Recovering Southwestern Willow Flycatcher Populations Will Benefit Riparian Health

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When the U.S. Fish and Wildlife Service (USFWS) listed the southwestern willow flycatcher (*Empidonax traillii exigua*) as federally endangered in 1995, new incentives, controversies and energy were generated to conserve and restore southwestern riparian ecosystems. Close attention has been focused on river and stream conservation in the Southwest since at least 1977, when the U.S. Forest Service and other partners hosted a symposium entitled *"Importance, Preservation and Management of Riparian Habitat"* in Arizona (Johnson and Jones 1977). Although the symposium and other volumes (e.g., Rea 1983) precipitated new research on riparian ecosystems and their inhabitants, sound management of river habitats was not immediately implemented. The conservation of water and riparian resources for flora and fauna competed with the blunt call to supply drinking and irrigation water for the expanding human populations of California and Arizona (Rea 1983). Not until concerns for disappearing populations of riparian and aquatic species, such as the willow flycatcher and several fish, took center stage in the 1990s owing to strong petitions and listings under the Endangered Species Act did restoration and protection of rivers and streams in the Southwest become a top priority.

This paper briefly reviews the distribution, taxonomy and population status of the southwestern willow flycatcher then follows with a survey of problems and threats faced by fragmented flycatcher populations in the Southwest. It concludes with a summary of potential actions that various stakeholders, including private citizens, can take to benefit the flycatcher and, by doing so, can also take important strides in conserving and recovering riparian ecosystems. Many of the concepts and literature cited in this paper are elaborated more fully in the recently drafted volume, *Ecology and Conservation of the Southwestern Willow Flycatcher* (Finch et al. in press[a]). This volume, sponsored by the U.S. Forest Service's Southwest Region, was designed to be a precursor and building block to the Recovery Plan for the flycatcher. In April 1998, the U.S. Fish and Wildlife Service formed a Recovery Team for the

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flycatcher. This team was divided into a technical subgroup of experts and several regional implementation subgroups comprised of stakeholders. The laudable goal of the flycatcher recovery team is to develop a plan that will be implemented by involved stakeholders. I hope this paper is a useful stepping stone in the team's journey to design and implement the recovery plan.

Distribution and Taxonomy

The willow flycatcher differs from most other *Empidonax*. It lacks a conspicuous eye-ring and has a yellow lower mandible *and* a whitish throat, which contrasts with a pale olive breast. Its distinctive song, described as "fitz-bew," best separates it from the 11 other *Empidonax* flycatchers as well as all other bird species. Prior to 1973, the willow flycatcher and alder flycatcher (*E. alnorum*) were treated as one species, the Traill's flycatcher (*E. traillii*) (American Ornithologists' Union 1957), but subsequent analyses showed they were genetically, reproductively and phonetically distinct (Stein 1958, 1963, Seutin and Simon 1988). The American Ornithologists' Union (1973) published their checklist with willow and alder flycatchers separated in 1973. Phillips (1948) first described the southwestern subspecies, and Unitt (1987) and Browning (1993) confirmed its validity in their published taxonomic evaluations. Unitt recognized four subspecies and Browning recognized five subspecies.

The breeding range of the southwestern willow flycatcher includes southern California, Arizona, New Mexico, southwestern Colorado, southern extremes of Nevada and Utah, extreme northern Baja California and Sonora, Mexico, and historically in western Texas (Unitt 1987, Browning 1993, Sogge in press). A neotropical migrant, the southwestern willow flycatcher generally spends only three to four months on its breeding ground and the remainder of the year in migration or in wintering areas south of the United States.

Population Status

Since Unitt's (1987) review of the population status of the southwestern willow flycatcher wherein he proposed its total numbers to be between 500 to 1,000 pairs ("I suspect 500 is more likely"), much baseline information has been generated to estimate the size and geographic limitations of the subspecies' population. Survey efforts increased substantially when the flycatcher was petitioned to be listed under the Endangered Species Act in 1992. Standardized survey protocols (Tibbetts et al. 1994, Sogge et al. 1997a) were drafted after the U.S. Wildlife Service proposed listing the subspecies as endangered with critical habitat (USFWS 1993). When the southwestern willow flycatcher was federally listed as endangered in March 1995, the need for developing management guidance was complicated by continued uncertainty about the rangewide status and northern breeding boundary of the subspecies. Lawsuits filed in 1997 and 1998 by environmental groups to protect the subspecies from potential habitat loss from livestock grazing and impoundment releases encouraged the U.S. Forest Service to develop a conservation assessment of the southwestern willow flycatcher in 1997 (Finch et al. in press [a]) and the U.S. Fish and Wildlife Service to form a recovery team in March 1998.

Based on survey data from 1993 to 1996, Marshall (in press) estimated that 549 breeding territories and 386 breeding pairs of southwestern willow flycatchers occurred at 109 sites and 43 drainages in six states. Forty percent (223) of the total number of known territories from this period were in New Mexico, followed by 30 percent (163) in Arizona, 22 percent (121) in California, 5 percent (28) in Colorado, 2 percent (12) in Utah, and 1 percent (2) in Nevada. Breeding is suspected in Sonora and Baja, Mexico (Unitt 1987, Sogge in press) but more up-to-date records are needed. During this four-year period, 53 percent of the total population occupied only 10 sites, each had 10 or more territories (9 percent of the 109 known locations), and the remainder of the population was scattered in groups of 10 or fewer territories among 99 sites. Only one site, in the Cliff-Gila Valley of southwestern New Mexico, had greater than 100 territories, while the next three largest sites each having only about 30 known territories. The majority of occupied sites had fewer than four territories, suggesting that most sites are highly vulnerable to winking out in response to stochastic events. While 56 percent of known flycatcher sites occurred on lands managed by Federal agencies, 32 percent were on private lands, including the Cliff-Gila site containing almost a third of the total population. Estimates from this four-year period should be viewed with caution because some sites were extirpated due to high levels of nest predation and cowbird parasitism or habitat loss due to fire, flooding and clearing for agriculture, roads and bridges.

Characteristics of Breeding Habitat

The southwestern willow flycatcher breeds only in dense riparian vegetation near slack or still surface water, cienegas, seeps, or saturated soil. Hydrological conditions can vary from year to year, depending on annual precipitation and human-related regulation of flows. Reservoir sites may show greater year-to-year variation in proximity to water than other sites. Riparian patches occupied by breeding flycatchers may be long, continuous stands of dense vegetation or mosaics of open and closed vegetation. Patches may be as large as 100 hectares at Roosevelt Lake to as small as 0.6 hectare in the Grand Canyon (Sogge and Marshall in press). Because flycatchers often clump their territories into small portions of riparian habitats (Whitfield and Enos 1996), occupied patches are always larger than the sum of the territories they contain. This subspecies occupies both native and non-native dominated habitats, and two exotic woody plants, salt cedar (*Tamarix* spp.) and Russian olive (*Eleagnus angustifolia*) are used as nest substrates along with several native plant species. According to a survey of site records conducted by Sogge and Marshall (in press), 49 of 106 recent flycatcher breeding sites were dominated by native woody plants, 5 sites by exotic species, and 52 sites by a mix of native and exotic plant species. Of the 57 exotic or mixed sites reported to be occupied by flycatchers in six states, 59 percent (33 sites) were recorded in Arizona. Within Arizona, 73 percent (33) of 45 occupied sites were dominated by exotics or a mixture of exotic and native vegetation, whereas in New Mexico, 42 percent of 24 sites had high amounts of exotics, in California, 40 percent of 19 sites, and in Colorado, 20 percent of 10 sites. The Cliff-Gila Valley in New Mexico, host-site to the highest number of flycatchers, is dominated by native boxelder (*Acer negundo*) and contains very few exotic stems (Stoleson and Finch 1999).

Occupied sites vary from monotypic, single-layered patches to multi-layered, diverse habitats dominated by several plant species of different heights and structures. Low to mid-elevation sites dominated by native plants typically range from single plant species to mixtures of native broadleaf trees and shrubs (Sogge and Marshall in press). Native plants may include one or more willow species (e.g., Goodding's willow [*Salix gooddingii*]), cottonwood [*Populus* spp.], boxelder, ash [*Fraxinus* spp.], alder [*Alnus* spp.], and buttonbush [*Cephalanthus occidentalis*]). Canopy heights may range up to 30 meters, depending on whether overstory trees such as cottonwoods, tree willows or boxelders are present or not. At a site historically altered by phreatophyte (willow) control along the upper San Luis Rey River in San Diego County, California, southwestern willow flycatchers now breed in streamside habitats dominated by live oak (*Quercus agrifolia*).

Breeding sites at 1,900 meters and above are usually found in mountain meadows characterized by pooled water or beaver dams and habitats comprised completely of native plants, typically monotypic shrub willow such as Coyote willow (*S. exigua*), Geyer's willow (*S. geyeriana*) or peachleaf willow (*S. amygdaloides*). Foliage density is high, with complex branching and twig structure, and canopy height is limited to a single vegetation layer averaging from 3 to 7 meters.

Most exotic-dominated sites used by flycatchers are dense, closed stands of salt cedar or Russian olive, averaging 5 to 10 meters in canopy height (Sogge and Marshall in press). Exotic habitats tend to be restricted to lower elevations (<1,200 m). Two of the largest flycatcher sites occur in large, continuous stands of mature salt cedar at two inflows to Roosevelt Lake in Arizona. In mixed stands of exotics and natives, the exotics are typically in the understory, either in clumps or dispersed throughout the native vegetation. At some sites, salt cedar forms an understory covered by a cottonwood canopy. Surface water usually borders exotic sites in the form of marshes, runoff ditches, cienegas, or open water.

Threats

The loss, alteration and fragmentation of riparian habitats indirectly threatens the persistence of the southwestern willow flycatcher. Reproductive success of the flycatcher is also directly affected by factors such as parasitism by the brown-headed cowbird (*Molothrus ater*).

Water Development

The extent, configuration and species of riparian vegetation along southwestern rivers are influenced by the presence or absence of dams. Dams modify hydrological cycles below them, resulting in increased frequency and longer duration of minimum flow events that reduce instream flows and lower watertables. Sustained low flows can cause desiccation of plant communities, and sustained high flows can result in prolonged inundation. Sediment deposition, floodplain hydration and flushing, and seed dispersal are also constrained by dam-induced changes in flood flows. The filling and flooding of reservoirs has resulted in loss of southwestern willow flycatcher habitats due to prolonged inundation at Glen Canyon (Behle and Higgins 1959), Elephant Butte Reservoir (Hubbard 1987), Lake Isabella (Whitfield and Strong 1995, USFWS 1997). The habitat at Roosevelt Lake is anticipated to be lost when inflows fill the new reservoir space (USFWS 1996). Yet, deltas arising from reservoirs offer opportunities to restore historical riverine habitats, and conserve and recover the southwestern willow flycatcher.

Riparian habitats can be placed into jeopardy by high levels of groundwater withdrawal (Marshall and Stoleson in press). Surface diversions and overdraft of groundwater reduce watertables and surface flows, increasing the likelihood of habitat desiccation. Yet directed diversions through flycatcher habitat, as in the Cliff-Gila Valley of New Mexico (Stoleson and Finch 1999), can also be used to hydrate and improve specific sites. However, floodplain isolation of this area may be the downside (Marshall and Stoleson in press).

Flood control projects can cut off main channels from secondary channels and reduce meander patterns which dampen flood velocity and effects (Marshall and Stoleson in press). Channelization generally elevates stream banks above groundwater levels, reducing water access by roots of native riparian shrubs and trees. It also reduces the width of riparian woodlands, reduces overbank flooding needed to deposit sediments, rehydrates soils, flushes salts, and reduces upstream storage capacity causing accelerated water flow and increased flood intensity. Flood-control structures such as bank armor (e.g., rip-rap, levees) can protect banks and vegetation but can also lead to increased scouring of unprotected banks and reduced overbank flooding needed for seed germination. Urban development within floodplains increases the need for flood control projects, resulting in reduced benefits for maintaining or creating riparian habitats suitable for southwestern willow flycatchers.

Phreatophyte removal is still practiced along some watercourses, especially irrigation ditches and reservoir delivery channels, driven by the desire to decrease water loss through evapotranspiration and remove flow barriers. Riparian shrubs and trees are cleared by mowing, rootplowing, herbicide application, clipping, and cutting. Vegetation that could become suitable breeding habitat for flycatchers never reaches its potential under phreatophyte control schemes, and even migration habitat suitability is diminished (Finch and Kelly 1999). When willow removal was eliminated at the Malheur National Wildlife Refuge, willow flycatcher populations increased (Taylor and Littlefield 1986). At the Bosque del Apache Wildlife Refuge, more stopover willow flycatchers were caught in mist-nets during spring and fall migration in unmowed willow than in mowed willow along a conveyance channel (Yong and Finch 1997, Finch and Kelly 1999). Delaying mowing for three years along selected channel stretches fostered rapid willow growth, improving stopover habitat suitability for migrant flycatchers (Finch and Kelly 1999).

Agricultural Clearing and Livestock Grazing

The clearing of floodplain riparian shrubs and trees for agriculture has resulted in loss of flycatcher habitat along the lower Colorado River (Marshall and Stoleson in press). According to Ohmart et al. (1986), more than 75 percent of the Mohave, Parker, Palo Verde and Yuma valleys on the lower Colorado has been converted to agriculture. Historical clearing and burning of southwestern riparian woodlands by early Native Americans and Spanish settlers also contributed to patchiness and fragmentation of river habitats (Periman and Kelly in press).

Livestock grazing is pervasive in the Southwest and can detrimentally alter flycatcher habitats in several ways. Cattle tend to congregate along rivers and streams where water, forage and shade are plentiful and terrain is easy to move upon. Browsing of mature woody riparian vegetation by cows decreases canopy cover and foliage density, creates spaces between shrubs, shapes shrubs into umbrella-like structures, and shifts composition toward unpalatable species such as saltcedar or juniper (Kauffman and Kreuger 1984, Cannon and

Knopf 1984, Szaro and Pase 1983, Taylor 1986). Heavy foraging on willow and cottonwood shoots can reduce or eliminate regeneration (Rickard and Cushing 1982, Boles and Dick-Peddie 1983). Upland vegetation and birds may invade wetland ecosystems where livestock grazing has caused a reduction in perennial flow (Dobkin et al. 1998). Late autumn and winter grazing may have little or no effect on vegetation, whereas late spring and summer grazing can substantially reduce recruitment and regeneration of plants, creating open park-like woods that are unsuitable for occupancy by southwestern willow flycatchers (Kauffman and Krueger 1984). Where livestock have been removed, elk (*Cervus canadensis*) have been known to prevent willow habitats from recovering (Case and Kauffman 1997). This suggests that in areas where elk and flycatchers are sympatric, elk may continue to damage occupied habitats even after cows are fenced or driven out.

Trampling by livestock can lead to destabilized stream banks, erosion, non-point source pollution, compacted soils, crushed vegetation, expanded channels, and opened soil and water surfaces (Kauffman and Kreuger 1984, Szaro 1989, Marshall and Stoleson in press). Livestock have been documented to directly trample willow flycatcher nests in low vegetation (Valentine et al. 1988) as well as knock low nests out of trees (M. Whitfield personal communication). Cattle trampling during any season can break down streambanks, increase channel size and accelerate erosion. Upland trampling and grazing may reduce water infiltration and increase runoff, resulting in erosion and stream channel blowouts (Trimble and Mendel 1995).

Removal of grazing from rivers and streams typically allows a resurgence of riparian vegetation growth that can trigger an increase in the number of bird species associated with dense riparian understories (Kreuper 1993), including willow flycatchers (Taylor 1986, Taylor and Littlefield 1986, Harris et al. 1987). In the Cliff-Gila valley in southwestern New Mexico, livestock currently graze in irrigated pastures adjacent to riparian patches used by the largest concentration of southwestern willow flycatchers (Parker and Hull 1994). Here, in riparian stringers grazed by cows, neither flycatcher nesting success nor cowbird parasitism rates significantly differed from ungrazed riparian patches (Stoleson and Finch 1999). Flycatcher nests that were placed higher in the canopy were, however, more likely to successfully fledge young than lower nests (Stoleson and Finch 1999), suggesting that high nests can potentially escape direct effects of livestock. The potential for a site to support flycatchers in the presence of livestock grazing may depend on how the site is managed. In the Cliff-Gila Valley, for example, water for irrigating stock pasture flows in ditches through flycatcher habitats, saturating soils, watering riparian plants, and providing habitat for flycatchers and their insect prey. This management strategy is not typical but does appear to have potential for replenishing grazed and ungrazed sites with water, allowing local riparian habitats to rebound or be sustained.

Urban Development and Recreation

Urban development is associated with the clearing of riparian vegetation for construction of homes and buildings, water containment structures, dewatering of rivers and streams, bridge and road installations, introduction of exotic plants and predators, and recreational facilities and activities. Bridge construction has resulted in direct loss of habitat used by willow flycatchers (Marshall and Stoleson in press). Roads bisect riparian habitats, potentially fragmenting them into patches less suitable in size for flycatcher occupancy or more vulnerable to nest predation or cowbird parasitism.

Recreational activities in the Southwest heavily concentrate along watercourses and lakes, damaging plants, increasing fire risks, compacting soils, and altering banks. Clearing of riparian vegetation for campsites and recreational vehicle parks removes habitat for flycatchers. Disturbance from recreationists can reduce the abundance and diversity of bird assemblages (Aitchison 1977, Riffell et al. 1996) and trash and food remains can attract predators and cowbirds (Johnson and Carothers 1982, Blakesley and Reese 1988). Blakesley and Reese (1988) report that willow flycatcher presence was negatively associated with Utah campgrounds.

Fire

Fires in riparian habitats can be catastrophic, especially in areas where fuel loads have accumulated due to reduced flooding or where salt cedar, an ignescent species, has spread (Marshall and Stoleson in press). Salt cedar recovers quickly after fire and can invade new areas where native vegetation has burned (Busch 1995), causing riparian communities to convert to salt cedar especially at lower elevations. Fires are more frequent in southwestern riparian systems now than they were historically because of salt cedar dominance, reduced flooding and recreational use. Fire has threatened potential and suitable flycatcher habitats, burning about six miles on the Gila River in Arizona in 1995, five occupied sites in 1996 (two on the Rio Grande, a site on the San Pedro River, and two on the Gila River in Arizona), and a flycatcher breeding site on the Escalante Wildlife Area near Delta, Colorado in 1997 (Marshall and Stoleson in press).

Invasive Exotic Plants

Salt cedar, a plant originally introduced from Asia as an ornamental to stabilize banks, has become a dominant species along many waterways of the arid West (Hunter et al. 1987), thriving in areas with low surface flow (Horton 1977, Marshall and Stoleson in press). While native plant species are relatively intolerant to fire, salt cedar regenerates quickly after an area is burned (Busch 1995). Salts from salt cedar accumulate in unwashed soils, creating inhabitable sites for reestablishment of many native species. Salt cedar can occur as monotypic stands or as dense understories beneath a tree willow or cottonwood canopy. Many Arizona riparian sites dominated by salt cedar or mixtures of salt cedar and native plants are used by southwestern willow flycatchers for breeding (Sogge and Marshall in press). Flycatcher nesting success on salt cedar substrates may not be detrimentally affected. However, with a few exceptions, most occupied sites in salt cedar have few territories. Much of the dense, monotypic thickets of low-stature salt cedar commonly observed along the middle Rio Grande and Lower Colorado River are vacant of flycatchers. Nevertheless, migrating willow flycatchers are sometimes mist-netted in these same saltcedar thickets, although they are more frequently captured in willow (Yong and Finch 1997, Finch and Kelly 1999).

Russian olive is also invasive, but typically less so than salt cedar, and forms a tall shrub layer under canopies of larger riparian trees such as cottonwoods (Knopf and Olson 1984). Russian olive is used by a variety of birds and mammals for nesting and berry-feeding (Cannon and Knopf 1984), and southwestern willow flycatchers will nest in them (Sogge and Marshall in press). Stoleson and Finch (1999) report that Russian olive is disproportionately selected as a nesting substrate by southwestern willow flycatchers in boxelder-dominated habitats along the Gila River in New Mexico. Even so, flycatcher nesting success in Russian olive was lower than that in most other substrates (Stoleson and Finch 1999).

Other exotic southwestern riparian plants such as giant reed (*Arundo donax*), Siberian elm (*Ulmus pumilis*) and tree of heaven (*Ailanthus simaruba*) are not reported to be used by southwestern willow flycatchers as nesting substrates. Giant reed, in particular, has an unfavorable form for nest placement, forms dense monotypic masses, and is spreading rapidly in California.

Cowbird Parasitism

At nine sites where 10 or more nests of southwestern willow flycatchers were monitored, annual parasitism rates ranged from 3 percent at the San Pedro River in Arizona to a high of 66 percent at the South Fork Kern River in California (Uyehara et al. in press). High rates of cowbird parasitism can substantially reduce nesting success of southwestern willow flycatchers (Whitfield 1994, Whitfield and Strong 1995) and may negatively influence their population levels (Whitfield 1994, Sogge et al. 1997b, Uyehara et al. in press). Host fecundity is detrimentally affected when flycatchers desert parasitized nests, when flycatcher eggs are removed by cowbird adults and when flycatcher nestlings starve to death as cowbird chicks outcompete them for food (Whitfield 1990, Whitfield 1994, Whitfield and Strong 1995). If a cowbird hatches in a flycatcher nest, hosts are rarely successful in fledging their own young with the cowbird. Cowbird trapping has had limited success in reducing parasitism rates and increasing flycatcher productivity on the Kern River, suggesting that other factors may limit reproductive success (Uyehara et al. in press). Elasticity analyses conducted by Uyehara et al. (in press) suggest, however, that even small increases in reproductive success per flycatcher female due to cowbird management may contribute to population recovery.

When host nests and cowbird forage sites are spatially separated, female cowbirds split their time between host-rich areas and concentrated food sources such as feedlots, pastures, and dairy forms (Rothstein et al. 1984, Thompson 1994, Gates and Evans 1998, Morris and Thompson 1998). Typically, cowbirds feed near livestock (Morris and Thompson 1998). In the Southwest, riparian habitats host high numbers of breeding songbirds and nest-searching cowbirds. Cowbird commuting distances vary across landscapes (Thompson 1994), depending on the distances between hosts and food sources, and are reported to reach as high as 13.6 kilometers in California (Farmer in press). Moving cattle further from songbird breeding sites can decrease cowbird abundance and parasitism rates of hosts (Goguen and Matthews 1997, Cook et al. 1997). Management of cattle distances in relation to flycatcher breeding sites may therefore be useful in controlling cowbird parasitism rates and improving flycatcher productivity.

Predation

Populations of southwestern willow flycatcher experience high rates of nest predation ranging from 14 to 60 percent (Whitfield and Strong 1995, Sogge et al. 1997b, Marshall and Stoleson in press). Predation is typically the major cause of nest failure. Nest predators include tree-climbing snakes, predatory birds, raccoons, weasels, ringtails, and rodents (McCarthey et al. 1998). While data are lacking to determine the relationship between habitat fragmentation and rates of nest predation of southwestern willow flycatchers, Whitfield (1990) noted that predation, was higher on flycatcher nests closer to edges than distant nests. Further research is needed to evaluate whether measures, such as patch size, nest distance to edges, and extent of patch isolation and habitat fragmentation influence predation and cowbird parasitism rates of flycatcher nests. Given that riparian habitats are naturally fragmented, such relationships may be obscured by other factors or may operate at different scales than those reported for eastern forests.

Conserving and Restoring Riparian Habitats

In 1997, the Southwest Region of the U.S. Forest Service contracted with the Rocky Mountain Research Station to write a Conservation Assessment of the southwestern willow flycatcher. The goal was to review the status and habitat requirements of the subspecies, summarize state-of-the-art information about factors contributing to its endangerment, and develop guidance for managing habitats on National Forests occupied by the flycatcher. A team of experts was assembled to draft the Conservation Assessment. While subgroups wrote each white-paper chapter, the entire team used a consensus process to identify management and education actions that could potentially serve to sustain, benefit or recover flycatcher populations (Finch et al. in press[b]). The results of this exercise, a list of possible actions to mitigate or remove major threats, were modified and condensed into a table for this paper (Table 1).

The majority of actions identified to benefit the southwestern willow flycatcher emphasize methods and management scenarios that minimize habitat damage from land use practices, restore habitats by removing threats, sustain water by implementing alternatives, and protect occupied sites by limiting use and planning ahead. Direct threats to flycatcher reproductive success by cowbird parasites and nest predators can be reduced using recommendations for monitoring cowbirds and nests, and implementing pest control strategies when necessary. Detrimental effects of a multitude of land use practices and biological threats on flycatcher survival and productivity are cumulative. Disentangling flycatcher responses to cumulative threats is an arduous task because mixed effects are not easily tested or understood using field experimental designs, and consequently, knowledge to design actions for conserving flycatchers and their habitats may not be sufficiently cross-cutting or complex to address the convoluted environmental crisis the flycatcher is in. The interdisciplinary nature of the recovery team may create the necessary synergy and dynamic force to fit the pieces of the puzzle together, using the goals for flycatcher recovery to paint a bigger and brighter picture of riparian health.

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Table 1. Actions that may benefit southwestern willow flycatchers (modified from Finch et al. in press [b]).

Water management

Maintain or increase instream flow, when possible. Identify alternatives to diverting water from riparian areas. Eliminate or reduce phreatophyte control. Encourage vegetation growth along earthen ditches. Minimize habitat damage caused by flood control practices. Educate managers and public on alternative water uses. Minimize destructive effects of catastrophic floods. Avoid prolonged inundation of flycatcher habitat. Restore habitats below dams through controlled water releases.

Livestock grazing

Exclude cattle from occupied habitat during breeding season. Monitor vegetation if site is grazed during dormant season. To restore degraded riparian habitats, remove cattle year-round. Remove trespassing cattle using attractants rather than by herding. Use photo points and habitat measures to monitor grazing effects. Develop cooperative relations between stockraisers and managers.

Recreation

Close occupied sites to off-road vehicles year-round. Exclude human access of occupied sites during breeding season. Avoid construction of recreational facilities in occupied sites. Limit use of occupied sites during nonbreeding season. Provide trash receptacles and trash pick-ups near occupied sites. Use interpretive signs to close areas and prevent fires. Prohibit road and trail construction in or near occupied sites.

Fire management

Prepare and enforce fire management plans for occupied sites. Erect fire prevention signs at occupied sites. Identify water sources for fire fighting away from occupied sites. Reduce fuels adjacent to occupied sites. Host training sessions to educate fire fighters about flycatchers. Use care installing fuel breaks during fires to avoid habitat losses. Restore occupied habitats after a fire event.

Exotic plants

Leave exotics as is in occupied habitats. Consider removing exotics at historic or previously occupied sites. Monitor effects of invasion of exotics into occupied sites. Evaluate site potential for restoration prior to removing exotics.

Cowbird parasitism

Monitor cowbird presence or abundance at occupied sites. Survey flycatcher nests for evidence of parasitism. Trap cowbirds if parasitism rates exceed predefined threshold. Remove cowbird attractants from occupied sites. Trap cowbirds over multiple years, stop when cowbird numbers or parasitism rates decline, or flycatcher population shows a significant upward trend.

Predators

Control presence of predator attractants such as food and trash. Use sensitive methods to check nests to avoid drawing predators. Identify predators during nest monitoring whenever possible. Educate public about pets as predators of birds. Trap feral cats when they are a problem. Control predators, when feasible, at sites with high predation.

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