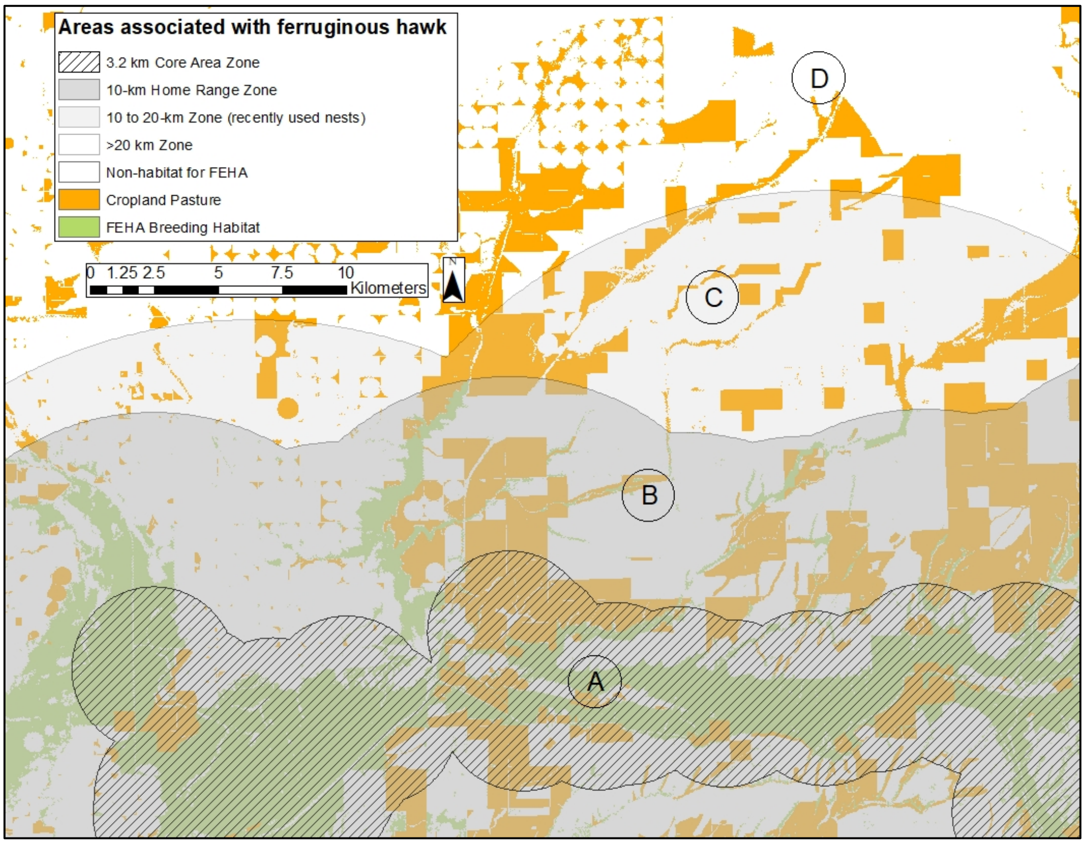

Figure 7. See Table 3 for recommended Next Steps in each of the management zone illustrated here.

Table 3. Spatial zones and preferred habitats associated with breeding ferruginous hawk that project proponents should reference in their site assessments to determine next management steps. Zones are illustrated in Figure 7.

Zone	Nearest nest (km)	Area of influence	Next steps for land use proposals
A	<3.2 km (core area)	All lands within 3.2 km of a ferruginous hawk nest. Managed this area to avoid disturbing nesting hawks by protecting active and inactive nests as well as foraging areas.	• ***Survey Assessment -*** Recommended • ***Habitat Management Plan*** ✓ Avoidance strongly recommended in this zone. ✓ Minimization measures requires no net loss of function ✓ Compensatory mitigation strongly discouraged.
B	3.2 to 10 km (home range)	Lands between 3.2 to 10 km of a ferruginous hawk nest when lands are composed of vegetation types listed in Table 2 or are in pasture, CRP, or the edges of irrigated agriculture. These lands often support the prey that breeding hawks require.	• ***Survey Assessment -*** Recommended • ***Habitat Management Plan*** ✓ avoidance and minimization in areas associated with ferruginous hawk ✓ Strongly discourage compensatory mitigation for areas with ground squirrel colonies.
C	10 to 20 km	Lands between 10 to 20 km of a nest used by ferruginous hawks in the past five years <u>and</u> when these lands are composed of vegetation types listed in Table 2.	• ***Rapid Assessment -*** Required • ***Survey Assessment*** – Dependent on rapid assessment results. • ***Habitat Management Plan –*** Only if ferruginous hawk nests or ground squirrel colonies are observed during rapid or survey assessment.
D	>20 km	All lands where the closest Ferruginous Hawk nest is >20 km away.	No action necessary

Site Assessment

Avoidance of any land use proposal is strongly advised when the proposal is in **Zone A**. A survey assessment should be required for any land use proposal in Zone A that cannot be completely avoided. A survey assessment should also be required in **Zone B** when the project or project disturbance to ferruginous hawk cannot be avoided. The protocol for conducting a survey assessment is in Appendix 1. The survey assessment is required for gathering the necessary information needed to develop a Habitat Management Plan (HMP).

We recommend a *rapid on-site assessment* whenever an activity is proposed in **Zone C**. The protocol for conducting a *rapid on-site assessment* is in Appendix 2. This type of assessment will not require collecting any detailed or elaborate measurements. Rather, it is a brief survey of the site to determine if further action is necessary. If the rapid assessment demonstrates a need for further action, then proceed with a more detailed *survey assessment*. No action is required to manage or mitigate land use proposals for ferruginous hawk when a proposed activity is in **Zone D**.

Mitigation

A Habitat Management Plan describes the mitigation measures designed to avert project impacts to ferruginous hawk habitat. We recommend that users of this document follow the mitigation sequence when evaluating a project in habitat associated with ferruginous hawk. The mitigation sequence is a framework of alternate actions that a land use applicant should consider for reducing a project's negative impacts. These alternate actions are listed in order of preference:

- **Avoiding** impacts altogether by not taking a certain action. In this framework, avoidance is always the first action to consider because it is the preferred approach to conserving habitat for ferruginous hawk.

- **Minimizing** impacts by limiting the degree or magnitude of the action and its implementation by using appropriate technology, or by taking affirmative steps to best reduce impacts (e.g., habitat restoration). This alternate action is meant to minimize the negative impacts of a project on ferruginous hawks. Minimization should only be implemented after thoroughly considering all avenues to avoid impacts altogether. Project planners and developers at a minimum should aim to achieve a standard of no-net-loss of habitat function when devising a plan to minimize impacts. The preferred standard is a net-ecological gain of habitat function. This standard is preferred because ferruginous hawk is an Endangered Species in Washington that will likely require a greater amount of functional habitat to reverse population declines.

  A Habitat Management Plan should be designed to identify the strategies that the project applicant will take to minimize impacts. Common strategies to minimize impacts include reducing a project's footprint and intensity, siting a project further away from higher quality habitat, creating or restoring habitat, or using low impact development practices. A successful strategy will ultimately be designed around the site-specific opportunities to benefit the species. Often there will be more opportunities to mitigate negative impacts on ferruginous hawk when the parcel being developed is either relatively large or when it consists of varying levels of habitat quality. Parcels almost entirely comprised of higher quality habitat or where options to minimize impacts are limited should be strong candidates for taking a strategy of avoiding impacts altogether.

- **Compensating** involves the use of off-site mitigation for impacts. It is considered the last resort option and should be used only after all other on-site mitigation options have received serious consideration and are deemed unfeasible. Compensation is not supported within the core nesting habitat of Ferruginous Hawks (within 3.2 km of a nest) because of the highly imperiled status of this species in Washington. Beyond this 3.2 km zone of core nesting habitat, compensation is still the least preferred alternative from a conservation standpoint. This is because compensatory mitigation will result in habitat loss and will likely harm or destroy areas of Ferruginous Hawk breeding habitat.

  Because Ferruginous Hawk is an Endangered Species in Washington and a species in decline, sites secured elsewhere to compensate for lost habitat should be larger than the site being replaced. Off-site mitigation can also be combined with minimization, especially when actions to minimize impacts on-site cannot achieve no-net-loss of habitat function.

  Compensatory mitigation should occur as close in proximity as possible to the parcel being replaced. Sites considered as off-site replacement habitat should undergo a survey assessment. The following are selection criteria for identifying an alternative site suitable to provide off-site mitigation:

  - ✓ Mitigation site is of equal or greater habitat quality than the site being replaced as determined through a survey assessment of the mitigation site.
  - ✓ Mitigation site should be as close in proximity as possible from the site being replaced and no further than 10 km from replaced site.
  - ✓ Mitigation sites adjacent to other conserved properties are preferred.
  - ✓ Mitigation site should be three times the area of site being replaced (3:1 mitigation ratio)
  - ✓ Mitigation sites greater than 10 km from replaced site should require a 5:1 mitigation ratio.
  - ✓ Mitigation site is well connected to other areas of natural or semi-natural habitat.
  - ✓ Mitigation site has little or no artificial impervious surfaces.
  - ✓ Mitigation site will not require long-term maintenance to sustain ferruginous hawk breeding habitat functions.

Mitigation sites secured to replace lost or degraded habitat should be protected with a conservation easement or a comparable legal instrument in perpetuity. The legal instrument should be put into place before any portion of the replaced site undergoes construction or other disturbances. The legal documentation must, to the extent appropriate and practicable, prohibit incompatible uses on the mitigation site that might otherwise jeopardize the objectives of the compensatory mitigation project.

Habitat Management Plan

Planners and developers should develop a HMP for parcels where there are available options to minimize impacts. A HMP (often called a Critical Area Report), when implemented, should at a minimum result in no-net-loss of ferruginous hawk habitat function. Although habitat function cannot be precisely measured, known attributes of quality habitat can be used to generate useful estimates.

A template for developing a HMP is provided in Appendix 3. This template is made up of three parts:

Part 1 is filled in with basic information about the applicant, their representatives, the location of the site, and a description of the proposed project that will be mitigated through the measures outlined in this HMP.

Part 2 is where the site features of significant value to ferruginous hawks are described as well as depicted in a map that is attached with the HMP. This is where the survey assessment of the site will provide critical information.

Part 3 is where a detailed explanation of mitigation and post mitigation monitoring measures are described. This section should be written with sufficient detail so that anyone reviewing it can assess with confidence if the mitigation measures will or will not achieve no-net-loss of habitat function.

To aid in the development of a HMP, we provide potential mitigation measures (Appendix 4) that can be used to create a plan to mitigate impacts. The mitigation measures are categorized by development type and can be established within a HMP to address the loss of ferruginous hawk breeding habitat function. Industrial and residential construction activities should be avoided between April 1 (earliest time of incubation) through July 21 (average time of adult departure).

Prior to its approval and implementation, the HMP should be reviewed by an unbiased party knowledgeable in the ecology of regional habitats. The WDFW district wildlife biologist in your area should be contacted to request their review or to provide a reference for a qualified reviewer.

Additional Guidance

Guidance for Community and Long-range Planning

Local governments can play an important role in helping to conserve and maintain functional ferruginous hawk breeding habitat. This section provides guidance to help local governments review, develop, and implement regulatory tools and incentives to protect habitat for ferruginous hawk.

Local governments should strive to maintain existing habitat functions for ferruginous hawk by regulating land use activities likely to impact these important ecological functions. To ensure this happens, the first step is to include language in critical areas ordinances (CAO) to require the use of maps showing known and potential habitat for ferruginous hawks (such as those published by our PHS program). That information can then be used to flag land use projects and proposals in or near areas of potential habitat.

It is also important to have language in a CAO requiring a site visit whenever a land use proposal is flagged and could impact areas of potential habitat. For that, we recommend referring to the process outlined in our recommendations for conducting an on-site assessment to help determine when an area is associated with ferruginous hawk breeding habitat (see *Identification of Ferruginous Hawk Habitat* above). The results of that assessment should also inform mitigation actions, including the development of a HMP, that when implemented, will achieve at a minimum no-net-loss of habitat function on the site being developed.

While it is important to have ferruginous hawk habitat protections built into local codes, it is also important for jurisdictions to use the mapped data to inform decisions about zoning, comprehensive planning designations, and urban growth areas (UGA). More specifically, we recommend that local planning authorities carefully consider the potential impacts of rezoning sites with ferruginous hawk breeding habitat to more intensive land use designations. We recommend avoiding the expansion of UGAs or creating more intense land use designations in areas associated with ferruginous hawk breeding habitat. Such changes in land use designations creates greater expectations for development that then may be difficult to mitigate.

In places where land use designations are already set at levels likely to result in impacts, other tools should be made available to landowners to minimize potential impacts to ferruginous hawk breeding habitat. An example might be to incentivize cluster development with bonus densities for setting aside areas in proposed parcels where there is habitat. This can work on certain parcels that are large enough to accommodate the development while also having enough space to set aside as protected area for breeding hawks.

Alternately, jurisdictions could adopt programs to offer financial incentives that promote land uses to levels that will not result in impacts to ferruginous hawk breeding habitat. One example would be a transfer of development rights program where landowners gain financial benefits by sending their development rights to other less sensitive areas. A second example is a Public Benefit Rating Systems program to provide tax incentives to encourage voluntary resource conservation on private property. A third example would be a conservation futures levy, which would levy local tax dollars for the use of acquiring properties for conservation. In general, jurisdictions with conservation futures programs can develop ranking criteria for selecting lands out of an application pool. A local jurisdiction could develop or modify such a program to give more points to applicants with ferruginous hawk breeding habitat in high-risk development zones.

Lastly, we strongly advise having a process in place to make sure all departments involved in land use permitting are coordinated. In addition to local planning departments, other departments can include public works that sometimes oversee permits for clearing and grading, which can be the precursor to a site being developed. So, all departments involved in permitting any part of a project proposal (e.g., building, clearing and grading, utilities) on a site flagged for ferruginous hawk breeding habitat should be coordinated and made aware of any related conditions or regulations in the local CAO.

Guidance for Voluntary Stewardship Planning

In addition to developing regulations to protect ferruginous hawk habitat, local governments, conservation districts, private landowners, and other entities can utilize voluntary and incentive-based conservation tools to improve recovery outcomes for the species.

Within the ferruginous hawk's geographic range, agriculture is the most prevalent land use activity. Compared to more intensive land uses, agricultural land can provide important habitat features to support the species foraging, breeding, and nesting life history needs. Conservation work on agricultural land therefore provides a valuable opportunity to support the species recovery. Common agricultural uses in the region include livestock grazing, irrigated crops, and dryland agriculture, which together create a mosaic of natural and cultivated land use features within the ferruginous hawk's range. Several federal and state programs exist for funding voluntary and incentive-based conservation practices on agricultural land to support the species recovery. This section provides guidance on voluntary conservation planning tools for achieving conservation outcomes for the species on agricultural land.

Protecting and restoring shrubsteppe and grassland habitat within the ferruginous hawk's geographic range is the preferred management approach for supporting the species recovery. To protect critical habitat, conservation tools should seek to limit the conversion of agricultural land to more intensive land uses. Keeping agricultural land viable and in production supports the state's agricultural economy and provides habitat for ferruginous hawk to forage and breed. Rangelands, which are used for livestock grazing and often composed of native shrubs and grasses, provide important foraging habitat for ferruginous hawks. Converting rangeland to cultivated crop may impact the species long-term survival by further fragmenting the natural landscape. We recommend limiting the intensification of agriculture on rangelands to less than 30% cultivation within a ferruginous hawk's home range to protect native habitat features. To further limit agricultural conversion, we recommend using zoning policies , such as zoning for long-term agricultural significance, and conservation easements to limit the conversion of agricultural land to higher intensity land uses and permanently protect land for its agricultural or conservation value.

To restore valuable habitat, federal and state programs exist for funding conservation actions on private land. The federal Farm Bill offers several programs that agricultural landowners can use to receive financial support. The Conservation Reserve Program (CRP) provides funding to lease agricultural land for conservation purposes. Landowners can enroll in 10–15-year contracts, with the option for renewal, while receiving ongoing rental payments. Eligible counties within Washington can apply for the Ferruginous Hawk State Acres for Wildlife Enhancement Program, which provides targeted funding to restore habitat conditions for the species. Long term participation and management in these programs helps restore habitat to historic conditions, making CRP programs more valuable through time. Other applicable federal programs include the Conservation Reserve Enhancement Program, Environmental Quality Incentives Program, and Conservation Stewardship Program.

At the state level, counties enrolled in the Voluntary Stewardship Program (VSP) are eligible for state funding to protect and enhance environmentally sensitive areas, referred to as critical areas, on agricultural land. The ferruginous hawk, which is listed as a Priority Species within WDFW's Priority Habitats and Species (PHS) Database, is considered a type of Fish and Wildlife Habitat Conservation Area and a focal species for recovery under VSP. Counties enrolled in VSP receive funding to work with agricultural producers to voluntarily implement best management practices (BMPs) on agricultural land to protect and enhance critical areas. Within the ferruginous hawk's geographic range, WDFW recommends the following BMPs to support the species recovery. These BMPs can be implemented through a variety of federal, state, and local programs to support voluntary conservation outcomes:

- Nest Structures: Maintain agricultural fence posts, lone trees or small groves, and other structures to provide perch and nesting habitat. Limit disturbance at nest sites during breeding season (1 April through 21 July) and reinforce nest trees from cattle rubbing. Where nest structures are limited, install artificial nest structures after consultation with WDFW biologists (see Appendix 5).
- Prey Abundance: Implement agricultural practices that provide habitat for native prey populations, including ground squirrel and pocket gophers. Restore and protect edge of field habitats and hedgerows, especially on irrigated alfalfa fields. Do not burn or plow edge of fields. Mow grain crops and other vegetation periodically to improve access to prey. After mowing or harvesting, maintain brush piles to provide cover for prey.
- Range Restoration: Rehabilitate pastures and rangeland through cheatgrass removal and restoration of native grasses and shrubs. Where appropriate, reduce stand density of

juniper and aspen to support open rangeland for foraging. Tree density should be in 4 small clumps per 2.6 km^2 for all raptors.

- Managed Grazing: Implement a grazing management plan that implements low-to-moderate grazing intensity to prevent the degradation of native habitat.

Finally, Conservation Districts and other local entities also play an important role in voluntary and incentive-based conservation. Conservation Districts provide financial support, technical assistance, education, and outreach to the agricultural community. Farm Plans are a resource tool developed jointly between a landowner and a Conservation District to identify voluntary actions landowners can take to achieve their land use goals, improve farm productivity, and protect natural resources. Conservation Districts and local entities can help producers apply for federal and state cost-share programs to implement voluntary actions identified in their Farm Plans.

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Appendices

Appendix 1. Protocol for conducting a survey assessment.

A *survey assessment* should be conducted for all land use proposals in **zone A** (Figure 3) and in zone **B** when the land use proposal is flagged as occurring on lands consisting of the vegetation types listed in Table 2. A survey assessment should also be conducted in **zone C** when the result of a rapid assessment shows that it is needed (see appendix 2). The survey assessment documents nests, prey, and habitat within the proposed project boundary.

We recommend hiring a professional consultant to conduct the survey assessment. The consultant should preferably be skilled in identifying and mapping vegetation as well as surveying wildlife. These skills are important for anyone carrying out the survey assessment because this is a tool that will be used to generate the data necessary for writing an HMP. Prior to collecting data for this survey assessment, please carefully read Appendix 3 to become familiar with the type of data that will be necessary to write an HMP.

Nest Documentation

Surveys for nests can be conducted by ground (optionally by air for professional consultants). This data will be used to provide the information required for subsection 2a in the HMP (see Appendix 3).

- Between 15 March and 15 May search for any raptor and common raven nests. Identify nesting species and map their nest locations when observed. Suspected raptor or raven nets should be mapped even when birds are not observed. To avoid disturbance do not approach nests and use optics at a distance to observe nests and record geolocations. Record the number of adult birds observed at the nest.
- Identify, document, map, and describe locations where there are elevated structures suitable for raptor nesting.
- Search elevated structures for nests including trees and artificial structures like transmission towers and windmills. Search cliffs, talus slopes, and rock outcrops.
- Use photo documentation and/or field identification guides to identify species.

Prey Documentation

Surveys for pray and prey habitat should be conducted from the ground. This data will provide the information required for subsection 2b in the HMP (see Appendix 3).

- Between 15 March and June 15 conduct ground surveys for and potential prey.
- Surveys for ground squirrels and jackrabbits are labor-intensive because animals are timid and signs of activity are used to determine animal presence (scat for both, and vocalizations and active burrows for ground squirrels). Ground squirrels may reside in disturbed habitats (roadsides, edges of orchards) and some species, like California ground squirrels (*Otospermophilus beecheyi*) may reside in rocky outcrops. These areas should be surveyed by direct inspection. More open and level habitats should be systematically searched by walking and listening or looking for sign along geolocated transects for complete coverage of the survey

area (Finger et al. 2007). Spot-lighting at night may enhance searches for jackrabbits (Smith and Nydegger 1985).

- Presence of pocket gophers is often evidenced by mounds of excavated soil in ground squirrel colonies or along edges of agricultural land.
- When small mammals are located the second step is to map the distribution (e.g., extent of ground squirrel colony) and point locations of prey species identified during surveys.

Habitat Documentation

Survey and map lands proposed for development composed of the habitat types in Table 2. Also, identify on the map any areas that are used as pasture or that are enrolled in CRP. This data will provide the information required for subsection 2c in the HMP (see Appendix 3).

- Survey and map areas composed the vegetation types listed in Table 2 along with a description of their state of quality or level of degradation.
- Survey and map any areas used as pasture or that are enrolled in CRP.
- The protocol in Appendix 9 in *Management Recommendations for Washington's Priority Habitats: Shrubsteppe* can be used to map vegetation and describe habitat quality.

Appendix 2. Protocol for conducting a rapid site assessment.

A rapid site assessment involves an on-ground assessment of habitats in zone B (Fig. 3; between 10 km and 20 km from a nest used by ferruginous hawks within the past five years).

Within this zone:

- Document any ferruginous hawk nests.
- Document evidence of ground squirrel colonies.

If either ferruginous hawk nests or ground squirrel colonies are identified, a survey assessment should then be required (Appendix 1). If neither nests nor colonies are identified, no further action is necessary.

Submit the results of the *rapid site assessment* to the current planner assigned to the proposal. The current planner should then include these results as documentation with the project proposal.

Appendix 3. Habitat management plan template.[1]

PART 1

1a. Applicant's Full Name	1b. Applicant's mailing address:
1c. Plan prepared by: (Full name and company affiliation)	1d. Date submitted:
1e. County	1f. Parcel ID number(s) of proposed development site.
1g. Description of the proposed project:	

PART 2

2a. Location of nests In the space provided below (and on a separate sheet if more space is needed), please briefly describe any nests found on or adjacent to the parcel where the land use activity is proposed. This data is gathered as part of the survey assessment described in this report. Identify which nests, if any, are occupied, condition of each nest, and features supporting each nest (e.g., juniper, rock outcrop, telephone pole, ground). Label each of the nest descriptions with a unique nest ID (e.g., nest #1, nest #2). Also, Identify, document, map, and describe locations where there are elevated structures suitable for raptor nesting. Attachment: • Map of site to scale clearly showing nest points with their ID numbers.[2]

[1] Attach supplemental pages if space in template is insufficient. Indicate in template when content for a section is continued on a separate page and indicate on the sheet the section(s) where the content is continuing from (e.g., continued from 2a).
[2] Attach a single map (rather than 3 separate maps) for all information required in sections 2a, 2b, and 2c.

2b. Prey Describe below (and on a separate sheet if more space is needed) any signs of prey species (e.g., burrows, scat, animal observations) on the parcel. This data is gathered as part of the survey assessment described in this report. Also, describe below any verified prey locations on site that are mapped in a WDFW databases (e.g., PHS on the Web) or that are observed during the survey assessment. In the description, identify the species if known. Attachment: • Map of site to scale with locations along with legend clearly depicting species and type of sign.
2c. Space Describe below (and on a separate sheet if more space is needed) the physical and ecological features that occur on the site. This includes the types of habitats, recent disturbances, location of waterbodies including creeks, as well as any physical features that Ferruginous Hawks might use for nesting. These include trees, rock outcrops and cliffs, as well as any elevated artificial features such as buildings or telephone poles. Habitat types on site should be identified using [Ecological Systems of Washington State](#). Attachment: • Map of site to scale showing locations of all physical and ecological features. Habitat types should be shown on map as areas. Other features can be displayed with lines (e.g., creeks) or points (e.g., a single tree).

Part 3

3a. Mitigation sequencing Describe below in detail reasonable efforts made to apply mitigation sequencing. Mitigation sequencing, to avoid, minimize, and compensate impacts to critical areas.
3b Mitigation On a separate sheet (attached to HMP) describe plan you intend to implement to ensure no-net-loss of habitat features important to ferruginous hawk (see Appendix 4 for mitigation examples). Create a plan that includes adequate detail so that any reader will clearly understand the steps that will be taken, their precise mapped locations on the parcel, and their timing. Describe how these steps will ensure that no-net-loss of habitat function is achieved on the site, and if the site is being developed or undergoing any land use action, how the measures will fully offset the loss of function that may be caused by the land use activity. Also, include a description of the process that will be implemented to monitor the mitigation measures to ensure their success over the long-term.
3c. Financial guarantees Please describe in detail the financial guarantees to ensure compliance with the measures described in the mitigation section, such as a performance bond describing the dollar amount, terms in which claims can be made against the bond, as well as the period that the bond will be in effect.

Appendix 4. Sample mitigation measures.

Industrial development – Wind Energy

- Build turbine strings and infrastructure outside of ferruginous hawk core use areas and home ranges to avoid nests, prey concentrations, and disturbance and collision impacts.
- Maximize proposed construction in areas that are already disturbed and reduce project footprint necessary to meeting project needs.
- Arrange turbines differently (Pearce et al. 2016; for ferruginous hawks avoid slope and rim edges and concentrate industrial development on unproductive agricultural land).
- Erect fewer turbines (fewer, newer, larger turbines are preferred over older turbines will lower energy generation).
- Consider whether solar panels may be part of project design to account for kilowatt hours in less impacting parts of the project area (homogenous agricultural land).
- Reduce risk of turbines proposed inside home ranges by stopping turbine motion when hawks are present using "Identiflight" or similar technology (Watson et al. 2018*b*, McClure et al. 2021).
- Address impacts related to new infrastructure (see Industrial development – Transmission Lines).

Industrial development – Solar Energy

- Build solar farms and infrastructure outside of ferruginous hawk core use areas and home ranges to avoid nests, prey concentrations, disturbance and collision impacts. Access the Washington Columbia Plateau Least-Conflict Solar Siting Gateway https://wsuenergy.databasin.org/
- Concentrate panels in unproductive agricultural areas to reduce impacts to raptors (Pearce et al. 2016).
- Setback panels from ridgelines to avoid potential impacts to ridge soaring, thermals, and hunting habitats.
- Address impacts related to new infrastructure (see Industrial development – Transmission Lines).
- For projects that use collection towers, spread aim points of mirrors to reduce temperatures when facilities are in stand-by mode that will reduce burn risk (Dwyer et al. 2018).

Industrial development – Transmission Lines

- Establish new distribution lines outside of hawk home ranges.
- Bury lines where possible.
- Develop raven monitoring and nest management (e.g., removal) plan for new transmission lines built within industrial developments.
- Apply state-of-the-art methods to prevent electrocutions and collisions (perch diverters, supplemental perches, wire-markers to improve visibility of lines).
- Report pole numbers and electrocution incidents to local utility companies and WDFW as soon as possible for remedial actions.

Industrial development – Surface Mining, Gravel Pit Construction, and Road Construction

- Develop surface mines, gravel pits and new roads outside of ferruginous hawk core use areas and home ranges to avoid nests, prey concentrations, and disturbance and collision impacts.
- Maximize line-of-site to hawk nests for projects located in coulees and narrow draws.

- Limit number of access roads to minimize recreational use. Reclaim abandoned as soon as possible after completion of operation or construction. Gate permanent roads to reduce access and post as “no-shooting”.
- Leave remnant rockpiles in strategic locations to provide raptor perches and prey habitat.
- Improve ledges and crevices on solid banks to provide potential nest substrate.
- Implement program to remove road-killed carrion away from highways to prevent collision (Slater et al. 2022).

Residential development

- Develop residential housing outside of home range buffers.
- Cluster development and set aside areas with features important to breeding ferruginous hawks as undeveloped for conservation of habitat. This can work on certain parcels that are large enough to accommodate the development while also having enough space to set aside a protected area for breeding birds.
- Use open space requirements for residential developments to maintain prey habitats outside of home range buffers.

Mammal control and toxins

- Control small mammals if necessary for damage control versus complete eradication.
- Prohibit recreational shooting at ground squirrel colonies.
- Do not use lead bullets; only non-toxic ammunition. If encountered, bury animal carcasses shot with lead (e.g., ground squirrel, coyote, livestock).
- Support restoration/translocation of ground squirrels on adjacent rangeland.

Climate change

(note: all proposed projects, whether they contribute to these impacts or not, should consider how to minimize effects of increased fire, cheatgrass invasion, and nest loss)

- Create and maintain firebreaks and develop fire control plans for pasture/grassland interface. Use controlled fire to mimic natural fires to improve small mammal communities in sagebrush habitats Holmes and Robinson 2016).
- Remove cheatgrass and restore perennial grasses in pastures and native habitats (e.g., Clements et al. 2017).
- Reinforce and stabilize existing nests, nest trees, and cliff ledges to withstand extreme weather and provide protection from wind, sun, and rain (Shank and Bayne 2015, Migaj et al. 2011). See Appendix 5 for information on artificial nest structures.

Appendix 5. Artificial nest structures.

Artificial nest structures (ANS) can be placed strategically to provide nest substrates on established ferruginous hawk territories that are limited by an absence of nest structure. For example, ANS may provide for lone nest trees lost through inclement weather, tree decadence, or cattle rubbing. We recommend against broad-scale placement of platforms to enhance ferruginous hawk habitat. These platforms may be used by other raptors and ravens that compete with and predate ferruginous hawks. ANS placement can be used to create new potential nesting opportunities but after consultation with a WDFW biologist. ANS placement is not an alternative for nest removal or translocating birds from a proposed development area. The lone exception is to move a nest from a hot distribution pole to protect the birds and equipment from fire. Ferruginous hawk nests on distribution poles that pose risk should be removed after the nest season, replaced with perch deterrents and installation of an artificial nest platform 250-500 m away. Movement of a nest that is in use should be progressive initially to a mobile artificial nest platform 25 m away and the permanent platform following the nesting season (Kemper et al. 2020).

Before considering ANS placement, management and maintenance of existing trees should be given priority. Bases of nests in trees can be reinforced with wire netting where limbs are failing, and predator access to the nest reduced using tin sheathing around the base (Craig and Anderson 1979). Groves of trees can be thinned as necessary to provide individual trees as or scattered stands for nest structure (Olendorff 1993).

New ANS placement is recommended only after an authorized wildlife biologist identifies open habitats devoid of nest structure, prey populations, and nearest-neighbor distance of >2.7 km. This is the distance Cottrell (1981) found ferruginous hawk nests were spaced on adjacent territories in Oregon.

Neal et al. 2011 provided recommendations to maximize utility of ANS placement: 1) occupancy of ANS is highest by hawks already habituated to disturbance or use of man-made substrates; 2) placement of ANS should be in association with extensive prey bases; 3) if translocating nestlings or eggs to an ANS it should be <1000 m and line-of sight of nest; 4) placement should consider potential for and implications of attracting other species to ANS; 5) provisions should be allocated for long-term monitoring, repair, and replacement of ANS at the time of installation; and 6) In dense development areas, placement of ANS should consider whether habitat quality is too poor because of dense development and may create a biological trap that attracts hawks but results in consistent nest failure. Additional considerations are that installation of ANS may also result in potential increased predation of sensitive species (e.g., sage grouse and burrowing owls) and may affect local ecosystem stability because of mammalian predation. We re-emphasize the need to plan for long-term maintenance and monitoring of ANS before placement.

ANS platform and pole designs are detailed elsewhere (Bohm 1977, Howard and Hilliard 1980, Schmutz et al. 1984, Olendorff 1993, Tigner et al. 1996, Skeen 1990, Neal 2007, Migaj et al. 2011). With increased summer temperatures shading of platforms should be considered. Shade designs for platforms were described by Schmutz et al. 1984. We recommend placement of sticks of the type and size used by ferruginous hawks on nest platforms (see description under **Nests** above). Schmutz et al. (1984) found shaded nest platforms were used twice as often as those that were unshaded, and Woffinden and Murphy (1983) found hawks tree nests used over repeated years that had branches above them but were otherwise unshaded. Howard and Hilliard (1980) recommended against “shade structure" based on two of three pairs that preferred non-shaded structure. Panting behavior and an unusually wide gape are adaptations of ferruginous hawks to extreme temperatures and may help nestlings avoid the need to seek shade on exposed nests (Martin et al. 2015).