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The **Fish and Wildlife Service** (FWS) Proposed Rule: **Endangered and Threatened Wildlife and Plants: Regulations for Listing Endangered and Threatened Species and Designating Critical Habitat**

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***RE*: 50 CFR Part 424; [Docket No. FWS–HQ–ES–2020–0047, FF09E23000 FXES1111090FEDR 201; Docket No. 200720–0197] ; RIN 1018–BE69; 0648–BJ44 - Endangered and Threatened Wildlife and Plants; Regulations for Listing Endangered and Threatened Species and Designating Critical Habitat**

Ladies and Gentlemen,

The Pima Natural Resource District and the Pima Center for Conservation Education appreciate the opportunity to provide the following comments on the proposed rule.

1. Issues

1.1. Misinterpretation of Endangered Species Act requirements

The Service has misinterpreted the requirements of the Endangered Species Act (Act) in designating critical habitat for threatened and endangered species. It also has misinterpreted the Supreme Court's (SCOTUS) analysis and opinion in *Weyerhaeuser Co. v. U.S. Fish and Wildlife Service* (*Weyerhaeuser*).[1] As a result, the Service has proposed two definitions of "habitat" that are inappropriately broad and generic.

The proposed definitions cannot satisfy the requirements of the Endangered Species Act. The Service has misunderstood its legal requirement to define "habitat for a species," and focuses instead on developing a far less useful definition of generic "habitat."

[1] *Weyerhaeuser Co. v. United States Fish and Wildlife Service,* 139 S.Ct. 361 (2018), accessed August 30, 2020 at https://www.supremecourt.gov/opinions/18pdf/17-71_omjp.pdf

1.2. Missed Opportunity

The Service has overlooked the opportunity to incorporate into the Code of Federal Regulations the Ninth Circuit Court's interpretation of "areas that are occupied" by a species.

1.3. A revised approach to existing land uses will benefit listed species.

The Service must immediately begin to acknowledge and routinely consider the possibility that extant human land uses, in areas occupied by a species at the time of listing, may *provide* one or more of the essential physical and biological features that the species depends upon for survival**.**

We will cite herein numerous examples in Arizona where well-intended but myopic critical habitat regulations, prohibiting extant and historical land uses, resulted in adverse habitat modification. The end result was the regulations themselves caused the extirpation of threatened or endangered species from areas the species formerly occupied.

2. Recommendations

2.1. Withdraw the proposed definitions of "habitat" and replace them with a definition of "habitat for a species."

We suggest the following definition:

The terms "habitat for a species" and "species habitat" mean:

> The physical places with all essential, extant physical and biological features, including extant land uses, that a reproducing population of a species currently, and for the foreseeable future, can depend upon to carry out and transition between essential life-cycle stages. Essential life cycle-stages are defined as birth or hatching, metamorphosis, growth, and reproduction. Extant land uses are those that have co-occupied an area with a species over a reasonable span of time. Habitat for a species requires no routine human intervention beyond traditional land uses. "Foreseeable future" as used herein assumes that neither traditional human land uses nor natural events will permanently remove any extant category of the physical or biological features that are essential to the species' survival.

2.2. Add the 9th Circuit Court's interpretation of "areas occupied by a species" into the proposed rule.

We suggest the following definition:

The terms "areas occupied by the species" and "occupied areas" mean:

> "Areas occupied by a species" are those areas that the species currently uses with sufficient regularity that it is likely to be present during any reasonable span of time."

2.3. We recommend the Service consider extant land uses that have coexisted with the species over a reasonable span of time as an integral and possibly essential part of occupied species habitat.

3. Discussion

3.1. Background

The U.S. Fish and Wildlife Service (Service) is proposing its first regulation that defines the term, "habitat." - FR 84 No. 151 at 47333-47337

The Service explains the purpose of the proposed rule at 47334:

The Supreme Court recently held that an area must logically be "habitat" in order for that area to meet the narrower category of "critical habitat" as defined in the Act, regardless of whether that area is occupied or unoccupied. Weyerhaeuser Co. v. U.S. FWS, 139 S. Ct. 361 (2018). The Court stated: "Section 4(a)(3)(A)(i) does not authorize the Secretary to designate [an] area as critical habitat unless it is also habitat for the species." 39 S. Ct. at 368. Given this holding in the Supreme Court's opinion in Weyerhaeuser, we are proposing to add a regulatory definition of "habitat."

3.2. Misinterpretation of case law

The Service misinterprets the opinion the Supreme Court delivered in vacating and remanding *Weyerhaeuser* to the Fifth Circuit Court of Appeals.

The quotation above indicates the Service misinterprets the Supreme Court's opinion in *Weyerhaeuser*. The Court did not hold that an area must be "habitat" in some broad, generic sense to meet the narrower category of "critical habitat" as defined in the Act. The Court stated, rather, that for an area to be designated critical habitat, it must first be habitat *for the species***.**

The Supreme Court's analysis in Part II A states,

> *Our analysis starts with the phrase "critical habitat." According to the ordinary understanding of how adjectives work, "critical habitat" must also be "habitat." Adjectives modify nouns—they pick out a subset of a category that possesses a certain quality. It follows that "critical habitat" is the subset of "habitat" that is "critical" to the conservation of an endangered species.*
>
> *Of course, "[s]tatutory language cannot be construed in a vacuum," Sturgeon v. Frost, 577 U. S. ___, ___ (2016) (slip op., at 12) (internal quotation marks omitted), and so we must also consider "critical habitat" in its statutory context. Section 4(a)(3)(A)(i), which the lower courts did not analyze, is the sole source of authority for critical- habitat designations. That provision states that when the Secretary lists a species as endangered he must also "designate any habitat* ***of such species*** *which is then considered to be critical habitat." 16 U. S. C. §1533(a)(3)(A)(i) (emphasis added). Only the "habitat"* ***of the endangered species*** *is eligible for designation as critical habitat. Even if an area otherwise meets the statutory definition of unoccupied critical habitat because the Secretary finds the area essential for the conservation of the species, Section 4(a)(3)(A)(i)*

does not authorize the Secretary to designate the area as critical habitat unless it is also habitat ***for the species****.*

(emphasis added)

3.3. The Service's proposed definitions are inappropriately broad and generic.

The Service has proposed two possible definitions of "habitat," to wit:

Alternative 1:

"The physical places that individuals of a species depend upon to carry out one or more life processes. Habitat includes areas with existing attributes that have the capacity to support individuals of the species."
-85 FR 151 at 47334

Alternative 2:

"The physical places that individuals of a species use to carry out one or more life processes. Habitat includes areas where individuals of the species do not presently exist but have the capacity to support such individuals, only where the necessary attributes to support the species presently exist."

-85 FR 151 at 47334

Despite citing and quoting several Executive Orders to write clearly and avoid unexplained jargon in proposed rules, both of the Service's proposed definitions of "habitat" employ unexplained terms of scientific jargon. The most troublesome term used is, "life processes." We infer that "life processes" refers to a living organism's normal internal vital functions. Examples of life processes include respiration, circulation, temperature regulation, digestion, excretion, myosis and mitosis.

Hence, we infer that the Service considers "habitat" in both proposed definitions as existing anywhere a single member of a species can carry out just one life process – even if it cannot carry out any of the additional life processes that are all necessary for its survival.

Hence, we infer that the Service intends to designate "critical habitat" for a species in areas where that species cannot possibly survive.

Under both proposed definitions, the Service might inappropriately consider a mayonnaise jar to be "habitat" to a grasshopper hopelessly trapped inside, because the grasshopper can carry out a single life process – breathing – until it dies of starvation.

Under the proposed definitions, the Service might inappropriately reinstate the critical habitat designation for the Dusky gopher frog, which the Supreme Court vacated in 2018 in *Weyerhaeuser*. The Service reasons that "habitat" exists on the contested St. Tammany

Parish property because tadpoles of the species can breathe in the vernal pools. The Service appears unconcerned that adults of that endangered species cannot survive in the closed canopy forest on that parcel of land.

The Service might likewise inappropriately consider a southern Arizona wash that is dry for all but a few hours of the year as, "habitat" to the Sonora chub, simply because individuals of the species can swim across the border from Mexico into the extreme southern United States. Nonetheless, the minnows will surely die as soon as the water that carried them into Arizona soaks into the sand and/or evaporates.

Under the Service's proposed definitions, "habitat" does not mean an area can sustain life. In fact, it means nothing at all. We consider both proposed definitions of "habitat" inappropriately broad to the point they are nonsensical.

Congress intended the Service to focus on habitat needs of individual species. Congress intended the Service to define "habitat for a species," meaning the specific geographical locations where a species can find not just one, but *all* the physical and biological features necessary for its continued existence. Such areas are "habitat for the species." The "critical habitat" subset of such areas are those areas that require special management attention.- ESA Section 3 (5)(A)(i)(II)

3.4. To the maximum extent practicable, the definition of "habitat for a species" should employ the same "terms of art" that Congress used in defining "critical habitat for a threatened or endangered species in U.S.C. §1532 (5)(A)

The Service states at 47334**,**

> *" While we have intentionally refrained from using within this proposed regulatory definition of "habitat" terms of art from other definitions in the Act to avoid potential confusion, including the phrase "physical or biological features" from the definition of "critical habitat," we propose "existing attributes" to include, but not be limited to, such "physical or biological features." We invite comment on this issue, including whether the words "existing attributes" are appropriate to include and whether they warrant further clarification or change or should be differently or further defined or explained."*

Here, the Service fails to provide any supporting evidence or logical reasons for why it considers statutory terms sources of potential "confusion."

To the contrary, statutory "terms of art" within the Act have been discussed, defined, regulated and litigated for nearly half a century. Those are the most commonly familiar terms and jargon available. They are the most easily understood by the most people. The Service has not provided satisfactory justification for replacing familiar terms with new jargon.

Moreover, the SCOTUS opinion in *Weyerhaeuser* suggests Congress intended the designation of critical habitat for a threatened or endangered species to be a subset of all habitat for that species. Therefore, it makes sense to define "habitat for a species" and "critical habitat for a threatened or endangered species" using identical "terms of art" so that the meaning of "critical habitat" is easily nested within the confines of "habitat for a species" as a compatible subset.

Congress intended "habitat" to mean "habitat for a species" and thus defined "critical habitat" accordingly, as quoted below:

> *ESA §3 (5)(A) The term "critical habitat" **for a threatened or endangered species** means – (i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species.* (emphasis added)

3.5. A definition for, "areas occupied by a species" conforming to the Ninth Circuit Court's interpretation should be added into the proposed rule.

The areas occupied by a species are relevant and almost inextricably connected to the habitat of a species. The Code of Federal Regulations currently wants for definitions of the terms, "areas occupied by a species" or "occupied areas," as interpreted within the United States judicial system. In 1987, the United States Ninth Circuit Court of Appeals delivered its opinion in *Arizona Cattle Growers' Ass'n. v. Salazar.*[2] The Court found,

> *"The [Service] has authority to designate as "occupied" areas that the [species] uses with sufficient regularity that it is likely to be present during any reasonable span of time."*

3.6. **The Service must begin to acknowledge extant land uses as potentially *providing* essential physical and biological features in areas upon which a species depends for survival**.

Human beings make mistakes. Organizations are groups of humans that make mistakes. The Service has made serious past mistakes. The Service cannot fulfill its mission until it admits it has made serious management mistakes in the past and changes its policies to avoid those errors in the future. The cost of continuing to make the same mistakes is the increased likelihood of impending species extinction.

One of the Service's most serious routine management errors is its false but pervasive assumption that legal, historic, and productive or recreational land uses by private parties threaten all species. Federal land use regulations typically consist of a nearly identical copied and pasted

[2] *Arizona Cattle Growers' Ass'n v. Salazar*, 606 F.3d 1160 (9th Cir. 2010)

"boilerplate" condemning all extant productive and recreational land uses as "threats" to species. Typically the boilerplate text makes no mention of any possible benefit that human land uses may provide to a species.

As a result, extant land uses that coexist synergistically with listed threatened or endangered species are soon prohibited without a balanced examination of the benefits that will be discarded. The prohibitions can result in adverse habitat modifications. We note the following examples (with cited documentation included in attachment) where habitats of threatened or endangered species were adversely modified and the species harmed or extirpated as a result of prescriptive prohibitions on livestock grazing:

3.6.1. **Unintended consequences of grazing exclosures meant to protect endangered warm water fish**

Rinne (2004)[3] states,

"The increase in cover and change in water depths have favored introduced, "cover seeking," more lentic species such as smallmouth bass (Micropterus dolomieus) and green sunfish (Lepomis cyanellus) (Pflieger 1975), yellow bullhead (Ameiurus natalis), mosquito fish (Gambusia affinis) and red shiner (Cyprinella lutrensis)."

Rinne and Miller (2006)[4] states,

"Management activities affect fish assemblage structure in southwestern rivers. Grazing Management. Coinciding with the current dominance of non-natives in Reach I in the Upper Verde River has been the removal of livestock grazing in 1997 (Rinne, 2006). Since that time, riparian and instream vegetation have increased dramatically (Rinne, 1999a; Medina and Rinne, 1999; Medina et al., 2005; Rinne, 2003b). We suggest that the resulting marked increase in instream and stream bank vegetation and narrowing and deepening of the channel mentioned above provide better habitat for cover-seeking species such as smallmouth bass and green sunfish (Pflieger, 1975).

Here, we see that prescriptive exclusion of livestock from riparian habitat decreased sun exposure, decreased water temperature, increased water depth, and thereby in-

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[3] Rinne, J.N. 2004. Forest and fishes: effects of flows and foreigners on southwestern native fishes. Pages 119-124 in G.J. Scrimgeour, G. Eisler, B. McCulloch, U. Silins and M. Monita. Editors. Forest Land–Fish Conference II – Ecosystem Stewardship through Collaboration. Proc. Forest-Land-Fish Conf. II, April 26-28, 2004, Edmonton, Alberta.

[4] Rinne, John N. and Dennis Miller, 2006. Hydrology, Geomorphology and Management: Implications for Sustainability of Native Southwestern Fishes. *Reviews in Fisheries Science*, 14:91–110, 200

creased the abundance of non-native predator species. As such, livestock exclusion may have adversely modified the habitat where native, warm-water fish formerly thrived.

Aquatic biologist Al Medina[5] pointed out another common blind spot in wildlife habitat management. He wrote,

> *"For several years fish biologists, ecologists, and hydrologists have emphasized the need to understand linkages between hydrological functions and fish ecology (Medina and Neary, 2012; Medina and Rinne, 1999; Rinne and Miller, 2006; Propst et al., 2008; Neary et al., 2012). For decades warm water fisheries were managed based on cold water studies based principally on trout species. There is an aversion to accept new concepts, abandon unfounded suppositions about livestock grazing, and instead reexamine new science that looks at fish management from the viewpoint of the species life strategy, rather than the biologist's point of view. Rarely is the question presented of whether the riparian/aquatic land management action, e.g. structural treatment, channel restoration, revegetation, etc. is beneficial to the fish species of interest. The prevailing assumption is that all native fish require stable stream environments to sustain stable populations. Most important is to know the species habitat requirements (Bonar et al., 2010) before engaging in stream improvements or translocations or other management actions that may have lasting adverse consequences, i.e. grazing management plan.*
>
> *Sheller et al. (2006) reported translocation attempts in Arizona for Gila Topminnow met with little success and is validated in AGFD (2018). For years a "shotgun" approach was used to reestablish Gila Topminnow in locations within its reported historical range without considering specific habitat requirements or interactions with other native or nonnative fishes. This approach has proved fruitless, i.e. Redrock Canyon, and is discouraged by Sheller et al. (2006) who makes specific recommendations such as future translocations should be undertaken in late summer or fall (not early summer), should occur into ponds (not streams, wells, or tanks), contrary to what the BA proposes for stock tanks. This new concept is promoted by other biologists to improve chances of success (Biedermann et al.,2014). None of these new studies implicate grazing as an adverse or limiting factor, rather cite basic ecology and hydrologic influences."*

[5] University of Arizona Natural Resource Users Law and Policy Center, May 2019, comments submitted in response to Coronado National Forest Draft Biological Assessment on Livestock Grazing.

Parker and Darling (2010)[6] identified a number of streams in Arizona where monitoring surveys have provided evidence of negative impacts on native fish following regulatory exclusions of livestock. They stated,

"Native fishes, including Gila topminnows, have precipitously declined after livestock grazing has been excluded for their alleged benefit. In upper Cienega Creek, for example, the Gila topminnow was found to have declined by more than 98% just a decade after all livestock presence was excluded for their alleged benefit by the BLM (Bodner, Gori and Simms, (2007)). In Redrock Canyon, AGFD surveys reveal that Gila topminnows declined and then disappeared altogether less than a decade after the Forest Service arbitrarily and capriciously excluded all livestock from their presence.

Similarly, in the upper Verde River, the Spikedace declined precipitously and became extinct less than three years after all riparian presence of livestock was excluded for its alleged protection by the Forest Service. Moreover, the remainder of the upper Verde's native fishes assemblage has also precipitously declined in the absence of livestock presence from making up more than 80% of all fishes found there in 1997 (Rinne and Miller (2006)), to less than 15% of all fishes found there today (RMRS, Flagstaff, 2009)."

3.6.2. **Unintended consequences of grazing exclosures meant to protect Pima pineapple cactus**

The Pima Pineapple cactus depends on antelope jack rabbits for seed dispersal. The antelope jackrabbit avoids tall grass habitat where predators can hide. Prescriptive grazing exclosures and tightened grazing utilization limits in the Coronado National Forest have modified the former habitat of the Pima pineapple cactus into tall grass habitat. The antelope jackrabbit no longer disperses the seeds of the endangered cactus. Monitoring reports on the cactus indicate severe population crashes within the grazing exclosures.[7]

Biologist Robert Schmalzel, a widely recognized authority on the Pima pineapple cactus (PPC), wrote,

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[6] Dennis Parker and Mary Darling, 2010, comments submitted to U.S. Fish and Wildlife Service on behalf of Arizona/New Mexico Coalition of Counties et al. for Docket No. FWS–R2–ES–2010–0072; Comments on Endangered Status and Designation of Critical Habitat for Spikedace and Loach Minnow; Proposed Rule (Federal Register / Vol. 75, No. 208 / Thursday, October 28, 2010 / Proposed Rules Pages 66482 – 66552)

[7] Robert Schmalzel comments to the CNF Feb 2019 BA; submitted May 10, 2019 for J. Chilton; pages 10-11

"In less than 20 years, the Forest Service by its management actions (the construction of two cattle exclosures and the significant reduction of grazing utilization of Lehmann's lovegrass) has essentially extirpated PPC from the Alisos allotment along Duquesne Road. These actions very quickly reduced the amount of bare ground and the visibility and mobility afforded to jackrabbits on formerly well-grazed Lehmann's lovegrass stands. By loss of bare ground and the avoidance of these same areas by jackrabbits, PPC population recruitment stopped and the population is now represented by only two (?) known adult plants along Duquesne Road." (sic)

"The Duquesne Road population of PPC monitored by the Forest Service has undergone a well-documented crash from about 100 plants to 2 plants today."

(Ibid.)

We could cite more examples. In summary, the Service must try to understand that extant and historical land uses can and often do contribute essential physical and biological features to the habitat of a species. We recommend, therefore, that the Service consider extant land uses, in areas where they have coexisted with a species for a reasonable span of time, as an integral part of occupied species habitat.

4. **Conclusion**

4.1. We recommend the Service adopt the following definition of "habitat for a species":

We recommend the Service withdraw both of its proposed generic definitions of "habitat" and consider instead the following suggested definition of "habitat for a species":

The terms, "habitat for a species" and "species habitat" mean:

> The physical places with all essential, extant physical and biological features, including extant land uses, that a reproducing population of a species currently, and for the foreseeable future, can depend upon to carry out and transition between essential life-cycle stages. Essential life cycle-stages are defined as birth or hatching, metamorphosis, growth, and reproduction. Extant land uses are those that have co-occupied an area with a species over a reasonable span of time. Habitat for a species requires no routine human intervention beyond extant land uses. "Foreseeable future," as used herein, assumes that neither traditional human uses nor natural events will permanently remove any extant category of the physical or biological features that are essential to the species' survival.

4.2. We recommend the Service adopt the following definition of "areas occupied by a species":

The terms, "areas occupied by a species" and "occupied areas" mean:

> "Areas occupied by a species" are those areas that the species currently uses with sufficient regularity that it is likely to be present during any reasonable span of time."

4.3. We recommend the Service consider extant land uses that have coexisted with the species over a reasonable span of time as an integral and possibly essential part of occupied species habitat.

Thank you for considering these comments.

Sincerely,

Jim Chilton
Chairman, Pima NRCD/Chairman PCCE

Syllabus

NOTE: Where it is feasible, a syllabus (headnote) will be released, as is being done in connection with this case, at the time the opinion is issued. The syllabus constitutes no part of the opinion of the Court but has been prepared by the Reporter of Decisions for the convenience of the reader. See *United States* v. *Detroit Timber & Lumber Co.,* 200 U. S. 321, 337.

SUPREME COURT OF THE UNITED STATES

Syllabus

WEYERHAEUSER CO. *v.* UNITED STATES FISH AND WILDLIFE SERVICE ET AL.

CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FIFTH CIRCUIT

No. 17–71. Argued October 1, 2018—Decided November 27, 2018

The Fish and Wildlife Service administers the Endangered Species Act of 1973 on behalf of the Secretary of the Interior. In 2001, the Service listed the dusky gopher frog as an endangered species. See 16 U. S. C. §1533(a)(1). That required the Service to designate "critical habitat" for the frog. The Service proposed designating as part of that critical habitat a site in St. Tammany Parish, Louisiana, which the Service dubbed "Unit 1." The frog had once lived in Unit 1, but the land had long been used as a commercial timber plantation, and no frogs had been spotted there for decades. The Service concluded that Unit 1 met the statutory definition of unoccupied critical habitat because its rare, high-quality breeding ponds and distance from existing frog populations made it essential for the species' conservation. §1532(5)(A)(ii). The Service then commissioned a report on the probable economic impact of its proposed critical-habitat designation. §1533(b)(2). With regard to Unit 1, the report found that designation might bar future development of the site, depriving the owners of up to $33.9 million. The Service nonetheless concluded that the potential costs were not disproportionate to the conservation benefits and proceeded to designate Unit 1 as critical habitat for the dusky gopher frog.

Unit 1 is owned by petitioner Weyerhaeuser and a group of family landowners. The owners of Unit 1 sued, contending that the closed-canopy timber plantation on Unit 1 could not be critical habitat for the dusky gopher frog, which lives in open-canopy forests. The District Court upheld the designation. The landowners also challenged the Service's decision not to exclude Unit 1 from the frog's critical habitat, arguing that the Service had failed to adequately weigh the

benefits of designating Unit 1 against the economic impact, had used an unreasonable methodology for estimating economic impact, and had failed to consider several categories of costs. The District Court approved the Service's methodology and declined to consider the challenge to the Service's decision not to exclude Unit 1. The Fifth Circuit affirmed, rejecting the suggestion that the "critical habitat" definition contains any habitability requirement and concluding that the Service's decision not to exclude Unit 1 was committed to agency discretion by law and was therefore unreviewable.

Held:

1. An area is eligible for designation as critical habitat under §1533(a)(3)(A)(i) only if it is habitat for the species. That provision, the sole source of authority for critical-habit designations, states that when the Secretary lists a species as endangered he must also "designate any habitat of such species which is then considered to be critical habitat." It does not authorize the Secretary to designate the area as critical habitat unless it is also habitat for the species. The definition allows the Secretary to identify a subset of habitat that is critical, but leaves the larger category of habitat undefined. The Service does not now dispute that critical habitat must be habitat, but argues that habitat can include areas that, like Unit 1, would require some degree of modification to support a sustainable population of a given species. Weyerhaeuser urges that habitat cannot include areas where the species could not currently survive. The Service, in turn, disputes the premise that the administrative record shows that the frog could not survive in Unit 1. The Court of Appeals, which had no occasion to interpret the term "habitat" in §1533(a)(3)(A)(i) or to assess the Service's administrative findings regarding Unit 1, should address these questions in the first instance. Pp. 8–10.

2. The Secretary's decision not to exclude an area from critical habitat under §1533(b)(2) is subject to judicial review. The Administrative Procedure Act creates a "basic presumption of judicial review" of agency action. *Abbott Laboratories* v. *Gardner*, 387 U. S. 136, 140. The Service contends that the presumption is rebutted here because the action is "committed to agency discretion by law," 5 U. S. C. §701(a)(2), because §1533(b)(2) is one of those rare provisions "drawn so that a court would have no meaningful standard against which to judge the agency's exercise of discretion," *Lincoln* v. *Vigil*, 508 U. S. 182, 191.

Section 1533(b)(2) describes a unified process for weighing the impact of designating an area as critical habitat. The provision's first sentence requires the Secretary to "tak[e] into consideration" economic and other impacts before designation, and the second sentence authorizes the Secretary to act on his consideration by providing that he

Syllabus

"may exclude any area from critical habitat if he determines that the benefits of such exclusion outweigh the benefits of " designation. The word "may" certainly confers discretion on the Secretary, but it does not segregate his discretionary decision not to exclude from the mandated procedure to consider the economic and other impacts of designation when making his exclusion decisions. The statute is, therefore, not "drawn so that a court would have no meaningful standard against which to judge the [Secretary's] exercise of [his] discretion" not to exclude. *Lincoln*, 508 U. S., at 191. Weyerhaeuser's claim—that the agency did not appropriately consider all the relevant statutory factors meant to guide the agency in the exercise of its discretion—is the sort of claim that federal courts routinely assess when determining whether to set aside an agency decision as an abuse of discretion. The Court of Appeals should consider in the first instance the question whether the Service's assessment of the costs and benefits of designation and resulting decision not to exclude Unit 1 was arbitrary, capricious, or an abuse of discretion. Pp. 10–15.

827 F. 3d 452, vacated and remanded.

ROBERTS, C. J., delivered the opinion of the Court, in which all other Members joined, except KAVANAUGH, J., who took no part in the consideration or decision of the case.

SUPREME COURT OF THE UNITED STATES

No. 17–71

WEYERHAEUSER COMPANY, PETITIONER *v.* UNITED STATES FISH AND WILDLIFE SERVICE, ET AL.

ON WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FIFTH CIRCUIT

[November 27, 2018]

CHIEF JUSTICE ROBERTS delivered the opinion of the Court.

The Endangered Species Act directs the Secretary of the Interior, upon listing a species as endangered, to also designate the "critical habitat" of the species. A group of landowners whose property was designated as critical habitat for an endangered frog challenged the designation. The landowners urge that their land cannot be *critical* habitat because it is not *habitat*, which they contend refers only to areas where the frog could currently survive. The court below ruled that the Act imposed no such limitation on the scope of critical habitat.

The Act also authorizes the Secretary to exclude an area that would otherwise be included as critical habitat, if the benefits of exclusion outweigh the benefits of designation. The landowners challenged the decision of the Secretary not to exclude their property, but the court below held that the Secretary's action was not subject to judicial review.

We granted certiorari to review both rulings.

I

A

The amphibian *Rana sevosa* is popularly known as the "dusky gopher frog"—"dusky" because of its dark coloring and "gopher" because it lives underground. The dusky gopher frog is about three inches long, with a large head, plump body, and short legs. Warts dot its back, and dark spots cover its entire body. Final Rule To List the Mississippi Gopher Frog Distinct Population Segment of Dusky Gopher Frog as Endangered, 66 Fed. Reg. 62993 (2001) (Final Listing). It is noted for covering its eyes with its front legs when it feels threatened, peeking out periodically until danger passes. *Markle Interests, LLC* v. *United States Fish and Wildlife Serv.*, 827 F. 3d 452, 458, n. 2 (CA5 2016). Less endearingly, it also secretes a bitter, milky substance to deter would-be diners. Brief for Intervenor-Respondents 6, n. 1.

The frog spends most of its time in burrows and stump holes located in upland longleaf pine forests. In such forests, frequent fires help maintain an open canopy, which in turn allows vegetation to grow on the forest floor. The vegetation supports the small insects that the frog eats and provides a place for the frog's eggs to attach when it breeds. The frog breeds in "ephemeral" ponds that are dry for part of the year. Such ponds are safe for tadpoles because predatory fish cannot live in them. Designation of Critical Habitat for Dusky Gopher Frog, 77 Fed. Reg. 35129–35131 (2012) (Designation).

The dusky gopher frog once lived throughout coastal Alabama, Louisiana, and Mississippi, in the longleaf pine forests that used to cover the southeast. But more than 98% of those forests have been removed to make way for urban development, agriculture, and timber plantations. The timber plantations consist of fast-growing loblolly pines planted as close together as possible, resulting in a closed-canopy forest inhospitable to the frog. The near

eradication of the frog's habitat sent the species into severe decline. By 2001, the known wild population of the dusky gopher frog had dwindled to a group of 100 at a single pond in southern Mississippi. That year, the Fish and Wildlife Service, which administers the Endangered Species Act of 1973 on behalf of the Secretary of the Interior, listed the dusky gopher frog as an endangered species. Final Listing 62993–62995; see 87 Stat. 886, 16 U. S. C. §1533(a)(1).

B

When the Secretary lists a species as endangered, he must also designate the critical habitat of that species. §1533(a)(3)(A)(i). The ESA defines "critical habitat" as:

> "(i) the specific areas within the geographical area occupied by the species . . . on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and
>
> "(ii) specific areas outside the geographical area occupied by the species . . . upon a determination by the Secretary that such areas are essential for the conservation of the species." §1532(5)(A).

Before the Secretary may designate an area as critical habitat, the ESA requires him to "tak[e] into consideration the economic impact" and other relevant impacts of the designation. §1533(b)(2). The statute goes on to authorize him to "exclude any area from critical habitat if he determines that the benefits of such exclusion outweigh the benefits of [designation]," unless exclusion would result in extinction of the species. *Ibid.*

A critical-habitat designation does not directly limit the rights of private landowners. It instead places conditions on the Federal Government's authority to effect any physical changes to the designated area, whether through

activities of its own or by facilitating private development. Section 7 of the ESA requires all federal agencies to consult with the Secretary to "[e]nsure that any action authorized, funded, or carried out by such agency" is not likely to adversely affect a listed species' critical habitat. 16 U. S. C. §1536(a)(2). If the Secretary determines that an agency action, such as issuing a permit, would harm critical habitat, then the agency must terminate the action, implement an alternative proposed by the Secretary, or seek an exemption from the Cabinet-level Endangered Species Committee. See *National Assn. of Home Builders* v. *Defenders of Wildlife*, 551 U. S. 644, 652 (2007); 50 CFR 402.15 (2017).

Due to resource constraints, the Service did not designate the frog's critical habitat in 2001, when it listed the frog as endangered. Designation, at 35118–35119. In the following years, the Service discovered two additional naturally occurring populations and established another population through translocation. The first population nonetheless remains the only stable one and by far the largest. Dept. of Interior, U. S. Fish and Wildlife Serv., Dusky Gopher Frog (*Rana sevosa*) Recovery Plan iv, 6–7 (2015).

In 2010, in response to litigation by the Center for Biological Diversity, the Service published a proposed critical-habitat designation. Designation, at 35119. The Service proposed to designate as occupied critical habitat all four areas with existing dusky gopher frog populations. The Service found that each of those areas possessed the three features that the Service considered "essential to the conservation" of the frog and that required special protection: ephemeral ponds; upland open-canopy forest containing the holes and burrows in which the frog could live; and open-canopy forest connecting the two. But the Service also determined that designating only those four sites would not adequately ensure the frog's conservation.

Because the existing dusky gopher frog populations were all located in two adjacent counties on the Gulf Coast of Mississippi, local events such as extreme weather or an outbreak of an infectious disease could jeopardize the entire species. Designation of Critical Habitat for Mississippi Gopher Frog, 75 Fed. Reg. 31394 (2010) (proposed 50 CFR Part 17).

To protect against that risk, the Service proposed to designate as *unoccupied* critical habitat a 1,544-acre site in St. Tammany Parish, Louisiana. The site, dubbed "Unit 1" by the Service, had been home to the last known population of dusky gopher frogs outside of Mississippi. The frog had not been seen in Unit 1 since 1965, and a closed-canopy timber plantation occupied much of the site. But the Service found that the site retained five ephemeral ponds "of remarkable quality," and determined that an open-canopy forest could be restored on the surrounding uplands "with reasonable effort." Although the uplands in Unit 1 lacked the open-canopy forests (and, of course, the frogs) necessary for designation as occupied critical habitat, the Service concluded that the site met the statutory definition of unoccupied critical habitat because its rare, high-quality breeding ponds and its distance from existing frog populations made it essential for the conservation of the species. Designation, at 35118, 35124, 35133, 35135.

After issuing its proposal, the Service commissioned a report on the probable economic impact of designating each area, including Unit 1, as critical habitat for the dusky gopher frog. See 16 U. S. C. §1533(b)(2); App. 63. Petitioner Weyerhaeuser Company, a timber company, owns part of Unit 1 and leases the remainder from a group of family landowners. Brief for Petitioner 16. While the critical-habitat designation has no direct effect on the timber operations, St. Tammany Parish is a fast-growing part of the New Orleans metropolitan area, and the land-

owners have already invested in plans to more profitably develop the site. App. 80–83. The report recognized that anyone developing the area may need to obtain Clean Water Act permits from the Army Corps of Engineers before filling any wetlands on Unit 1. 33 U. S. C. §1344(a). Because Unit 1 is designated as critical habitat, Section 7 of the ESA would require the Corps to consult with the Service before issuing any permits.

According to the report, that consultation process could result in one of three outcomes. First, it could turn out that the wetlands in Unit 1 are not subject to the Clean Water Act permitting requirements, in which case the landowners could proceed with their plans unimpeded. Second, the Service could ask the Corps not to issue permits to the landowners to fill some of the wetlands on the site, in effect prohibiting development on 60% of Unit 1. The report estimated that this would deprive the owners of $20.4 million in development value. Third, by asking the Corps to deny even more of the permit requests, the Service could bar all development of Unit 1, costing the owners $33.9 million. The Service concluded that those potential costs were not "disproportionate" to the conservation benefits of designation. "Consequently," the Service announced, it would not "exercis[e] [its] discretion to exclude" Unit 1 from the dusky gopher frog's critical habitat. App. 188–190.

C

Weyerhaeuser and the family landowners sought to vacate the designation in Federal District Court. They contended that Unit 1 could not be critical habitat for the dusky gopher frog because the frog could not survive there: Survival would require replacing the closed-canopy timber plantation encircling the ponds with an open-canopy longleaf pine forest. The District Court nonetheless upheld the designation. *Markle Interests, LLC* v.

United States Fish and Wildlife Serv., 40 F. Supp. 3d 744 (ED La. 2014). The court determined that Unit 1 satisfied the statutory definition of unoccupied critical habitat, which requires only that the Service deem the land "essential for the conservation [of] the species." *Id.,* at 760.

Weyerhaeuser also challenged the Service's decision not to exclude Unit 1 from the dusky gopher frog's critical habitat, arguing that the Service had failed to adequately weigh the benefits of designating Unit 1 against the economic impact. In addition, Weyerhaeuser argued that the Service had used an unreasonable methodology for estimating economic impact and, regardless of methodology, had failed to consider several categories of costs. *Id.,* at 759. The court approved the Service's methodology and declined to consider Weyerhaeuser's challenge to the decision not to exclude. See *id.*, at 763–767, and n. 29.

The Fifth Circuit affirmed. 827 F. 3d 452. The Court of Appeals rejected the suggestion that the definition of critical habitat contains any "habitability requirement." *Id.,* at 468. The court also concluded that the Service's decision not to exclude Unit 1 was committed to agency discretion by law and was therefore unreviewable. *Id.,* at 473–475. Judge Owen dissented. She wrote that Unit 1 could not be "essential for the conservation of the species" because it lacked the open-canopy forest that the Service itself had determined was "essential to the conservation" of the frog. *Id.,* at 480–481.

The Fifth Circuit denied rehearing en banc. *Markle Interests, LLC* v. *United States Fish and Wildlife Serv.*, 848 F. 3d 635 (2017). Judge Jones dissented, joined by Judges Jolly, Smith, Clement, Owen, and Elrod. They reasoned that critical habitat must first be habitat, and Unit 1 in its present state could not be habitat for the dusky gopher frog. *Id.,* at 641. The dissenting judges also concluded that the Service's decision not to exclude Unit 1 was reviewable for abuse of discretion. *Id.,* at 654, and

n. 21.

We granted certiorari to consider two questions: (1) whether "critical habitat" under the ESA must also be habitat; and (2) whether a federal court may review an agency decision not to exclude a certain area from critical habitat because of the economic impact of such a designation. 583 U. S. ___ (2018).[1]

II

A

Our analysis starts with the phrase "critical habitat." According to the ordinary understanding of how adjectives work, "critical habitat" must also be "habitat." Adjectives modify nouns—they pick out a subset of a category that possesses a certain quality. It follows that "critical habitat" is the subset of "habitat" that is "critical" to the conservation of an endangered species.

Of course, "[s]tatutory language cannot be construed in a vacuum," *Sturgeon* v. *Frost*, 577 U. S. ___, ___ (2016) (slip op., at 12) (internal quotation marks omitted), and so we must also consider "critical habitat" in its statutory context. Section 4(a)(3)(A)(i), which the lower courts did not analyze, is the sole source of authority for critical-habitat designations. That provision states that when the Secretary lists a species as endangered he must also "designate any *habitat of such species* which is then considered to be critical habitat." 16 U. S. C. §1533(a)(3)(A)(i) (em-

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[1] Intervenor Center for Biological Diversity raises an additional question in its brief, arguing that Weyerhaeuser lacks standing to challenge the critical-habitat designation because it has not suffered an injury in fact. We agree with the lower courts that the decrease in the market value of Weyerhaeuser's land as a result of the designation is a sufficiently concrete injury for Article III purposes. See *Village of Euclid* v. *Ambler Realty Co.*, 272 U. S. 365, 386 (1926) (holding that a zoning ordinance that "greatly . . . reduce[d] the value of appellee's lands and destroy[ed] their marketability for industrial, commercial and residential uses" constituted a "present invasion of appellee's property rights").

phasis added). Only the "habitat" of the endangered species is eligible for designation as critical habitat. Even if an area otherwise meets the statutory definition of unoccupied critical habitat because the Secretary finds the area essential for the conservation of the species, Section 4(a)(3)(A)(i) does not authorize the Secretary to designate the area as *critical* habitat unless it is also *habitat* for the species.

The Center for Biological Diversity contends that the statutory definition of critical habitat is complete in itself and does not require any independent inquiry into the meaning of the term "habitat," which the statute leaves undefined. Brief for Intervenor-Respondents 43–49. But the statutory definition of "critical habitat" tells us what makes habitat "critical," not what makes it "habitat." Under the statutory definition, critical habitat comprises areas occupied by the species "on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection," as well as unoccupied areas that the Secretary determines to be "essential for the conservation of the species." 16 U. S. C. §1532(5)(A). That is no baseline definition of habitat—it identifies only certain areas that are indispensable to the conservation of the endangered species. The definition allows the Secretary to identify the subset of habitat that is critical, but leaves the larger category of habitat undefined.

The Service does not now dispute that critical habitat must be habitat, see Brief for Federal Respondents 23, although it made no such concession below. Instead, the Service argues that habitat includes areas that, like Unit 1, would require some degree of modification to support a sustainable population of a given species. *Id.*, at 27. Weyerhaeuser, for its part, urges that habitat cannot include areas where the species could not currently sur-

vive. Brief for Petitioner 25. (Habitat can, of course, include areas where the species does not currently *live*, given that the statute defines critical habitat to include unoccupied areas.) The Service in turn disputes Weyerhaeuser's premise that the administrative record shows that the frog could not survive in Unit 1. Brief for Federal Respondents 22, n. 4.

The Court of Appeals concluded that "critical habitat" designations under the statute were not limited to areas that qualified as habitat. See 827 F. 3d, at 468 ("There is no habitability requirement in the text of the ESA or the implementing regulations."). The court therefore had no occasion to interpret the term "habitat" in Section 4(a)(3)(A)(i) or to assess the Service's administrative findings regarding Unit 1. Accordingly, we vacate the judgment below and remand to the Court of Appeals to consider these questions in the first instance.[2]

B

Weyerhaeuser also contends that, even if Unit 1 could be properly classified as critical habitat for the dusky gopher frog, the Service should have excluded it from designation under Section 4(b)(2) of the ESA. That provision requires the Secretary to "tak[e] into consideration the economic impact . . . of specifying any particular area as critical habitat" and authorizes him to "exclude any area from critical habitat if he determines that the benefits of such exclusion outweigh the benefits of specifying such area as part of the critical habitat." 16 U. S. C.

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[2] Because we hold that an area is eligible for designation as critical habitat under Section 4(a)(3)(A)(i) only if it is habitat for the species, it is not necessary to consider the landowners' argument that land cannot be "essential for the conservation of the species," and thus cannot satisfy the statutory definition of unoccupied critical habitat, if it is not habitat for the species. See Brief for Petitioner 27–28; Brief for Respondent Markle Interests, LLC, et al. in Support of Petitioner 28–31.

§1533(b)(2). To satisfy its obligation to consider economic impact, the Service commissioned a report estimating the costs of its proposed critical-habitat designation. The Service concluded that the costs of designating the proposed areas, including Unit 1, were not "disproportionate" to the conservation benefits and, "[c]onsequently," declined to make any exclusions.

Weyerhaeuser claims that the Service's conclusion rested on a faulty assessment of the costs and benefits of designation and that the resulting decision not to exclude should be set aside. Specifically, Weyerhaeuser contends that the Service improperly weighed the costs of designating Unit 1 against the benefits of designating *all* proposed critical habitat, rather than the benefits of designating Unit 1 in particular. Weyerhaeuser also argues that the Service did not fully account for the economic impact of designating Unit 1 because it ignored, among other things, the costs of replacing timber trees with longleaf pines, maintaining an open canopy through controlled burning, and the tax revenue that St. Tammany Parish would lose if Unit 1 were never developed. Brief for Petitioner 53–54. The Court of Appeals did not consider Weyerhaeuser's claim because it concluded that a decision not to exclude a certain area from critical habitat is unreviewable.

The Administrative Procedure Act creates a "basic presumption of judicial review [for] one 'suffering legal wrong because of agency action.'" *Abbott Laboratories* v. *Gardner*, 387 U. S. 136, 140 (1967) (quoting 5 U. S. C. §702). As we explained recently, "legal lapses and violations occur, and especially so when they have no consequence. That is why this Court has so long applied a strong presumption favoring judicial review of administrative action." *Mach Mining, LLC* v. *EEOC*, 575 U. S. ___, ___–___ (2015) (slip op., at 7–8). The presumption may be rebutted only if the relevant statute precludes review, 5 U. S. C. §701(a)(1), or if the action is "committed to agency

discretion by law," §701(a)(2). The Service contends, and the lower courts agreed, that Section 4(b)(2) of the ESA commits to the Secretary's discretion decisions not to exclude an area from critical habitat.

This Court has noted the "tension" between the prohibition of judicial review for actions "committed to agency discretion" and the command in §706(2)(A) that courts set aside any agency action that is "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law." *Heckler* v. *Chaney*, 470 U. S. 821, 829 (1985). A court could never determine that an agency abused its discretion if all matters committed to agency discretion were unreviewable. To give effect to §706(2)(A) and to honor the presumption of review, we have read the exception in §701(a)(2) quite narrowly, restricting it to "those rare circumstances where the relevant statute is drawn so that a court would have no meaningful standard against which to judge the agency's exercise of discretion." *Lincoln* v. *Vigil*, 508 U. S. 182, 191 (1993). The Service contends that Section 4(b)(2) of the ESA is one of those rare statutory provisions.

There is, at the outset, reason to be skeptical of the Service's position. The few cases in which we have applied the §701(a)(2) exception involved agency decisions that courts have traditionally regarded as unreviewable, such as the allocation of funds from a lump-sum appropriation, *Lincoln*, 508 U. S., at 191, or a decision not to reconsider a final action, *ICC* v. *Locomotive Engineers*, 482 U. S. 270, 282 (1987). By contrast, this case involves the sort of routine dispute that federal courts regularly review: An agency issues an order affecting the rights of a private party, and the private party objects that the agency did not properly justify its determination under a standard set forth in the statute.

Section 4(b)(2) states that the Secretary

> "shall designate critical habitat . . . after taking into consideration the economic impact, the impact on national security, and any other relevant impact, of specifying any particular area as critical habitat. The Secretary may exclude any area from critical habitat if he determines that the benefits of such exclusion outweigh the benefits of specifying such area . . . unless he determines . . . that the failure to designate such area as critical habitat will result in the extinction of the species concerned." 16 U. S. C. §1533(b)(2).

Although the text meanders a bit, we recognized in *Bennett* v. *Spear*, 520 U. S. 154 (1997), that the provision describes a unified process for weighing the impact of designating an area as critical habitat. The first sentence of Section 4(b)(2) imposes a "categorical requirement" that the Secretary "tak[e] into consideration" economic and other impacts before such a designation. *Id.,* at 172 (emphasis deleted). The second sentence authorizes the Secretary to act on his consideration by providing that he may exclude an area from critical habitat if he determines that the benefits of exclusion outweigh the benefits of designation. The Service followed that procedure here (albeit in a flawed manner, according to Weyerhaeuser). It commissioned a report to estimate the costs of designating the proposed critical habitat, concluded that those costs were not "disproportionate" to the benefits of designation, and "[c]onsequently" declined to "exercis[e] [its] discretion to exclude any areas from [the] designation of critical habitat." App. 190.

Bennett explained that the Secretary's "ultimate decision" to designate or exclude, which he "arriv[es] at" after considering economic and other impacts, is reviewable "for abuse of discretion." 520 U. S., at 172. The Service dismisses that language as a "passing reference . . . not necessarily inconsistent with the Service's understanding,"

which is that the Secretary's decision not to exclude an area is wholly discretionary and therefore unreviewable. Brief for Federal Respondents 50. The Service bases its understanding on the second sentence of Section 4(b)(2), which states that the Secretary "*may* exclude [an] area from critical habitat if he determines that the benefits of such exclusion outweigh the benefits of [designation]."

The use of the word "may" certainly confers discretion on the Secretary. That does not, however, segregate his discretionary decision not to exclude from the procedure mandated by Section 4(b)(2), which directs the Secretary to consider the economic and other impacts of designation when making his exclusion decisions. Weyerhaeuser's claim is the familiar one in administrative law that the agency did not appropriately consider all of the relevant factors that the statute sets forth to guide the agency in the exercise of its discretion. Specifically, Weyerhaeuser contends that the Service ignored some costs and conflated the benefits of designating Unit 1 with the benefits of designating all of the proposed critical habitat. This is the sort of claim that federal courts routinely assess when determining whether to set aside an agency decision as an abuse of discretion under §706(2)(A). See *Judulang* v. *Holder*, 565 U. S. 42, 53 (2011) ("When reviewing an agency action, we must assess . . . whether the decision was based on a consideration of the relevant factors and whether there has been a clear error of judgment." (internal quotation marks omitted)).

Section 4(b)(2) requires the Secretary to consider economic impact and relative benefits before deciding whether to exclude an area from critical habitat or to proceed with designation. The statute is, therefore, not "drawn so that a court would have no meaningful standard against which to judge the [Secretary's] exercise of [his] discretion" not to exclude. *Lincoln*, 508 U. S., at 191.

Because it determined that the Service's decisions not to

exclude were committed to agency discretion and therefore unreviewable, the Court of Appeals did not consider whether the Service's assessment of the costs and benefits of designation was flawed in a way that rendered the resulting decision not to exclude Unit 1 arbitrary, capricious, or an abuse of discretion. Accordingly, we remand to the Court of Appeals to consider that question, if necessary, in the first instance.

* * *

The judgment of the Court of Appeals for the Fifth Circuit is vacated, and the case is remanded for further proceedings consistent with this opinion.

It is so ordered.

JUSTICE KAVANAUGH took no part in the consideration or decision of this case.

Forest and Fishes: Effects of Flows and Foreigners on Southwestern Native Fishes

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Abstract

Habitat alteration in physical (stream channel characteristics), chemical (nutrients, temperature), or biological (introduced species) form can have dramatic effects on native southwestern USA fishes. Southwestern flow regimes, their alterations, and introduction of alien species have had a dramatic, negative impact on native southwestern fishes. The cumulative and interactive impacts may result in various responses by native fish assemblages. Managers should not expect the same result when one or more factors are in operation that may affect an aquatic ecosystem in the southwestern USA. Ultimately, consideration of temporal-spatial influences, natural factors, interactions of factors, and sound monitoring or research activities will determine which factors most influence southwestern fish assemblages in respective situations.

Rinne, J.N. 2004. Forest and fishes: effects of flows and foreigners on southwestern native fishes. Pages 119-124 in G.J. Scrimgeour, G. Eisler, B. McCulloch, U. Silins and M. Monita. Editors. Forest Land–Fish Conference II – Ecosystem Stewardship through Collaboration. Proc. Forest-Land-Fish Conf. II, April 26-28, 2004, Edmonton, Alberta.

Introduction

Native fishes of the southwestern United States (Minckley 1973, Rinne 2003a) have declined dramatically in range and numbers in the last century (Rinne 1994, Mueller and Marsh 2002). Multiple, cumulative factors such as dams, diversions, introductions of non-indigenous species, and varying land uses have been implicated as factors causing their demise. The question can be asked, "What are the relative impacts of hydrology, introduced fishes and other organisms, and land uses such as timber harvest and livestock grazing on native fishes occupying southwestern riparian ecosystems?" The primary objective of this paper is to briefly introduce and delineate factors that have impacted historically and will potentially continue to negatively impact the native, largely threatened and endangered fish fauna of the American Southwest (Rinne and Minckley 1991, Rinne 2003a, 2003b). Each factor that individually, and ultimately, cumulatively impacts native fish assemblages will be introduced and evidence presented documenting the degree of impact on native fish assemblages in the southwestern U. S.

Cumulative, impacting factors

Hydrological and physical habitat alteration and introduction of nonnative fishes (Miller 1961, Rinne 1994, 2003b) are the two factors most commonly associated with the marked decline in range and numbers of most native fish species in the Southwest. As a result, the majority of the southwestern fish species have been officially listed as threatened or endangered (Rinne 2003a). Recently, land uses such as domestic livestock, grazing of forest landscapes and their riparian corridors (Rinne 2000) have been implicated as a negative impact on native fish assemblages. Studies of changes in fish assemblages on the upper Verde River, Arizona over the past decade (Figure 2) and literature on the topic over the past few decades will be used to demonstrate and document the relative impact of flows or stream hydrographs on fishes and the removal of livestock grazing and associated habitat changes.

Natural and human-altered hydrology

Where natural flow regimes persist, rivers change dramatically and abruptly temporally and spatially from flood to drought across the arid, more xeric regions of the interior West (Hubbs and Miller 1948). Similarly, the natural hydrology of southwestern desert rivers and streams is highly variable and episodic (Minckley and Meffe 1987, Rinne and Stefferud 1997) (Figure 1). In absence of any human-imposed factors, native fishes appear to be adapted to survive and sustain themselves under these conditions. Natural flow regimes have generally been considered optimum for sustaining native fishes (Poff et al. 1997).

The Southwest has sustained extensive and recently intensive human immigration. Accompanying this influx of Europeans was the ever-increasing demand for water that has resulted in dramatic alteration of the historic hydrology of the Southwest (Rinne 2002). The 1902 Bureau of Reclamation Act instituted these dramatic changes. The first Reclamation dam, Roosevelt, was completed on the Salt River in 1911 and the hydrology of the Salt River downstream was irreversibly changed. This dam and others retained peak flows that originated from upper elevation, forested areas in the Central Arizona Mountains.

In 1932, completion of Hoover Dam on the Colorado River and additional dams such as Glen Canyon Dam impounding Lake Powell imposed a dramatic and lasting change in the hydrologic regime of the Colorado River mainstem. Periodic natural and often quite dramatic flood flows (Mueller and Marsh 2002) were forever lost to the system. Rinne (1994) calculated that over 75% of the large mainstream river habitats in Arizona were either lost or altered between 1911 and 1970. Diversions such as Imperial Dam on the lower Colorado River and groundwater pumping imposed additional alterations to natural flow regimes. Coolidge Dam and the Ashurst-Hayden Diversion on the Gila River, both completed in 1928, effectively dried the Gila River to its confluence with the Salt River. Other major tributaries to the Gila from the south, the San Pedro, San Simon and Santa Cruz Rivers have been dried primarily as a result of groundwater pumping.

Fish response to altered hydrology

The Gila topminnow, *Poecilliopsis occidentalis*, was once (1940s) the commonest native species in the lower Colorado River (Minckley 1973, Hubbs and Miller 1941). It now persists naturally in fewer than a dozen, isolated diminutive spring heads or spring runs in southern Arizona (Meffe et al. 1983). The large Colorado pike minnow (*Ptyocheilus lucius*), historically referred to as the "Colorado salmon" by locals because of large spawning runs, is now extirpated in the lower Colorado River and might be only locally present as a result of restoration-repatriation programs. Similarly,

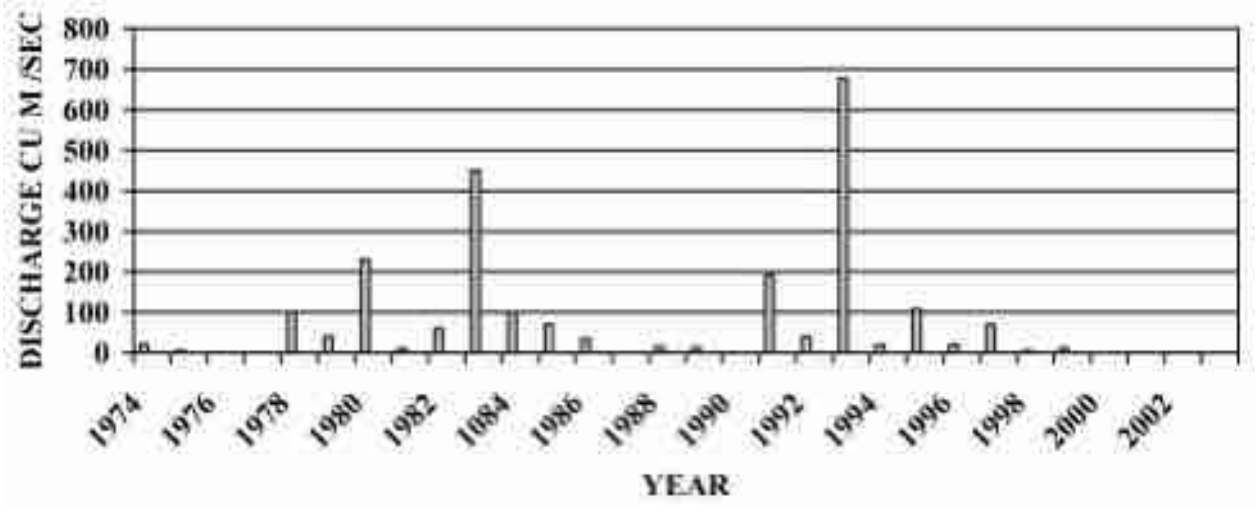

Figure 1. Instantaneous peak discharges in the Verde River, 1974-2002.

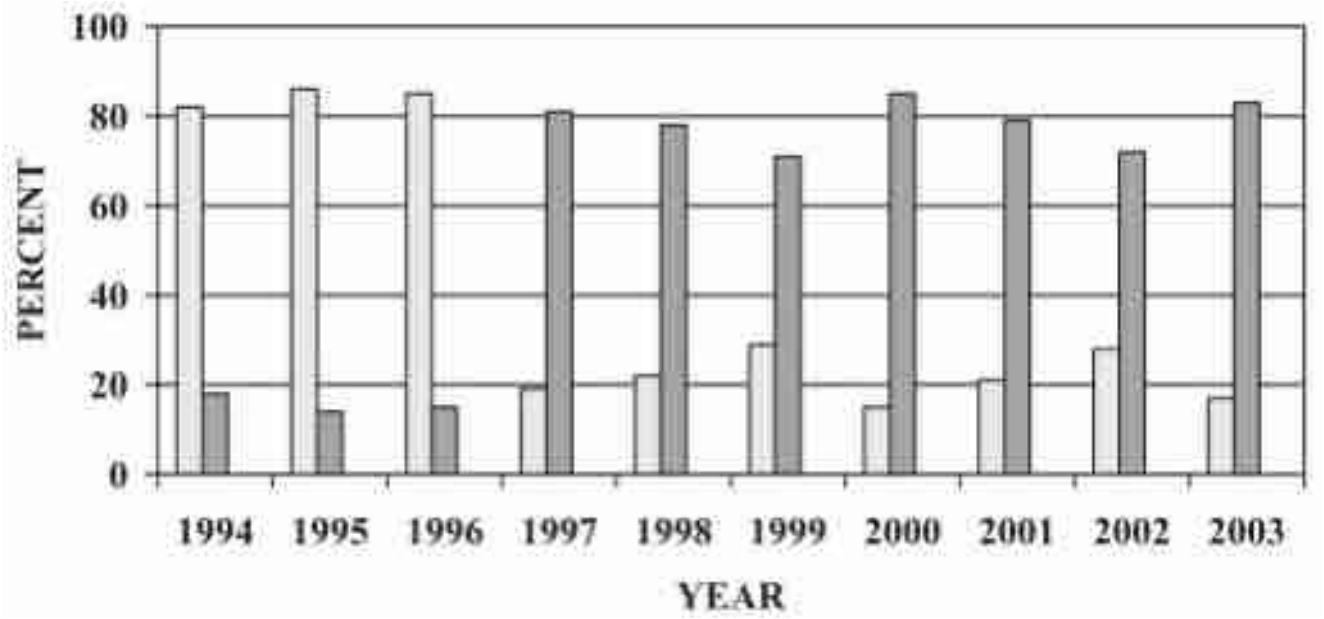

Figure 2. Change in relative proportions of natives (light bars) and nonnative (dark bars) in samples in the upper Verde River, 1994-2003, a period of low, drought flows (see Figure 1).

the razorback sucker (*Xyrauchen texanus)* was once so abundant in the river that it was pitch forked from canal systems in the Phoenix area and used as fertilizer. The bonytail chub (*Gila elegans)* along with razorback sucker occurs only in Colorado River reservoirs either as scenescent populations that correlate well with dam closures or as repatriated individuals. All these species are now officially listed as endangered. Others, such as spikedace (*Meda Fulgida)* and loach minnow (*Rhinichthys cobitis*) are threatened species. In the upper Verde River peak flows (Figure 1) have been demonstrated, in the short term, to be positively related to native fish populations (Figure 2; Rinne 2002).

Foreigners

Changes in fish assemblages

The native fish fauna of the Southwest is low in diversity and high in uniqueness and specialization (Miller 1961, Minckley 1973, Rinne and Minckley 1991). Fewer than 50 species of fishes naturally occurred in the waters of the Southwest and only two dozen were historic inhabitants in the waters of Arizona (Minckley 1973, Rinne and Minckley 1991). By comparison, over 100 species of fishes have been introduced into Arizona alone (Rinne 1994) and half have become established (Rinne 2003a) as self-sustaining populations. Most of the introductions were for sport fishing, which naturally

followed the massive increase in reservoir surface water acres and habitat (Rinne 2003a). Rinne and Janisch (1995) reported the extensive coldwater introductions, and Rinne et al. (1998) the warmwater introductions in Arizona streams and lakes.

Nonnative, or non-indigenous fish introductions into foreign waters have generally been shown to have a negative, often dramatic impact (Courtenay and Stauffer 1984). In the Southwest, increased presence and abundance of these species is negatively correlated with native species. In the upper Verde River, in 1994, nonnative fishes comprised less than 10% of fishes captured (Figure 2). Only a decade later, in 2003, 90% of the fishes captured were nonnative species. In the Gila River, Colorado (Mueller and Marsh 2002) and Rio Grande rivers similar patterns of increase in non-native fishes is paralleled by an often, dramatic decrease in native species. Native trout species have declined dramatically with the introduction on nonnative trout. Rinne and Minckley (1985) documented the inverse distributions of the native Apache trout (*Oncorhynchus apache*) and introduced rainbow (*O. mykiss*) and brown (*Salmo trutta*) trout. Gila topminnow populations decrease in presence of the introduced mosquitofish (*Gambusia affinis)* (Meffe et al. 1983). Replacement can come by way of competition, hybridization or direct predation (Minckley 1983, Rinne 2003a). In summary, native southwestern fishes and non-native, predatory or competitory fishes generally cannot co-exist (Rinne et al. in press) in the same reaches of stream. Hydrological and geomorphological influences and interactions can alter this statement (Rinne 2002).

Other foreign species

In addition, other foreign aquatic species also have been introduced into the waters of the West and Southwest. Two principal species are a vertebrate, bullfrog (*Rana catesbiena*) and an invertebrate, crayfish (*Procambarus sp)*. Data, albeit mostly observational, indicate the dramatic impact of these two foreign aquatic species. White (1999) documented the impact of crayfish on the native Colorado spinedace (*Lepidomeda vittata)* through predation on eggs of this native, threatened fish species. However, in general data are lacking on the potential or real impact of these two species.

Domestic Livestock

Grazing of domestic livestock on upper elevation forested landscapes and riparian areas is generally thought to have an effect on fish habitats and fish species. However, most of the information pertain to salmonid species (Rinne 2000) and would apply only to the three native species of southwestern trouts (Gila (*Oncorhynchus gilae*), Apache (*O. apache*), and Rio Grande (*O. clarki virginalis*) cutthroat). Data on the upper Verde River, a warm water aquatic ecosystem in Arizona, do not corroborate the contention that livestock have a significant or even a demonstrable effect on native fishes (Figure 2). Removal of livestock on the upper Verde River in 1997 has resulted in markedly improved riparian conditions in form of increased vegetation and stream bank and channel alterations (Rinne and Miller in press). However, most native species, including the threatened spikedace, have declined in abundance and distribution in the upper Verde River. Most of the information addressing livestock grazing effects on fishes is 1) largely opinionated and conjecture, 2) based on qualitative, short term, non-replicated data, 3) primarily for salmonids, and 4) not based on sound science. Further, complicating and confounding factors make it difficult to produce definitive answers. The negative effect of grazing on native, cypriniform species for such variables as stream banks (Rinne and Neary 1997) and sediment levels (Rinne 2001) are not demonstrable. At present, there is no evidence, based on sound science, that grazing by domestic livestock has an obvious and well-documented negative effect on native fish species.

Cumulative, inter-active factors

The above factors that potentially negatively impact native southwestern fishes obviously do not act independently. That is, several factors operating simultaneously may produce a different result on fish assemblages in southwestern rivers. For example, flood flows on the upper Verde River in 1993 immediately favored the native fishes (Rinne and Stefferud 1997). Subsequently, low or drought flows (Figure 1) were paralleled by an increase in non-native species. Removal of livestock grazing on the river corridor was then superimposed. Although this management action improved riparian vegetation and is generally considered a favorable restorative action for "fish habitat," it has not resulted in an increase in native fishes (Figure 2). Indeed, the opposite appears to be true. The increase in cover and change in water depths have favored introduced, "cover seeking," more lentic species such as smallmouth bass (*Micropterus dolomieus*) and green

sunfish (*Lepomis cyanellus*) (Pflieger 1975), yellow bullhead (*Ameiurus natalis*), mosquito fish (*Gambusia affinis*) and red shiner (*Cyprinella lutrensis*). The question becomes "Which of the two factors, flows (natural and altered) or foreigners in the form of nonnative fishes and domestic livestock has the greatest influence on native fishes?" Further, "Do livestock and non-native fishes have a greater influence on fish assemblages than does the hydrograph?"

In the upper Gila River, New Mexico, natural, historic flow regimes are extant in the Gila-Cliff Valley (Rinne 2002). Grazing occurs in most reaches of the river, however, livestock have been removed from the Gila Bird Area for a time period similar to that of the upper Verde River. The same native fish assemblage that occurs in the upper Verde consistently has comprised greater than 90% of the total numbers of fishes captured in these reaches over the past six years (Rinne and Miller in press). Native fishes also are predominant in contiguous grazed reaches. These data suggest that a natural, more variable hydrograph characterized by frequent flood events may override or more strongly influence fish assemblages than does domestic livestock grazing (Rinne 2002).

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Hydrology, Geomorphology and Management: Implications for Sustainability of Native Southwestern Fishes

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Native southwestern fishes have declined markedly in range and numbers. The factors responsible for their decline are many and varied. However, the primary stressors to native fish assemblages in southwestern rivers and streams are habitat alteration and introduction of non-native species. We present data that compare the fish assemblages in two desert rivers—the Gila and Verde (Arizona-New Mexico)—over a period of 7–12 years, respectively. We also present data on hydrographs, broadscale and local geomorphology, and past fisheries, water, and land management activities. Peak flow, mean volume of flow, variability of flow, canyon-bound and broad alluvial reaches, dams, and introduced fishes are all either directly or indirectly related to fish assemblages in southwestern rivers and streams. We suggest that three primary influencing factors—two natural and one human induced (hydrograph, geomorphology, management)—are critical features in delimiting native fish assemblages. Conserving and sustaining native fish assemblages in these and other southwestern rivers and streams will require land managers to address all aspects of these three major influencing factors with administrative and legal mandates.

Keywords hydrology, geomorphology, native fishes, Southwestern USA

Introduction

In the southwestern United States, the native fish fauna is low in diversity and is comprised primarily (95%) of cypriniform (minnow and sucker) species (Minckley, 1973; Rinne and Minckley, 1991). All native species have declined in range and numbers in the past 50 years (Miller, 1961; Rinne, 1994, 1996). As a result, most of the native fauna is either federally or state listed (Williams et al., 1989; Minckley and Deacon, 1991; Rinne and Minckley, 1991). Spikedace (*Meda fulgida*) and loach minnow (*Rhinichthys [Tiaroga] cobitis*) are two of the currently listed native southwestern fish fauna. These two federally threatened species are restricted to the Gila River basin—Arizona and New Mexico—and have declined dramatically in range and numbers (Minckley, 1973; U. S. Fish And Wildlife Service, 1990a, 1990b).

Largely because of regional hydrology and extensively modified river systems, research and management for native southwestern fishes has been approached on a species-by-species

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basis (Rinne and Stefferud, 1998). However, efforts must continually be made to study and manage native fishes at the assemblage level (Rinne et al., 1998; Rinne, 2003a, 2005). Information on factors limiting this disappearing resource (Rinne and Minckley, 1991) is needed by land managers to manage and sustain the native fish fauna in the Southwest.

Commencing in 1994, we initiated research and monitoring designed to determine factors that influence fish assemblage structure in the upper Verde River, Arizona (Stefferud and Rinne, 1995). Studies of fish populations and their habitats and possible abiotic and biotic factors influencing both have been conducted over the past 12 years in this reach of river, Arizona (Rinne and Stefferud, 1996, 1997; Rinne et al., 1998; Rinne, 1999a, 2005). In spring 1999, similar efforts to study fish assemblages were initiated in the upper Gila River, New Mexico, from its headwaters in the Gila Wilderness to the Arizona-New Mexico border (Rinne et al., 2005a). The primary objective of the effort on the upper Gila was to establish long-term monitoring sites for fish and their habitats. A second objective was to obtain temporal and spatial estimates of fish assemblages employing sampling methods similar to those used on the Verde. A major objective of the research and monitoring was to compare fish assemblages in the two river systems based on spatial and temporal changes in the native and non-native components and relative to factors possibly influencing respective assemblages. Because of critical threatened and endangered species issues and their legal ramifications, the distribution and abundance of two threatened species—spikedace and loach minnow—were of special interest.

Rinne (2002) introduced briefly the topics covered in this article. In this article, we examine in greater detail the primary factors that influence fish assemblages in the southwest. This article will: 1) describe fish assemblages in time and space in both rivers; 2) compare species trends in time and space in the two rivers; 3) describe trends in distribution and abundance of the two threatened species—spikedace and loach minnow; 4) outline factors that appear to be influencing or delimiting fish assemblage composition in the two southwestern desert rivers; and 5) relate these factors to management and conservation of the native fish resource in the arid American Southwest.

Study Areas and Methods

The primary study areas for the upper Verde and Gila Rivers are shown in Figure 1. Seven established monitoring sites have been sampled since 1994 in the Upper Verde River (Figure 2a) (Stefferud and Rinne, 1995). Additional major reaches (II–IV) from the headwaters to the mouth (Figure 2a) were also assessed with previously collected information provided by the Arizona Game and Fish Department.

The five major sampling reaches within the Upper Gila River are shown in Figure 2b. Sample sites in both rivers ranged in length from 150 to 300 m and were selected to include a diversity of aquatic macrohabitats that are occupied by all Gila River basin native species (Rinne and Stefferud, 1996; Sponholtz and Rinne, 1997). These same habitats were resampled annually to standardize catches among years. The specific habitat types are high-gradient riffles (HGR), low-gradient riffles (LGR), glide-runs (GRUN), and pools (POOL). Because physical descriptors of these habitat types are reported in Rinne and Stefferud (1996) and Sponholtz and Rinne (1997), specific habitat data relative to fish abundance and distribution will only be summarized here. Gradients of the different habitat types were estimated using laser technology. Velocities were measured with a direct readout current meter, and depths with a meter rule. Substrate composition was estimated using the methods of Bevenger and King (1995).

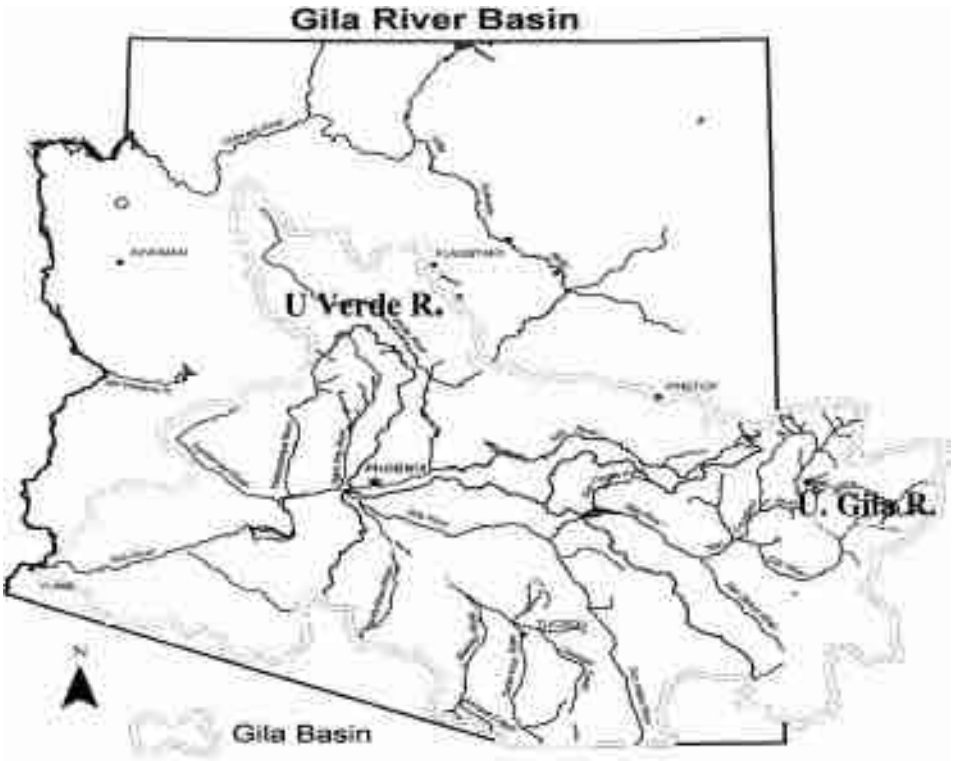

Figure 1. The Gila River Basin indicating the major study areas in the upper Verde River, Arizona and the upper Gila River, New Mexico-Arizona.

Fishes were collected by multiple sampling techniques depending on macro-habitat. Direct current, backpack electrofishing units were used to sample under debris, banks, and in riffles. In the case of HGRs and LGRs, shocking was conducted from upstream to downstream, and fish were collected into a 6-m, 3-mm mesh bag seine. Glide-runs were normally sampled by seining from up to downstream with the same bag seine. Deeper pools (>2 m) were trammel netted (30 m in length and meshes of 13-, 40-, and 80-mm mesh arrays) to sample for larger-sized (>30 mm) individuals. All fishes collected in each unit were counted, measured, and returned alive to the same reach of stream. Once 50 individuals of a species at a site were measured, all other individuals in a respective species were only counted. Hydrograph data are provided from the USGS web site www://water.usgs.gov/index.html.

Results and Discussion

Verde River

Fish. Total abundance of fish captured in Reach I in spring (April) from 1994 to 2005 has declined dramatically (Figure 3). The fish assemblage in this reach of river has changed from being predominantly (>80%) native from 1994 to 1996 to being dominated (>70%) by non-native fishes since 1997 (Figure 4). Similarly, downstream of Reach I to the mouth of the Verde River, non-native species increased and native species decreased (Figure 5).

Paralleling the overall decrease in native fishes, all six native species have declined markedly in abundance since initial sampling in 1994 (Table 1). Longfin dace (*Agosia chrysogaster*) numbered 1300 individuals in 1994, dropped to only a dozen individuals in 1995 (Table 1) and then increased to almost 300 individuals in 1996 before declining again to only 21 individuals among the seven sites in 1997 and a dozen in 1998. Only five individuals have been collected in the past 5 years of sampling at the seven monitoring sites.

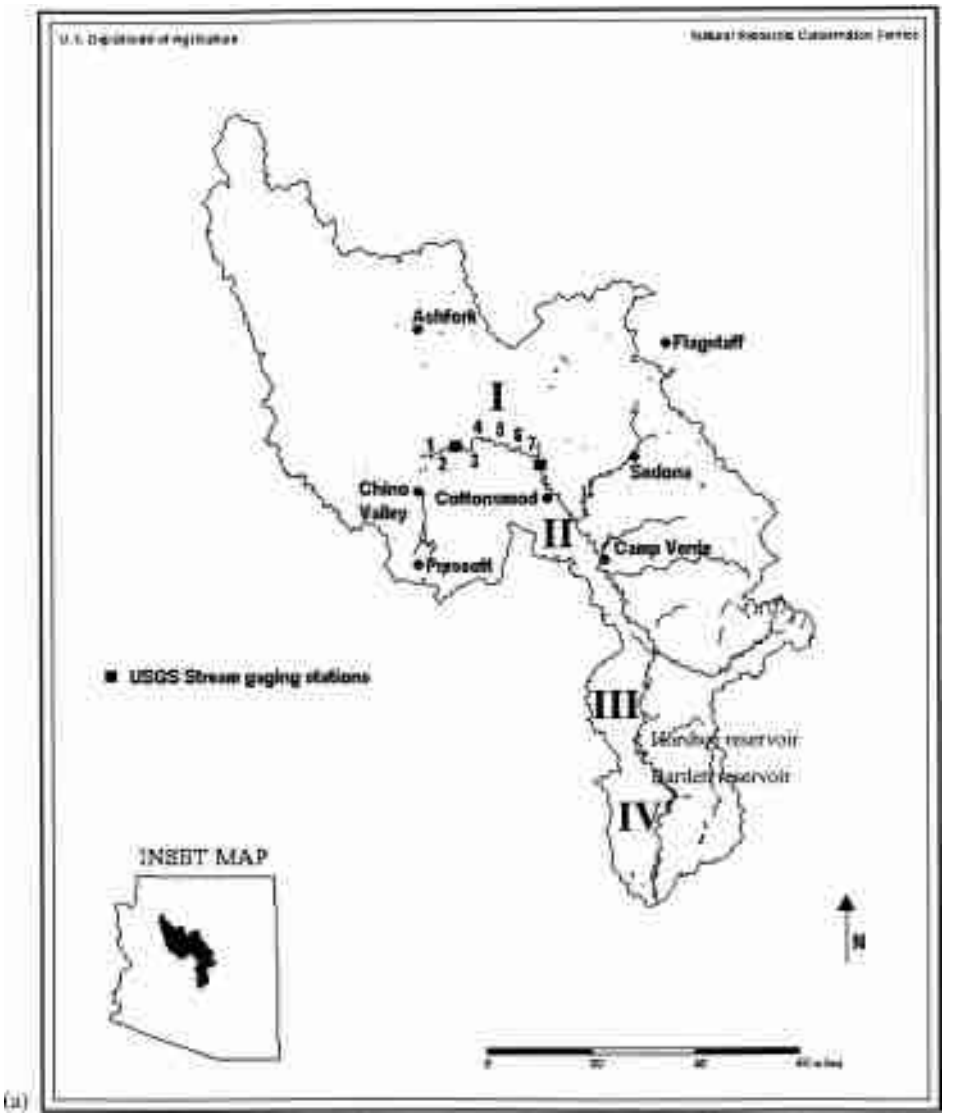

Figure 2. (a) The seven established sites sampled in Reach I since 1994, indicating the four major reaches from the headwaters to the mouth of the Verde River. Horseshoe (H) and Bartlett (B) reservoirs are indicated, and b) map of the upper Gila River showing the five major reaches where sampling was conducted March–July 1999 through June 2005. Map modified from Natural Resources Conservation Service watershed map. *(Continued)*

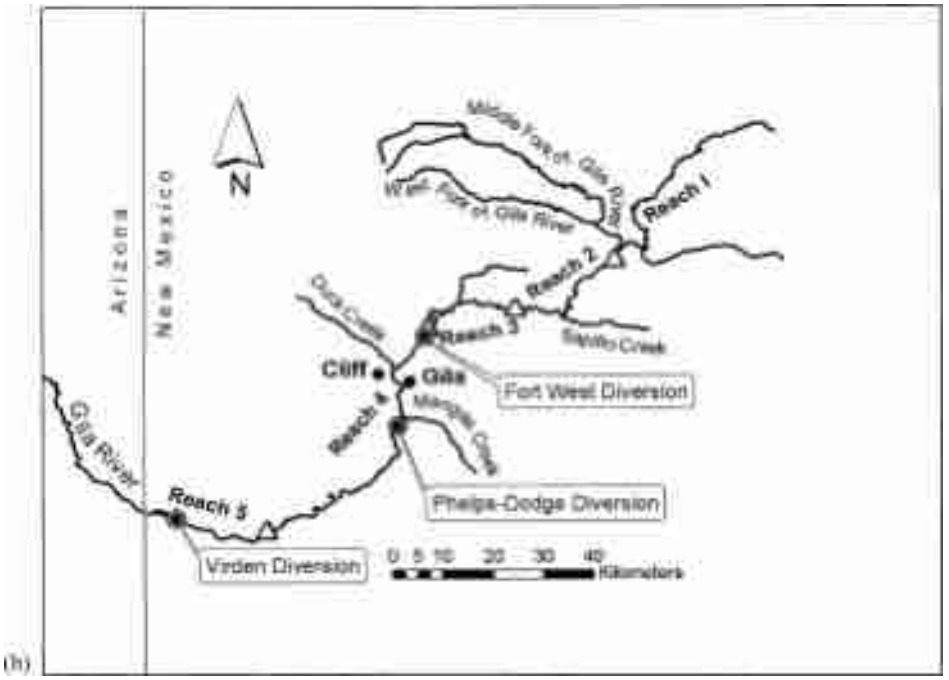

Figure 2. (Continued)

Similar to longfin dace, speckled dace (*Rhinichthys osculus*), another small-sized (<75 mm as adults) cyprinid, was most abundant in 1994 (171 individuals) before dropping 85% in 1995, more than doubling in 1996, and dropping to a single individual collected in 1997. A dozen speckled dace were collected in 1998, and only nine total have been collected between 1999–2005. None have been collected at the seven sites from spring 2001 to spring 2005.

As with longfin and speckled dace, abundances of the threatened spikedace, the last small-sized native species, were highest in 1994, dropped dramatically in 1995, increased slightly in 1996, and have dropped to zero at the seven established sites in all annual samples since 1997.

The three large-sized (>200 mm as adults) native species in the Upper Verde, desert sucker (*Catostomus clarki*), Sonora sucker (*Catostomus insignis*), and roundtail chub (*Gila robusta*), paralleled the smaller-sized species in temporal abundance (Table 1). Recruitment is poor in these three species and all have steadily declined in abundance since 1994 (Figures 6 a–c). Current (2005) numbers range from less than 1 to 3% of those recorded in 1994 following multiple, large flood events in winter 1992–1993 (see below).

By comparison, of the six non-native fish species, smallmouth bass (*Micropterus dolomieu*) and green sunfish (*Lepomis cyanellus*) have gradually increased in numbers between 1994 and 2003 before declining in 2004–2005 (Table 1). The other non-native species have fluctuated in abundances temporally. Mosquitofish (*Gambusia affinis*) increased markedly between 1997 and 2000, and except for 2004, has declined steadily in abundance since 2000 to the point of being absent in samples in spring 2005. Although numbers are still low, more (six individuals) young flathead catfish (*Pylodictus olivaris*) were collected in spring 2001 than in the previous 7 years of sampling; however, flathead and

Table 1
Fish assemblage structure estimated for the Upper Verde River, 1994–2005

	Year											
Species	1994	1995	1996	1997	1998	1999	2000	01	02	03	04	05
						Native fishes						
Longfin dace	1319	12	282	21	12	2	1	2	1	1	0	1
Spikedace	428	72	149	0	0	0	0	0	0	0	0	0
Speckled dace	171	25	68	1	12	2	7	0	0	0	0	0
Desert sucker	2644	328	471	231	126	167	137	365	148	106	67	44
Sonora sucker	810	322	654	240	125	118	197	189	90	61	47	24
Roundtail chub	776	341	259	50	84	25	20	43	20	4	6	0
						Nonnative fishes						
Smallmouth bass	14	10	32	35	66	104	48	170	211	150	57	13
Green sunfish	4	29	6	8	21	49	95	193	53	95	31	29
Yellow bullhead	31	29	9	40	33	15	22	36	19	21	16	2
Channel catfish	5	2	0	1	0	0	0	0	0	1	0	1
Flathead catfish	0	1	1	1	1	0	0	6	0	1	0	1
Common carp	23	6	13	19	9	4	15	15	4	3	4	10
Red shiner	1473	97	275	2238	1047	545	1594	1609	276	442	928	324
Mosquito fish	0	0	0	3	6	59	227	131	97	32	76	0
Percent native	82	86	85	19	22	29	15	19	28	17	15	16

channel catfish (*Ictalurus punctatus*) have been virtually absent in samples since 2003. Red shiner (*Cyprinella lutrensis*) has been the most abundant and cyclical non-native species in our decade of sampling on the Verde River. Samples in any year never contained more than 24 common carp (*Cyprinus carpio*).

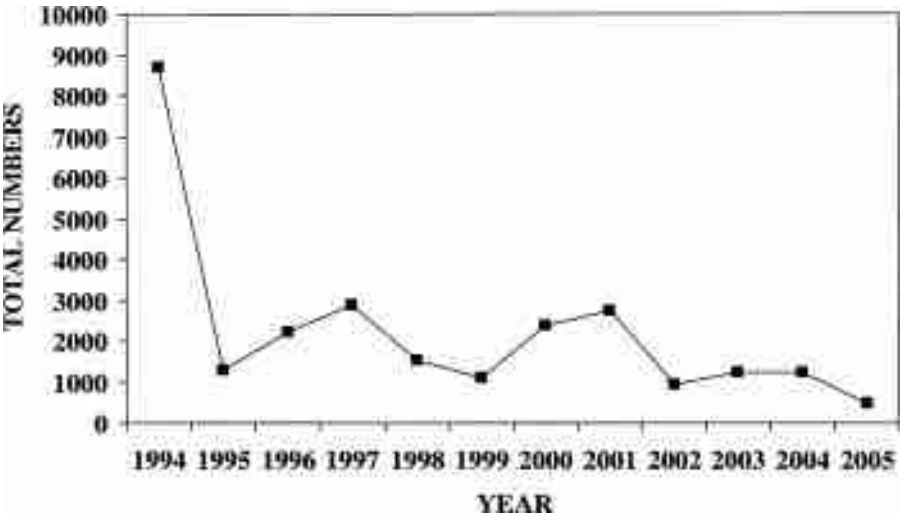

Figure 3. Total abundance of fish in Reach I, Upper Verde River, 1994–2005,

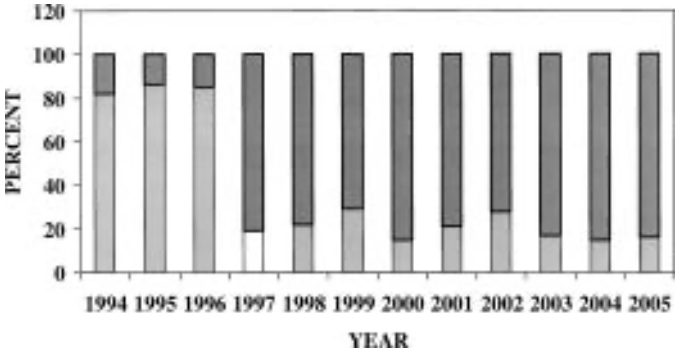

Figure 4. Relative components (%) of native (light bars) versus non-native (dark bars) species in the total fish assemblage in the Upper Verde, 1994–2005.

Habitat. Comparative flow statistics (Tables 4 and 5) and macrohabitat changes (Table 6) for the two rivers were calculated. The Gila River sustained much greater mean flow, flow variability, and peak or flood flows compared to the Verde River. Stream widths changed markedly in the upper Verde River between 1996 and 2000 resulting, in part, from livestock removal from the river and, in part, from a lack of flood events (Table 6). The channel became narrower, deeper, and streambank vegetation increased markedly (Rinne, 2006).

Gila River

Fish assemblages in the upper Gila River in the five major study reaches of river (Figure 2b) in 1999 are shown in Table 2. In Reach I, the Gila River headwaters in the Three Forks area, a single smallmouth bass was collected among the four sample sites. Similar to the Upper Verde River, desert and Sonora suckers comprised the major portion (60%) of the native fish assemblage. Speckled dace and roundtail chub were primarily (82%) collected at the West Fork of the Gila River site. Speckled dace were not collected in any of the four other major reaches in the mainstem Gila River. However, this species was abundant in Sapillo Creek at its confluence with the mainstem Gila River. All roundtail chub collected in the

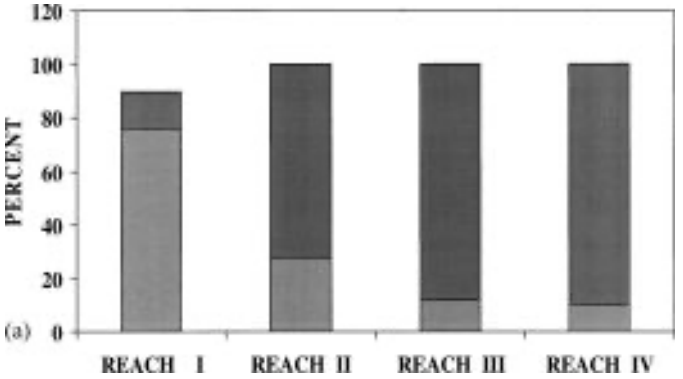

Figure 5. Relative abundance (% of total catch) of native (light bars) and non-native (dark bars) fish in the four major reaches of the Verde River Arizona: 1974–1997 (Arizona: Game and Fish records).

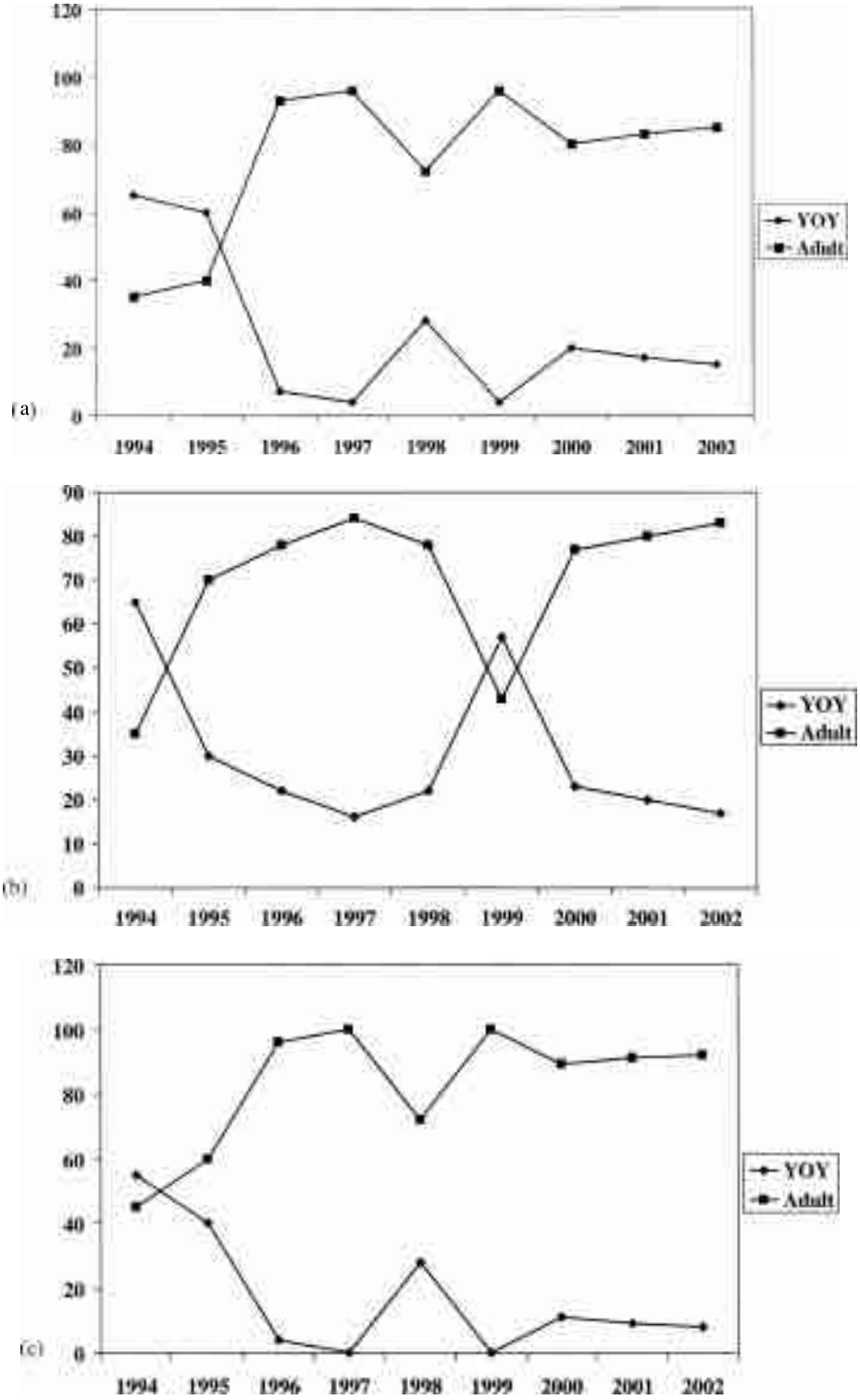

Figure 6. Relative proportions (%) of young-of-year (diamonds) and adults (squares) in the upper Verde River in autumn 1994–2002: a) Sonora sucker, b) desert sucker, and c) roundtail chub.

Table 2
Fish assemblage structure estimated at 17 sites in five major reaches (see Figure 2b) of the Upper Gila River, southwestern New Mexico, 1999

Site	PC	CI	AC	MF	TC	RO	GR	SMB	CAT	Other	Total
						Reach I					
W. Fk. Gila	3	42	2	10	0	67	53	0	0	0	167
M. Fk. Gila	32	63	5	0	37	3	23	0	0	0	163
E. Fk. Gila	165	43	6	69	11	0	0	1	0	0	295
Gila R.	95	24	0	0	27	7	0	0	0	0	153
Native/non-native ratio = 100/0									Total		778
						Reach II					
Smith Corral	60	3	21	0	0	0	0	16	3	2	105
Sapillo confl.	79	35	15	0	0	0	1	8	4	6	148
Sapillo Cr.	4	29	57	0	0	21	0	25	3	0	139
Seep Springs	4	0	3	0	0	0	0	4	0	11	22
Native/non-native ratio = 75/25									Total		414
						Reach III					
Brock Canyon	0	2	1	0	0	0	0	16	4	1	24
Watson Past.	32	15	17	0	0	0	2	12	1	10	89
Native/non-native ratio = 59/41						Total		113			
						Reach IV					
Riverside	9	0	3	22	0	0	0	0	1	0	35
Canyon Dam	39	5	5	189	13	0	0	1	1	0	253
Mangus Creek	354	0	86	280	20	0	0	0	0	0	740
Bird Area	32	25	8	50	1	0	0	0	0	0	116
Native/non-native ratio = 100/0									Total		1144
						Reach V					
Redrock	34	16	13	58	19	0	0	0	10	3	153
Nichols	6	1	0	14	0	0	0	0	6	0	27
Virden Diver.	72	24	243	12	1	0	0	1	5	331[1]	690
Native/non-native ratio = 59/41									Total		870
Totals	1010	327	485	694	129	98	79	84	38	365	3319

[1]All red shiners.

Species designations are PC, desert sucker; CI, Sonora sucker; AC, longfin dace; MF, spikedace; TC, loach minnow; RO, speckled dace; GR, roundtail chub; SMB, smallmouth bass, CAT, channel and flathead catfish; Other, all other non-native species such as sunfish, and bait species primarily comprised of red shiner (see footnote for Virden [Sunset] Diversion).

West Fork of the Gila River were taken in a single, large pool containing extensive woody organic debris.

The two threatened species, spikedace and loach minnow, were present in Reach I; however, spikedace were collected only at the West Fork and East Fork Gila River sites. No loach minnows were collected at the West Fork Gila River site; however, both loach

minnows and spikedace were taken about 1.5 km downstream from the West Fork Gila River sample site.

In Reach II, native fishes still predominated (75%) at three of the four sites sampled in this canyon-bound Gila Wilderness reach of the Gila River near the mouth of Sapillo Creek. Desert and Sonora suckers again comprised the major component (64%) of the native fish assemblage; however, longfin dace was the second most common species to desert sucker and comprised 31% of the native fish assemblage. In contrast to Reach I, non-native species increased and comprised 20% of the total fish assemblage in Reach II. Further, spikedace and loach minnow were absent at all sample sites within this reach. Smallmouth bass (65%) was the dominant non-native species. Spikedace and loach minnow were absent at all sample sites in Reach II.

In Reach III, non-native species comprised almost 41 of the total fish assemblage. Similar to Reach II, no spikedace or loach minnows were collected at this outlet reach of the wilderness canyon before the reach transitions into the alluvial Gila River Valley near Cliff, New Mexico (Reach IV). Again, desert and Sonora sucker made up the largest component (73%) of the native fish community.

Overall, fish abundance in Reach IV increased markedly from the upstream two reaches (II and III). Desert sucker and Sonora sucker again made up the major portion (43%) of the total fish assemblage; however, spikedace and loach minnow combined comprised 49% of the native fish assemblage. Longfin dace (9%) was the only other native species collected. Non-native species were virtually absent in samples in this reach: only a single smallmouth bass and two yellow bullheads (*Ameirus natalis*) were collected.

Total fish abundance decreased slightly from Reach IV to Reach V, and the two native suckers comprised 43% of the native fish assemblage. Native fishes made up only 42% of the total fish assemblage largely because of the abundance of red shiner at the Virden diversion site. Spikedace abundance decreased dramatically (84%) and loach minnow decreased 40% from its abundance in Reach IV. To summarize 1999 samples, spikedace and loach minnow were present in Reach I, absent in Reaches II and III, most abundant in Reach IV, and declined markedly in numbers again in Reach V.

Although temporal distribution and abundance data at specific sites are not as extensive in the Upper Gila River, 7 years of data at five U.S. Bureau of Land Management and private land sites are currently available (Table 3). Overall fish abundance was variable at the five sites. Between 1999 and 2005, total numbers of each species increased and decreased variably. Of all five sites sampled over the 7 years, the non-native component of the fish assemblage comprised greater than 10% of the total fish assemblage on only seven occasions. Spikedace and loach minnow were only present or most abundant in the initial year of sampling at Bennett Place, were most consistently abundant at Fred's Place and Redrock, and became very low in numbers or absent (2003–2005) in samples collected at Nichols Canyon and Virden Diversion. Loach minnow did reappear in samples at Nichols in 2005.

In summary, in the Upper Verde River, both total fish numbers and numbers of native fishes decreased over the 12 years of sampling. Native species decreased steadily in numbers and the native component of the fish assemblage decreased below 20% from 1997 to 2005. Spikedace became absent in samples at the seven sites in 1997, and longfin and speckled dace were rare-to-absent at the same time. Conversely, in 1997 the non-native component surpassed the native component and has maintained itself at 80% or greater. The native component of the fish assemblage also decreased downstream in the four major reaches of the Verde River. In the upper Gila River, total fish and numbers of natives were most

Table 3

Changes in fish assemblages at five U.S. Bureau of Land Management and private land long-term monitoring sites sampled from 1999 to 2005 in the Upper Gila River, NM

Loc.	Year	PC	CI	AC	MF	TC	R0	CAT	Other	Total
					(Reach III)					
Bennett Place	1999	109	2	46	8	30	1	0	0	196
	2000	20	1	0	0	8	0	0	0	29
	2001	5	92	14	0	1	0	0	0	112
	2002	0	0	0	0	0	0	0	0	0
	2003	0	33	0	0	0	0	2	90	125
	2004	3	802	0	0	0	0	2	29	836
	2005	3	120	96	0	2	0	1	6	221
Fred's Place	1999	9	1	22	41	14	0	0	0	87
					(Reach IV)					
	2000	33	121	63	5	48	0	1	0	271
	2001	12	215	5	11	5	0	0	5	253
	2002	41	1070	131	19	40	0	0	69	1307
	2003	0	1923	114	4	5	0	0	1	2047
	2004	84	220	41	50	51	0	0	4	450
	2005	444	99	1274	113	76	0	1	0	2007
Redrock	1999	34	16	13	58	19	0	10	3	153
					(Reach IV)					
	2000	9	287	504	9	10	0	15	0	879
	2001	45	44	35	1	11	0	2	5	143
	2002	100	60	641	42	8	0	34	19	967
	2003	62	8	1	0	1	0	7	87	166
	2004	5	0	8	0	0	0	5	59	81
	2005	41	19	127	10	4	0	7	41	251
Nichol's Canyon	1999	6	1	0	14	0	0	6	0	27
					(Reach V)					
	2000	3	481	262	5	0	0	1	41	793
	2001	19	275	79	9	1	0	1	25	409
	2002	75	83	194	5	0	1	127	26	510
	2003	128	19	7	0	0	0	2	33	189
	2004	2	0	4	0	0	0	6	74	86
	2005	4	0	91	0	3	0	43	10	153
					(Reach V)					
Virden (Sunset)	1999	72	24	243	12	1	0	1	331	684
Diversion	2000	1	13	29	1	0	0	49	11	104
	2001	19	33	41	17	0	0	0	12	122
	2002	39	43	34	5	0	0	6	7	134
	2003	25	4	3	0	0	0	2	9	43
	2004	0	0	2	0	0	0	2	8	12
	2005	206	2	92	0	0	0	15	0	315

Species designations are the same as give in Table 2.

CAT is for all catfishes and OTHER includes all other non-native fishes as defined in Table 2.

abundant in the uppermost reach in 1999, declined in numbers through the Gila Wilderness canyon (Reaches II and III) before increasing in abundance in Reach IV (the Gila/Cliff Valley) (Figure 2b). Native fish abundance declined in both abundance and percentage of the total fish assemblage in Reach V. The threatened spikedace and loach minnow were present in Reach I, disappeared in the Reaches II and III in the wilderness canyon, reappeared and become very abundant in Reach IV before declining again in the lowermost Reach V.

Practical Applications for Resource Managers. At the broadest scale, two major categories of factors affecting native fish and their habitats must be considered: 1) natural and 2) anthropogenic or human-induced influences. Because both types of factors interact and have cumulative effects, interpreting their relationships and relative effects on fish, their habitats, and their sustainability is difficult at best. However, managers must understand and manage native fishes not only from an administrative and legal perspective, but equally important, within a context of natural processes and functioning of southwestern river systems (Rinne, 2002, 2003a; Rinne et al., 2004; Medina et al., 2005). Further, they must consider human land and riparian management activities and their subsequent influences relative to these natural factors. By doing so, the likelihood that this valuable natural resource will be sustained and enhanced increases. We suggest there are several guiding principles or generalizations that land managers should understand and consider in efforts to conserve and sustain the native fish assemblages in southwestern desert rivers.

1. Hydrographs of southwestern desert rivers are fundamental to delimiting fish assemblage structure. Based on USGS data from the Paulden gage on the Verde River and the Gila gage on the Gila River, hydrographs are very different between the two rivers (Tables 4 and 5). First, mean annual streamflow in the Gila/Cliff Valley reach is almost four times that of the Upper Verde River. Second, the range of mean monthly discharge varied only 0.57 m^3/sec in the Verde River compared to 19 m^3/sec in the Gila River, or 20 times

Table 4

Flow statistics (hydrographs; m^3/sec) for the Verde and Gila Rivers at USGS Paulden and Gila gages between 1993 and 2005 comparing variability and peak flows between the two rivers

Parameter	Verde	Gila	Comparative Factor: Gila × Verde
Mean annual discharge	2	9	4×
Monthly discharge			
Range	.57–1.14	84–20	1–20×
Mean			
Winter	2.4	7.0	3×
Spring	0.8	4.0	5×
Summer	.94	3.4	4×
Autumn	.94	3.7	4×
Instantaneous peak discharge			
>143 (5000 cfs)	11	23	2×
>285 (10,000 cfs)	4	12	3×

Table 5
Annual maximum instantaneous peak flow (m^3/sec) comparisons in the Upper Verde and Gila Rivers, 1993–2005. Data are from the U.S. Geological Survey's Paulden and Gila gages

Year	Verde Rive	Gila Rive
1993	630	405
1994	5	12
1995	113	476
1996	30	72
1997	6	519
1998	17	60
1999	51	79
2000	43	86
2001	17	37
2002	43	38
2003	25	6
2004	329	21
2005	334	369

greater in the Gila than in the Verde River (Table 4). Third, mean monthly stream flows for the four seasons averaged three to five times greater in the Gila River than the Verde River. Fourth, instantaneous peak discharges in the Gila River, greater than 143 m^3/sec (5,000 cfs) and 285 m^3/sec (10,000 cfs) between 1993 and 2005, were twice to three times those in the Verde River. Finally, between 1993 and 2005, only in 5 of the 13 years did the Gila River have a maximum peakflow of less than 57 m^3/sec (1,200 cfs) (Table 5). By comparison, the Upper Verde River was less than the 57 m^3/sec peak flow level in 9 of those 13 years. Furthermore, most (8 of 9) of these low (<1,200 cfs) flows in the Verde River occurred between 1994 and 2003 compared to 4 of 5 in the Gila occurring between 2001 and 2004.

Further comparison of instantaneous peak flows (an indicator of level of flooding) in the two rivers since 1993 is instructive (USGS records) (Table 5). In 1993, peak flow at the Paulden gage (Figure 2a) was 630 m^3/sec. In 1995, maximum instantaneous peak flow was almost 114 m^3/sec at this gage. Peak flows in the Verde River in the decade between 1994 and 2003 have exceeded 75 m^3/sec only once since 1995. By comparison, peak flows in the Gila River exceeded 75 m^3/sec four times in this same decade and exceeded 400 m^3/sec in both 1993 and 1995. In contrast to the Verde River, peak flows from storms generated by Hurricane Linda in September 1997 exceeded 513 m^3/sec, which was the 4th highest peak flow ever recorded at the Gila gage since records began in 1928.

We suggest that instantaneous peak flows or the flood event component of the hydrograph partly accounts for the differences in fish assemblage structure in the two rivers. Stefferud and Rinne (1995) and Rinne and Stefferud (1997) partially substantiated this relationship for the Verde River and Minckley and Meffe (1987) did the same for other streams in the southwest. Both rivers sustained substantial floods in the mid 1990s; however, none have occurred in the Verde River between March 1995 and September 2004. The Gila River has a more variable and greater output of stream flow (volume) than the Verde River (Table 4). We suggest the two hydrological variables—variability and volume—are

equally or more important than instantaneous peak flows in influencing fish assemblages in desert rivers. Combined, all three factors (i.e., peak flow, variability of flow, and volume of flow) very likely explain the lack of non-native species in three of the five reaches in 1999 in the upper Gila River (Table 2) and the sustainability of this fish assemblage component between 1999 and 2005 (Table 3).

In summary, based on hydrologic data from the two rivers, peak or flood flows appear to have a pronounced, positive effect on most of the native fishes. However, the variability and differing flow volumes (Table 4) between the two rivers appear to influence microhabitats and fish assemblages (see below). That is, more variable hydrographs and greater flow volume sustain native fishes over non-natives between periodic flood events (Rinne, 2004). It is notable that since 1993, large (>400 m^3/sec) floods have occurred every other year up to 1997 in the Upper Gila River. Between 1998 and 2004, only lower peak flows (<86 m^3/sec-3000 cfs) have occurred and yet non-native fishes have generally increased at three of the five long-term sites (Table 3).

Similarly, by 1997, non-native fishes became the dominant component of the total fish assemblage in the Upper Verde River (Rinne et al., 1998; Rinne, 1999a; Rinne, 2006). The last flood event greater than 86 m^3/sec was in 1995. This desert river has been in drought and low peak or lack of flood flows since that time. At the time of this writing, no threshold of discharge that might stimulate reproduction and native fish increases could be offered (Rinne and Stefferud, 1997; Rinne, 2003a). The relative role of the hydrograph in structuring southwestern fish assemblages can only be better understood by continuing to monitor fish assemblages and hydrographs in the Verde River (and Gila River) until the next significant flood event. Defining a significant flow requires observations of fish assemblage response relative to the size of the event.

2. Geomorphology on two different scales is basic to sustaining southwestern native fishes. Broadscale geomorphology. Platts (1979) suggested geomorphology was an important determinant of fish community structure. On a localized, reach scale, specific habitat of fishes has frequently been reported (Armantrout, 1981). Temporal-spatial variations in distribution and abundance of spikedace and loach minnow in the upper Gila River are evident (Tables 2 and 3). Neither species was collected in the lowermost extent (Reaches II and III) of the canyon-bound reaches of the Gila Wilderness portion of the upper river, yet comprised significant proportions of the native fish assemblage in Reaches I (20 %) and IV (52%). No obvious differences in habitat availability for these two species were evident among these reaches (Rinne et al., 2005a).

Map estimation of gradient of the two rivers along their entire course sampled appears identical (0.5%). However, in Reach III of the canyon-bound segment of the Gila River, mean gradient was calculated at 0.8%. By comparison, the broader alluvial reaches (IV and V) were calculated to be 0.4% and 0.3% in mean gradient, respectively. Because of very specific habitat preferences of the native fishes (Rinne and Stefferud, 1996; Sponholtz and Rinne, 1997; Rinne, 2003a), smaller scale, localized geomorphic/fluvial, macro-habitat influences in these rivers are very basic to fish abundance and distribution. That is, aquatic macrohabitats (e.g., HGR, LGR, GRUN, and pools) are very directly linked with dispersion and abundance of the native fishes. Reduction of gradient by 50% or more in Reaches IV and V compared to Reach III results in the probability of more LGRs and GRUNs and may be significant in determining fish assemblages. Rinne and Deason (2000) documented these two habitat types as optimum for spikedace. Calamusso and Rinne (2002) noted distributional changes in one native sucker in New Mexico relative to slight changes in stream gradient.

Notable are both the relative abundance of non-native species in general and the presence of larger (>300 mm), predatory catfishes in deeper (>2 m) pool habitats in the Gila Wilderness reaches (Reaches II and III) and at sites in Reach V, a canyon-bound reach below the lower Gila Box. The presence and piscivorous habits of the non-native species must certainly affect both the presence and abundance of native species such as the roundtail chub and Sonora sucker. Only a single, small (66 mm, TL) chub was collected in Reach II and two were collected in Reach III (Table 2). Both the overall geomorphology and that reflected in local aquatic microhabitats were probably partly responsible for the low numbers of native fishes. This is consistent with native fish distribution and abundance relative to specific habitat featuress (e.g., velocity, substrate, gradient) (Rinne and Stefferud, 1996; Rinne and Deason, 2000).

The influence of pools on fish assemblages is best illustrated by data from the Upper Gila River (Rinne et al., 2005a). For example, based on habitat data in the canyon-bound middle reaches (II and III), the relative number of pools is greater than in the alluvial valley reaches. Further, removing pools from the analysis of fish assemblage structure dramatically and positively alters native/non-native fish ratios to the benefit of natives (Rinne et al., 2005a). In 3 of the 5 years of sampling pool habitats at the Redrock site (Reach V), a large number of catfish including large channel (*Ictalurus punctatus*) and flathead catfishes were captured. An attendant reduction of native fishes in pools containing these large predators plus and increase in smaller predators (sunfish and smallmouth bass) during successive years of sampling strongly suggests their negative impact on native fishes.

Finally, narrowing and deepening of the instream channel in the Upper Verde River (Table 6) effectively creates or mimics "pool type" or deeper water habitats. Channel confinement by vegetation has resulted from removal of livestock grazing in 1997 and a lack of significant flooding since 1995 (Rinne, 2006). Narrower channels have produced habitats better suited for the larger, non-native predatory species such as smallmouth bass. Narrowing and deepening of instream aquatic habitat has been documented to be beneficial to salmonid species (Platts, 1991). However, despite two of the larger native species (roundtail chub and Sonora sucker) being pool inhabitants, the other four species are more shallow water riffle and glide-run inhabitants (Rinne and Stefferud, 1996). These two habitat types (LGR and glide-run) are rare in the Upper Verde River. By contrast, they are ubiquitous in Reach IV or the alluvial Gila-Cliff Valley.

In summary, canyon bound reaches have a higher probability of the occurrence and greater depth of pools, which are more optimal habitat for large, non-native predators such as catfish and smallmouth bass. In contrast, broad alluvial valleys sustain fewer and shallower (<2 m) pools due to the dynamics of hydrology and bedload movement and sorting that tend to aggrade rather than degrade stream channels—conditions more favorable to some native fish species. Rinne and Deason (2000) documented strong selection of subtrate types in the Upper Verde Rvier by spikedace and loach minnow (Rinne and Stefferud, 1997)

Table 6

Comparison of physical habitat change (width and depth in meters) between the Burnt Ranch and Perkinsville sites in 1994, 2000, and 2005

	1994		2000		2005	
	Burnt Ranch	Perkinsville	Burnt Ranch	Perkinsville	Burnt Ranch	Perkinsville
Width	6.3	6.0	3.6	2.9	10.0	12.0
Depth	.26	.19	.35	.38	.24	.20

Specific aquatic macrohabitats. Aquatic macrohabitat types for the two rivers in 1999 were described by Rinne et al. (2005a) and Rinne and Deason (2000). Several differences were notable. First, calculations revealed there was an almost complete lack of HGR habitats (90 cm/sec or greater mean velocity) in the Upper Verde River compared to the Gila River, where HGRs comprised a little less than a third of all the habitats sampled. The lack of this habitat type and the fact that HGRs are optimal for loach minnow may be responsible, in part, for the absence of loach minnow in the Verde River. Second, during random sampling of study reaches, there was about half as many pools sampled in the Gila River compared to the Verde. Low-gradient riffles and GRUNs were similarly represented between the two rivers. Finally, in Reaches III and IV of the Gila, HGRs comprised a lower percentage (<25%) of the habitats sampled. Pools were evenly distributed throughout all sample reaches on the Gila River; however, deeper pools (>2 m) were rare in Reaches IV and V. Low-gradient riffles and GRUNs, habitats in which spikedace are normally captured (Rinne and Deason, 2000), comprised almost half of habitats sampled in Reaches I and II and in a majority of all habitats in Reaches IV and V (60% and 67%, respectively). The lowest percentage (37%) of these combined habitat types was in Reach III.

Not only is habitat type important, but also habitat diversity and physical location in a reach of river affect fish assemblages. Rosgen D-type channels (Rosgen, 1994, Rinne, 2003b), characterized by stream braiding, are currently viewed as an indication of "instability" and "increased sediment loading in stream channels." Nevertheless, these channel types appear more favorable to native fishes in general, and especially to the two threatened species—spikedace and loach minnow. However, more complete analyses of the relationship of D channels and native fishes are needed.

In summary, a mosaic of interdispersed HGRs, LGRs, and GRUNs, accompanied by a lack of pools (especially deeper, >2 m, pools), appears optimum for the native component of the fish assemblage (Rinne, 2003b). To recap, deep (>2 m) pools provide more optimum habitat for non-native predatory species such as smallmouth bass and catfishes. By contrast, a lack of such habitats reduces the abundance of these large-sized, piscine predators.

3. Management activities affect fish assemblage structure in southwestern rivers. Grazing Management. Coinciding with the current dominance of non-natives in Reach I in the Upper Verde River has been the removal of livestock grazing in 1997 (Rinne, 2006). Since that time, riparian and instream vegetation have increased dramatically (Rinne, 1999a; Medina and Rinne, 1999; Medina et al., 2005; Rinne, 2003b). We suggest that the resulting marked increase in instream and stream bank vegetation and narrowing and deepening of the channel mentioned above provide better habitat for cover-seeking species such as smallmouth bass and green sunfish (Pflieger, 1975). How these changes in grazing practices affect native versus non-native cypriniform fish and their habitats is not fully understood (Rinne, 1999a, 2000). These relationships need to be better defined with more specific, comparative studies of fish habitat relative to grazing on the Verde, Gila, and other rivers in the southwest. Only a preliminary study has been completed on the Verde River (Rinne and Neary, 1997) and none has been conducted on the Upper Gila River. Further studies are needed to determine if a connection exists between grazing, specific fish habitat, and fish presence and abundances (Rinne, 1999b). For example, controlled experiments could be conducted where 1–2 km reaches of the Upper Verde could be selectively grazed, and the fish communities of grazed and nongrazed reaches could then be compared.

Fisheries Management. Over the past century, fisheries management in southwestern rivers has introduced many non-native sport species (Rinne, 1996; Rinne et al., 2004; Cowley, this volume). For example, about 100 species of non-native fish have been

introduced into the waters of Arizona since the late 1800s and half of these species have become established (Rinne, 1994). Hundreds of stocking events involving millions of individual fishes have occurred on the Verde River (Rinne et al., 1998). Except for seasonal stocking of trout in the reach of river near Cottonwood, Arizona, most stocking in the river proper has ceased and occurs in reservoir environments for sport fishing enhancement.

Since 1994, smallmouth bass has increased steadily in samples in the Upper Verde River (Rinne, 2001) (Table 1). The presence of many (ca. 40%) age 1 smallmouth bass in the spring 1999 sample indicated favorable habitat and reproductive conditions for this piscivorous non-native species. Furthermore, non-native fish species have increased steadily in abundance in the Upper Verde River, in part, because of the extensive stocking events over the past 60 years (Rinne et al., 1998). The increased abundance of juvenile flathead catfish in Spring 2001 samples is cause for alarm in the Upper Verde River. Prior to 2001, only four individuals were collected (Table 1). By contrast, six young flatheads were collected in 2001 alone. This species has completely replaced native fishes in the Salt River (Kirk Young, Arizona Game and Fish Department, Phoenix, personal communication) above Roosevelt Lake.

By comparison, stocking events have been limited in the Gila River relative to the Verde River. Lack of sustained introductions in combination with the hydrology and geomorphology of the Gila River have precluded greater abundance of non-native, sport species in all reaches but those in the Gila River wilderness, canyon-bound reaches. We postulate that this increased abundance of large predatory fish in these reaches largely results from the presence of deeper (>2 m) pools formed through the interactions of flood flows and canyon walls that result in increased degradation in these reaches.

Hydrological management (dams and diversions). The U.S. Bureau of Reclamation dam building era commenced with Roosevelt Dam in 1911 on the Salt River (Rinne, 1975; Rinne, 2003b; Rinne et al., 2005b). Neither Reach I of the Upper Verde River nor the Upper Gila River has a major dam impounding significant volumes of water. The Upper Verde River (Reach 1) has only Sullivan Dam near Chino Valley that impounds no permanent pool and one minor water diversion at Perkinsville (Figure 2a). By comparison, the Upper Gila River sustains three large diversions, one each in Reaches III, IV, and V (Figure 2b). During the Spring 1999 sampling, flows were very low (<6 m^3/sec) but the Phelps Dodge Diversion in Reach IV) (Figure 2b) did not dry the river. However, the Sunset and Fort West Ditch diversions (Figure 2b) completely removed all flow from the river channel in summer 1999 and 2000.

Non-native fish distribution and abundance are affected directly by dams and diversions (Rinne, 1994, 1996; Rinne et al., 2005b). Mainstem dams are absent in upper reaches of both rivers and do not play a major role in delimiting fish assemblages in these uppermost reaches of the two rivers. However, the effects of mainstream dams downstream (Figure 2b) on native fishes in the Upper Verde have been documented (Rinne et al., 1998). Principally, the alteration of natural flow regimes from stochastic to regulated flows appears to be more beneficial to non-native fish. By comparison, in the Upper Gila, reduced in-stream flow or complete drying as was observed in spring 1999 below the Sunset (Virden) Diversion, obviously has a marked impact on the entire fish community.

Summary and Conclusions

The two rivers examined tell two different stories of southwestern desert river fish assemblages. We hypothesize that the interactions of hydrology and geomorphology in combination with human activities, especially past fisheries management practices, explain these differences. That is, lower, stable base flows during a time of drought (1996–2004) in

the Upper Verde River have been favorable for non-native fishes (Rinne and Miller, 2006) (Table 5). In contrast, in the Upper Gila River, non-native fish, although present, have not increased in abundance because of flow regimes that result in a lack of aquatic vegetation, shallower waters and a general lack of pools (Rinne, 2006). Furthermore, monitoring of fish communities in the Verde and Gila Rivers and comparing these assemblages to corresponding hydrographs and human-induced changes in stream dynamics and composition, should continue and be expanded. Other rivers in the southwest should also be studied to test our hypotheses. We contend desert river systems are complex and very dynamic. Flow alteration and introduced fishes as major stressors to native fish assemblages in North America have been documented (Rinne et al., 2005b). Using simple linear, one-to-one relationships will not likely give land managers the answers needed to align management to sustain native fishes for perpetuity.

In a management context, the human-induced factors (e.g., fisheries management decisions, hydrologic modifications, grazing, and other landscape uses) can be addressed most directly relative to native fish sustainability. Geomorphic habitat at the reach scale can be affected by land management activities. In contrast, natural, broad-scale geologic features (i.e., narrow canyons versus broad alluvial valleys) cannot be feasibly altered through management. Hydrographs may be influenced by landscape and watershed uses. In summary, the interaction of natural factors and anthropogenic activities will continue to affect fish assemblages in aquatic habitats in the Southwest. Restricting future introductions of non-native fish in nearly pristine rivers and streams, restricting flow modification practices such as damming, diversions, or groundwater pumping, and ensuring that grazing practices are compatible with the goals of fisheries managers are the primary management strategies that will increase the probability that native fish assemblages will be sustained in southwestern rivers and streams.

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May 10, 2019

Mr. Kerwin Dewberry, Forest Supervisor
Coronado National Forest
300 W. Congress Street
Tucson, Arizona 85701

Dear Mr. Dewberry,

The Natural Resource Users Law and Policy Center (Center) with the University of Arizona is submitting the comments set forth below on the Biological Assessment (BA) for the Coronado National Forest (NF) Livestock Program prepared by the Coronado National Forest (NF) on behalf of the following five grazing permittees on the Forest: Jim Chilton, Andrew McGibbon, Bob Noon, Ted Noon, and Dan Bell.

In particular, the comments below represent a compilation of grazing and other comments prepared by Dr. George Ruyle, with the University of Arizona's School of Extension; and, comments on fish species prepared by Mr. Alvin Medina. The comments of Mr. Medina reflect his own views and not those of the University of Arizona.

In general, the commenters felt the conclusions about grazing or species management were not supported by data collected from the ground or from scientific literature where relevant. It was not obvious how the BA continues the same grazing management regime for another ten years of grazing without considering past experience through data collection to take this position. We understand that on one hand, management prescriptions are incorporated into recovery plans which is not what the BA is, and therefore the Coronado may have felt it unnecessary to provide data to support grazing prescriptions. On the other hand, the BA contains any number of grazing guidelines which serve as management without any connection to what the recent grazing experience and impact on listed species has been. The guidelines in the BA should be supported by data. We strongly support the use of real data and science to support Forest Service decisions.

Dr. George Ruyle

The most important concern for the grazing portion of the BA is that the range profession has developed guidelines, standards for the management of rangeland in the arid Southwest. The BA should properly define utilization, methods used to measure it (this is pretty well done in the Key Species discussion), when it is measured and how the data are interpreted. These should all comply with the following:

SRM Rangeland Assessment and Monitoring Committee. 2018. Utilization and residual measurements: Tools for adaptive rangeland management. Rangelands 40(5) 146-151.
Smith, Lamar, George Ruyle, Jim Maynard, Steve Barker, Walt Meyer, Dave Stewart, Stephen Williams, and Judith Dyess. 2005 (revised 2016). Principles of obtaining and interpreting utilization data on Southwest rangelands. University of Arizona Cooperative Extension publication AZ1375. 12pp.

Following is a list of the main points regarding utilization data.

1. Use of utilization
    a. Residual measurements and utilization data can be used: (1) to identify use patterns, (2) to help establish cause-and-effect interpretations of range trend data, and (3) to aid in adjusting stocking rates when combined with other monitoring data" (BLM 1999).
    b. Should not be used for management objective or standards to be met; as automatic triggers to move or remove livestock; without documenting how, when, where measured.
2. Accuracy and precision is usually low.
3. Different methods give different results – hard to compare.
4. Season of measurement is important to interpretation – must be considered
5. Utilization/stubble height guidelines not meant to be met every year- decisions should be over a period of years and take into account weather, etc.
6. Utilization triggers for moving livestock not consistent with coordinated management.
7. Utilization guidelines based on research that may only have general relevance to specific situations.
8. Interpretation of utilization and residual data must have demonstrated relevance to management decisions.

Primary considerations include:

1. Utilization is based on amount of vegetation removed compared to total annual production.
2. Utilization levels are not management objectives but tools for adaptive management (along with long-term monitoring, professional judgement, experience, weather and other factors including management objectives).
3. Utilization guidelines cannot be employed for seasonal utilization because there is no known consistent relationship between seasonal utilization estimates and utilization based on the entire growing season's forage production. "To establish such a relationship would require that the amount of subsequent forage growth could be accurately predicted at any given time during the growing season. Information to make such predictions does not exist. For this reason seasonal utilization estimates are not reliable for grazing compliance decisions employing utilization guidelines based on end-of-season production. There are some who maintain that "utilization" should be measured at the end of the grazing period, i.e. when livestock are moved out of a pasture. They claim that waiting to estimate use at the end of the growing season tends to obscure the impact of grazing due to regrowth. There is value to describing the level of use on a pasture at the time livestock are removed, so long as it is recognized that this use is "seasonal use", not utilization. However, the argument that grazing impact cannot be ascertained if measurement of utilization is deferred until the end of the growing season appears to lack understanding of the reason utilization is measured. Research and experience have shown that utilization of 30-50% based on total annual production, depending on whether it is defined on a key species/key area or range wide basis, will provide for continued productivity of the range.

However, this level of utilization may result from grazing early in the growing season that produces "seasonal utilization" far in excess of this guideline. Obviously, the decision of whether a given pasture is "properly" grazed depends not on the "seasonal use" when it was grazed, but on the comparison of grazed/ungrazed production at the end of the growing season. Thus, a proper use guideline of 40% may be achieved by considerably higher "seasonal utilization" early in the growing season and by utilization of 40% based on season-long production."

Utilization guidelines are not rigid limits to be met every year. As Holechek et al. (1999) describe in a review of stocking rate studies, "Desert forage plants can sustain about 40% use of annual herbage production. Use in the drought years approached 55-60% while use in the wet years was near 20-25%. Recommendations derived from grazing studies are averages resulting from such variability and are intended to be met over the long term and not on a year to year basis." Holechek and Galt (2000) go on to say, "…attainment of specific use levels is nearly impossible on a year-to-year basis due to variation in climate. Instead, we believe they should be a target across 5-10-year time periods." (Holechek, Jerry L. and Dee Galt. 2000. Grazing Intensity Guidelines. Rangelands 22(3): 11 – 14.

Additional grazing comments:

- Page 2, very last paragraph, add the following sentence: Guideline modification language should follow FS adaptive management guidance, R3 Supplement to the Forest Service Handbook, section 2209, page 2.

- Page 3, second bullet on burned areas, at the end of the existing language, add the following: Grazing decisions following burning should be made on a case-by-case basis according to Regional guidance. Deferment from grazing should not be a requirement, restricting management flexibility.

- Page 3, fifth bullet addressing structures in riparian areas, the following sentence should be added: Use of structures should be conditioned to incorporate the use of disturbance known to be required for some desert fishes, including the input of sediment into streams.

- Page 4; "The temporary increase should take place for no more than 2 consecutive years." The immediately preceding sentence says "[T]he Authorized Officer may temporarily authorize a higher capacity to evaluate the carrying capacity of an allotment. . . ." Forest Service adaptive management strategy discussed on page 5 of the BA calls for the kind of evaluation referenced here. What if the result of the evaluation shows the allotment has a higher carrying capacity than previously authorized? Why should there be an arbitrary, categorical bar on authorizing increased temporary use at two years that doesn't reflect the results of the evaluation? The first sentence should read:

    - The temporary increase should take place for no more than 2 consecutive years at which time the Forest Service will use the results of the evaluation to determine whether the period of the temporary increase should be further extended.

- Page 5, Adaptive Management, add the following words the end of the first sentence and add the following words: " . . . which is contained in a directive issued by Region 3, and in the Forest Service Handbook 2209.13-Grazing Permit Administration Handbook, Chapter 90."

- Page 7, Management in Drought, after the current second sentence, add the following sentence:
    - Additional information on drought management is available from a University of Arizona publication that can be found at: https://extension.arizona.edu/pubs/guide-co-developing-drought-preparation-plans-livestock-grazing-southwest-national-forests
- Page 10, #6, burned areas: See the comment above on management of burned areas.

Additional comments on species

Gila top minnow

- Evidence based conclusions are that cattle grazing can have positive impacts on habitat for Gila top minnow (Simms and Simms *Livestock management and the conservation of Imperilled Aquatic Species on the Las Cienegas Conservation Area, Arizona 1990-2010.* *https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=2ahUKEwi685T488rhAhWTtp4KHVr6CkAQFjAAegQIBBAC&url=http%3A%2F%2Fazrangelands.org%2Fpresentations%2FWinter%25202010%2FSimms_Simms_Livestock_Management_and_the_Conservation_of_Imperiled_Aquatic_Species_on_the_Las_C.pdf&usg=AOvVaw0k7C3R5ZNJLJj4Y0o8ZaHb.*
- Using targeted grazing as a tool to manage Gila topminnow should be considered in the Grazing Regime section of the BA (p17), without reference to a recovery effort.
- Redrock Canyon had the largest known population of Gila top minnows on forest service land when cattle were present there. However, the Gila top minnow disappeared and was extirpated from there by 2006, eliminated not long after all grazing of Redrock was excluded. Sources cited in the BA concur although they fail to clearly state the obvious. “Causes of the topminnow declines observed in the upper reaches of Cienega Creek are unclear but may include drought and habitat changes from lack of disturbance” (Bodner, G., J. Simms, and D. Gori. 2007. State of the Las Cienegas National Conservation Area: Gila Topminnow population status and trends 1989–2005. The Nature Conservancy, Tucson, AZ).

Discussion of positive effects of livestock grazing on Gila top minnow habitat should be included in the Determination of Effects. This would include development of targeted grazing regimes under Adaptive Management protocols. The BA is replete with references to Forest Plan guidelines which are management prescriptions. While we recognize the BA was written to minimize “recovery based” language, inserting some recognition of the potential to improve habitat with livestock could be carefully referenced subsequent to the conservation measures would be consistent with other management prescriptions already included in the BA.

Sonoran chub

Literature cited in Sonora chub discussion on page 20 seem to be selective to make the point that livestock grazing is harmful, eg. Fleischner 1994. This reference always shows up when authors want to demonstrate how bad livestock grazing is yet it is widely thought to be a hit piece on livestock grazing through selective review of available literature and is not a research paper. In fact, Brown and McDonald (1995) refer to the paper as "dangerously one sided" (Livestock grazing and conservation on Southwestern rangelands. Conservation Biology 9(6) 1644-1647). Other included references are not specific to the warm water species in question or referenced inappropriately (for example the literature (Roberts and White 1992) cited in the current USFS BA is the same literature previously cited relating to cattle trampling fish egg masses and swallowing fish. That citation actually describes issues in cold water trout streams with the trampling done by fishermen.

On the other hand, there is cold water fishery research that shows the positive effects of grazing management. Examples include, *Grazing management influences the subsidy of terrestrial prey to trout in central Rocky Mount streams* by W. Carl Saunders and Kurt D. Fausch. Freshwater Biology 2012, and *Improved Grazing Management Increases Terrestrial Invertebrate Inputs that Feed Trout in Wyoming Rangeland Streams* by W. Carl Saunders and Kurt D. Fausch. 2007 Transaction of the American Fisheries Society. The Fleishner work is not the only, nor the most recent, nor most credible work on the subject.

Other comments

- Sonoran tiger salamander section describing Effects of the Proposed Action are speculative and provide no evidence of on-going negative effects from livestock grazing.
- The likely to adversely affect call for the northern Mexican gartersnake in not supported by evidence and in fact the description of effects describes little to no impact from grazing.
- Grazing effects on ridge-nosed rattlesnakes is described as "the indirect effect of "excessive" grazing. There is nowhere in the BA that recommends reports or documents "excessive" grazing. The likely to adversely affect call seems inappropriate.

Mr. Alvin L. Medina, Senior Ecologist

Abstract

Comments are respectfully submitted to improve CNF_BA as a guidance document, provide defensible analytical support for CNF grazing program, reinforce commitment to conservation of TES species through adaptive management principles, and improve the public(s) understanding of the proposed actions. Review of the CNF_BA revealed several major areas of deficient supporting evidence for respective analyses of effects on fish and wildlife sensitive species. Coincident are weak adherence to adopted concepts of adaptive management and use of best available scientific information to transparently guide the public through the biological assessment processes. A principal failure to relate the past 16 years of management to status of TES species, especially Gila Topminnow which is extirpated from Redrock Canyon. The BA seems to promote a status-quo approach to management as opposed to embracing new advances in fishery and grazing sciences. References are outdated, irrelevant or fail to support analyses presented, and missing in references. There are no data, graphics or other supporting materials that relate riparian and aquatic conditions to TES species trends or otherwise provide a

transparent guide to the public understanding of the BA. Assessment of TES fishes is difficult without riparian and aquatic surveys that can be related to general population trends. Principal references are provided as needed to support comments and viewpoints, as well as assist CNF staff in this assessment. Considerable work is foreseen to get the BA to acceptable standards.

[Title Here, up to 12 Words, on One to Two Lines]

BASIS

Comments regarding the CNF_BA are founded on stated mandates, purpose(s) in the introduction (P-1, par-1/2) and agency management concepts that provide guidance for decision making as well as providing substantiating evidence of type and extent of analyses to transparently guide the public(s) through the BA processes. These elements are referenced in discussions within each specific comment. They are highlighted herein to frame an understanding of the what is missing, awry, or proposition of new or additional context.

Mandates/Purpose

"Section 7 of the ESA requires Federal agencies to ensure that any activities they authorize, fund, or carry out *do not jeopardize the continued existence of any species federally listed or proposed for listing, or result in the adverse modification to such species' designated critical habitat*. *Forest Service Manual (FSM) 2670.31 directs each Forest to evaluate its programs and site-specific actions to determine their potential effect on federally listed species*."
"This BA describes conditions where effects may occur and attempts to establish *governing criteria to which future actions will adhere*. This BA *analyzes the interaction of listed species and permitted actions related to grazing management* and is structured to account for species movement into new areas, and the *intent is that the effects of the grazing program on those species are covered in our analysis and in the resulting BO*."

Concepts/Authorities

Adaptive Management: The Forest Service subscribes to the concept of "*Adaptive management*" as a systematic approach for improving resource management by learning from management outcomes (Stankey et al. 2005) and invokes guidance from "FSH 1909.12.40 - Land Management Planning Handbook, Chapter 40 – Public Participation, Wo Amendment 1909.12-2015-1 and USDA-USFS (2012). Figure 1 illustrates context and elements of the AM process. Presumably, these were invoked to develop the 2002 CNF plan, and monitoring occurred, thereby places the 2019 plan at the second evaluation phase. Monitoring and evaluation of data (2002-2018) would support decisions and position CNF in support of conservation of TES species, despite requisite concurrence with guidance criteria for determination of effects (USFS, 2015b).

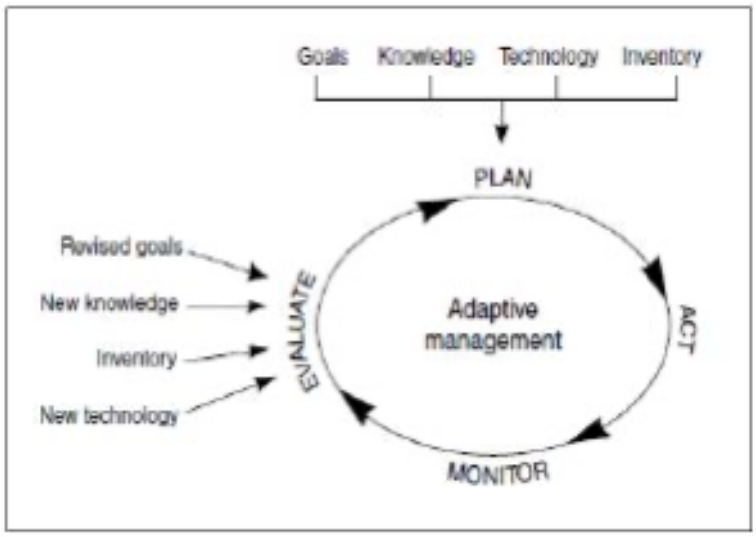

Figure 1. General model of adaptive management processes invoked during biological assessments and development of resource management plans. Adapted from Stanley et al. 2005.

Best Available Scientific Information (BASI): Included therein are requisites for use of *best available scientific information,* (FSH 1909.12.40 - Land Management Planning Handbook, Chapter 40 – Public Participation, Wo Amendment 1909.12-2015-1(page 11) and USDA-USFS (2012). "**c. Ensuring the use of *best available scientific information* in plan development. The Responsible Official is *required to document* how best available scientific information was used to inform the plan decision. Public feedback regarding the accuracy, reliability, and relevance of scientific information helps ensure the use and documentation of the best available scientific information".**
Careful review of references and their respective content reveals a shortage of current scientific and technical survey reports that bear directly on the status of TES species cited therein.

COMMENT 1

The BA lacks resource condition data to establish an environmental baseline to validate management status for listed TES species. With regards to the grazing program, "the Southwestern Region is using an adaptive management model to respond to dynamics such as drought and the need to adjust domestic livestock grazing based on implementation and effectiveness monitoring of grazing management practices. Monitoring determines if acceptable progress is being made towards attainment of resource management objectives and thus desired conditions" (USFS, 2015). Technical data summaries are provided (Appendix A) in support of the grazing program, but are lacking for fish, wildlife, and plant TES species, as well as riparian-aquatic condition reports that have more direct consequence on habitat dependent species. At minimum, graphic trend summaries by species, riparian areas, special interest sites, would greatly add understanding and transparency. There is no mention of (1) methods employed in riparian surveys, (2) watershed condition trends/surveys/reports, (3) or how such would relate to the grazing program.

COMMENT 2

The BA lacks analyses that relate fish monitoring data for period 2002-2018 to validate continuation of the 2002 management plan objectives regarding TES fish, e.g. Gila Topminnow. Management of endangered SW fishes requires an understanding of the consequences of management on sensitive species, especially if the species status on USFS lands failed to improve as premised in 2002. Such results

could imply complicity to failure of management to obtain the desired condition, since no defensible position is proposed.
On page 5 (Consultation History) the BA notes that since 2002 "baseline conditions for several listed species and some grazing allotment alignments have changed, and ecological conditions have greatly improved since the conditions that were referenced (mid-1990s) in the previous consultation". Presumably this refers to range conditions, but not riparian-aquatic conditions. A Coronado NF (USFS 2014) report notes aquatic wildlife and habitats are not doing well – "Aquatic wildlife resources are currently in a **dire state of affairs**. This is due in part to a drought that began around 1996 (still persisting, and likely to persist for an extended time), but also the effects of anthropogenic changes and demands of a burgeoning population. Since that time, little has been done to offset the widespread decline in native aquatic and semiaquatic species". The BA does not address how grazing of riparian areas will affect the aquatic resource objectively. Instead, there is a reliance on outdated sources (e.g. Fleischner 1994), unrelated sources (Roberts and White, 1992), and continue to promote unsubstantiated suppositions of such direct effects as trampling for which no credible scientific evidence exists*, [see determination of effects on page 22, e.g. "Direct effect to Gila topminnow may occur because livestock are not completely excluded from occupied topminnow habitat in some allotments within the action area and, therefore, may trample and ingest topminnow, impair water quality, and deteriorate habitat".] Specifically, over the course of the 2002 plan, no has been no evidence to substantiate the statement; over the course of grazing history in Region 3 for all Forests, there is no credible evidence to substantiate trampling, or ingestion of fish. Hence, the call for "may affect, and is likely to adversely affect, Gila topminnow" seems incorrect, but rather "may effect" is appropriate, since there is no scientific evidence to support direct effects to date. Furthermore, as stated, below, hydrological factors and other intrinsic elements, e.g. baseflows, floods, predation by non-native fish, etc., are considerably more important operative and limiting factors, which assuredly have immediate direct effects, but not considered herein. Important questions remain to be answered in the BA.

- What was the response of Gila Topminnow to 16+ years of management described in the 2002 plan and will this analysis be included in the BA?
- In the Redrock Canyon case, did grazing contribute to positive or negative (or neutral) responses to Gila Topminnow (or other) or were other factor operative beyond grazing?
- What are successes/failures can be identified and what changes would improve chances of success? Did the 2002 plan result in achieving the desired condition(s) with regards to TES species, i.e. fish?

COMMENT 3

The BA lacks current scientific evidence relating livestock grazing to SW listed fish species. It's important to note that some scientific references relating grazing effects on fishes of the SW have been strongly refuted, e.g. (Long and Medina, 2006) vs. (Clarkson and Wilson, 1991). Long and Medina (2006) reexamined the data and analytical procedures used by Clarkson and Wilson (1991) who extended their results beyond the statistical limits of the data to implicate livestock management practices on the White Mountain Apache Reservation as a major factor limiting recovery of Apache trout habitat. Long and Medina (2006) made it clear that confounding factors and inappropriate study design and statistical analyses may yield erroneous and opposing results, thereby obscuring real operative factors that lead to false implications. Many scientific works on grazing impacts on SW native fish are riddled with subjective assertions of potential effects and not based on sound scientific experimental designs (Rinne, 1998; Medina et al., 2005). In contrast, studies by Saunders and Fausch (2007, 2009) provide replication across

time and space and field test results. These studies emphasize the benefits of good grazing management on stream productivity and fish. Specific to the SW, Medina (2008) intensively examined an all native fishery and its habitat of Mangas Creek on the Gila NF, a stream grazed by cattle for decades and tributary to Gila River, and found sustained populations of loach minnow consistent to previous 1985 survey. The Mangas Creek fishery was comprised entirely of native fish, including listed TES species of loach minnow and spikedace, plus absence of two exotic species of minnows, mosquitofish and fathead minnow which were present in minute numbers in the 1983-84 surveys. These results are in stark contrast to other fish studies that have no livestock grazing, e.g. Gila Wilderness, Gila NF – (Paroz, et al. 2006), or grazing exclusions - (Hughes et al., 2005; Stefferud and Reinthal,2004), or modified grazing influences (Propst et al. 2008). In short, the evidence against negative livestock effects on fish is lacking, while some evidence on indirect short-term effects on localized channel conditions exists for cold-water fisheries.

COMMENT 4

The BA lacks an update on the status of Gila Topminnow which directly applies to the analyses on pages 16-19, and is different than the report by AGFD (2018). A principal question is why perform a "take" analyses for a site that has an extirpated fish population? AGFD (2018) provides a concise review of the status and conservation efforts since 1980's, including areas on CNF, e.g. Redrock Canyon – once considered a principal location (USFWS, 1984). Bottom line – AGFD reports all efforts to establish populations failed or "extirpated" (AGFD, 2018), as did other localities adjacent to CNF. AGFD (2018) further notes Gila Topminnow "is found throughout much of its former range in northern Mexico, watersheds that continue to be extensively and intensively grazed in the region. Why do observe major differences in population survival across intensively managed systems of the Southwest and basically unmanaged and highly exploited watersheds of the southern areas? Since the 1930's, AGFD (2018) notes that more than 200 attempts at reestablishment have been made into varied habitats and most failed. A primary reason for failure was "change in environmental conditions and negative interactions with nonnative fishes". Changes in environmental (habitat) conditions as a major factor has been noted in several studies (Medina and Neary, 2012, Rinne and Miller, 2006; Propst et al., 2008, Paroz et al., 2006).

COMMENT 5

The BA uses outdated scientific information to support analyses and decisions. Fish references are old (pre-2000) and do not reflect current state of knowledge or thinking about SW fish ecology and management. For several years fish biologists, ecologists, and hydrologists have emphasized the need to understand linkages between hydrological functions and fish ecology (Medina and Neary, 2012; Medina and Rinne, 1999; Rinne and Miller, 2006; Propst et al., 2008; Neary et al., 2012). For decades warm water fisheries were managed based on cold water studies based principally on trout species. There is an aversion to accept new concepts, abandon unfounded suppositions about livestock grazing, and instead reexamine new science that looks at fish management from the viewpoint of the species life strategy, rather than the biologist's point of view. Rarely is the question presented of whether the riparian/aquatic land management action, e.g. structural treatment, channel restoration, revegetation, etc. is beneficial to the fish species of interest. The prevailing assumption is that all native fish require stable stream environments to sustain stable populations. Most important is to know the species habitat requirements (Bonar et al., 2010) before engaging in stream improvements or translocations or other management actions that may have lasting adverse consequences, i.e. grazing management plan.
Sheller et al. (2006) reported translocation attempts in Arizona for Gila Topminnow met with little success and is validated in AGFD (2018). For years a "shotgun" approach was used to reestablish Gila Topminnow in locations within its reported historical range without considering specific habitat requirements or interactions with other native or nonnative fishes. This approach has proved fruitless, i.e. Redrock Canyon, and is discouraged by Sheller et al. (2006) who makes specific recommendations such as future translocations should be undertaken in late summer or fall (not early summer), should

occur into ponds (not streams, wells, or tanks), contrary to what the BA proposes for stock tanks. This new concept is promoted by other biologists to improve chances of success (Biedermann et al.,2014). None of these new studies implicate grazing as an adverse or limiting factor, rather cite basic ecology and hydrologic influences.

Current advances in fishery science embrace Winemiller (2005) conceptual model (see figure below) of life history strategies to categorize fish species into 3 major groups: periodic, opportunistic and equilibrium. Other scientists (Blanck et al., 2007; Mims and Olden, 2012; Olden et al., 2006; Escalera-Vázquez, 2017) advocate for the concept because it relies on species-specific life requisites and hydrological gradients of disturbance or natural functions and have validated the model in their respective ecosystems. Mims and Olden validated the model and determined that "(1) opportunistic strategists were positively related to measures of flow variability and negatively related to predictability and seasonality, (2) periodic strategists were positively related to high flow seasonality and negatively related to variability, and (3) the equilibrium strategists were negatively related to flow variability and positively related to predictability". The significance of this science is that managers need be aware of the context of their on-the-ground condition produced through short/long term actions, e.g. grazing, exclosures, improvements, that produce an outcome undesirable for the fish species. If the fish is an opportunist, then producing stable (equilibrium – like) habitats might be the wrong action to implore. Many desert minnows prefer open shallow water habitats where algae/detritus abounds versus overhanging banks suitable for trout. Hence, not only does the fish biologist need to know the fish life requisites, but the land manager needs to promote habitat conditions aimed at meeting those requisites, being less than stable in some cases, i.e. disturbance regimes. Contrary to modern advances, the CNF_BA subscribes to trial and error approaches or adaptive management in abbreviated form.

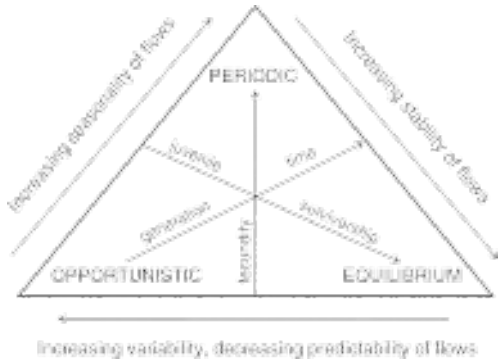

FIG. 1. Life history continuum model adapted from Winemiller (2005) and originally conceptualized in Winemiller and Rose (1992). Inside arrows summarize fundamental trade-offs between juvenile survivorship, generation time, and fecundity that define the three end-point strategies. Outside arrows summarize predicted relationships between flow dimensions and life history strategies.

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Respectfully submitted,

/s/

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December 27, 2010

Public Comments Processing,
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RE: Comments on Endangered Status and Designation of Critical Habitat for Spikedace and Loach Minnow; Proposed Rule (Federal Register / Vol. 75, No. 208 / Thursday, October 28, 2010 / Proposed Rules Pages 66482 – 66552)

On behalf of the Coalition of Arizona and New Mexico Counties (Coalition)[1], City of Sierra Vista, Arizona, Arizona Cattlemen's Association, Arizona Cattlemen's Association Federal Lands Committee, San Francisco SWCD, Southern Arizona Cattlemen's Protection Association, Prescott Livestock Auction, Stefanie and Andy Smallhouse Carlink Ranch lower San Pedro River, Sharon and George Yard Verde River, and David Gipe Verde River (Arizona & New Mexico Comments) we have reviewed the Proposed Rule on Endangered Status and Designation of Critical Habitat for spikedace (*Meda fulgida*) and loach minnow (*Tiaroga cobitis*) endangered 75 Federal Register 208, Thursday, October 28, 2010, Page 66482 et seq.). We conclude that scientific data does not support the proposed uplisting from threatened to endangered nor the designation of critical habitat. The proposed rule is based on an overzealous unscientific selection of a subset of old data taken out of context, coupled with an extreme anti-human bias. How this Federal Register Proposed Ruling got as far as publication brings into question U.S. Fish and Wildlife Service (FWS) employees at every level. This proposed ruling is egregious to the point that it should never have been published.

We strongly urge the FWS to withdraw this proposed rule because it attempts, in the face of substantial scientific information to the contrary, to implement the Endangered Species Act haphazardly on the basis of

[1] The Coalition is comprised of the Arizona Counties of Cochise, Gila, Graham and Greenlee and New Mexico Counties of Catron, Chaves, Eddy, Harding, Hidalgo, Lincoln, McKinley, Otero, Rio Arriba and Sierra along with representation from livestock, timber, mining, sportsmen, outfitter, farming and small business industries, as members of the Coalition of Arizona/New Mexico Counties (Coalition). The population of the combined membership exceeds 488,167.

speculation and surmise rather than by use of solely the best scientific and commercial information available as required by the ESA and Data Quality Act of 2000 (Paperwork Reduction Act. 44 U.S.C. 3501 et seq amendment) (herein referred to as DQA) standards.

The obvious purpose of the requirement that each agency use the best scientific and commercial information available, apparently wholly lost on the FWS throughout this proposed rule, "is to ensure that the ESA is not be implemented haphazardly, on the basis of speculation and surmise." *Bennett v. Spear,* 520 U.S. 152, 176 (1997). Another objective of this requirement, "(if not indeed the primary one), also completely lost on the FWS here, is to avoid needless economic dislocation produced by agency officials zealously but unintelligently pursuing their environmental objectives." *Bennett v. Spear,* 520 U.S. at 177 (1997).

As clearly shown below, many of this proposed rule's key conclusions used to justify both its geographic immensity and the severity of the many restrictions and exclusions of human activities it seeks to impose, are not based on the best scientific and commercial information available as required by the ESA and DQA. Instead, as also clearly shown below, those key conclusions are the product of zealous but unintelligent pursuit of environmental objectives by agency officials on the basis of nothing more than speculation and surmise contradicted, in many instances, by the best scientific and commercial information available. Accordingly, this proposed rule does not pass ESA muster for precisely the reasons stated by the U.S. Supreme Court in *Bennett v. Spear*:

> "The obvious purpose of the requirement that each agency "use the best scientific and commercial data available" is to ensure that the ESA not be implemented haphazardly, on the basis of speculation and surmise. While this no doubt serves to advance the ESA's overall goal of species preservation we think it readily apparent that another objective (if not indeed the primary one) is to avoid needless economic dislocation produced by agency officials zealously but unintelligently pursuing their environmental objectives." *Bennett v. Spear,* 520 U.S. at 176-77 (1997).

The authors of the proposed rule ignore facts, misrepresent statistical information, and attempt to stop all human beings from using land and water in Arizona for any purpose. If the proposed rule were to be implemented it would take Arizona back to the 1700s. We know that there is an extreme environmental faction that believes mankind is inherently evil and should not be on this planet. To allow their hypocritical thinking to permeate FWS to this level is simply not acceptable. The proposed rule is so egregious that we need to have the names of the people who drafted and finalized the ruling and the names of all the people who reviewed the ruling and allowed the ruling to get this far.

The proposed rule also has to be withdrawn because it does not meet the DQA standards. The DQA was an attempt by Congress to ensure that federal agencies use and disseminate **accurate** information. The Data Quality Act requires federal agencies to issue information guidelines ensuring the quality, utility, **objectivity**

and integrity of information that they disseminate and provide mechanisms for affected persons to correct such information (emphasis added).

At the request of FWS the following information is supplied, proving conclusively that the proposed rule does not meet the ESA intent nor the DQA requirements of quality, utility, objectivity and integrity of information.

Background
FR Page 66483, Column 3. The Verde River is presumed occupied; however, the last captured fish from this river was from a 1999 survey.

Comment: The authors begin their reliance on speculation and surmise for support of the proposed rule by "presuming" the Verde River is occupied by spikedace for purpose of this critical habitat designation, despite the fact that the spikedaces last known presence in the Verde River occurred in 1999. *Id.* The FWS offers no scientific evidence or citation to authority, however, in support of that speculation masquerading as a "presumption." Neither does the FWS make any mention of the considerable body of USDA Rocky Mountain Research Station (RMRS) long-term, fisheries monitoring data it is aware of from the upper Verde River. Nor does the FWS mention the fact that this fishery monitoring data, or the best scientific data available relative to the presence of spikedace in the Verde, directly contradicts its speculation that the Verde can be "presumed" to be occupied by the spikedace for purpose of critical habitat designation. Accordingly, the FWS's presumption that the Verde River is occupied by the spikedace clearly fails to pass DQA standards and ESA muster because that presumption is based solely on speculation and surmise contradicted by the best scientific and commercial information available.

(1) The factors that are the basis for making a listing determination for a species under section 4(a) of the Endangered Species Act of 1973, as amended (Act) (16 U.S.C. 1531 *et seq.*), which are:

(a) The present or threatened destruction, modification, or curtailment of its habitat or range;

FR Page 66486, Column 1 and FR 66487, Column 1. Activities such as groundwater pumping, surface water diversions, impoundments, dams, channelization (straightening of the natural watercourse, typically for flood control purposes), improperly managed livestock grazing, wildfire, agriculture, mining, road building, residential development, and recreation all contribute to habitat loss and stream habitat degradation in Arizona and New Mexico.

Comment: A prime example of the FWS's expansive and improper use of speculation and surmise, is that found in its treatment of stream channelization in this proposed rule. According to the FWS, "[s]ections of many Gila Basin rivers and streams have been, and continue to be, channelized for flood control." The FWS, however, provides no citation to study or example supportive of that conclusion while also failing to mention that it is virtually impossible to obtain a Section 404 permit from the EPA to "channelize" any river or stream in

the manner described by the FWS in this proposed rule. Nonetheless, the FWS speculates, in the absence of scientific support, that "[h]istorical and ongoing channelization will continue to contribute to riparian and aquatic habitat decline [by] most notably eliminating cover and reducing nutrient input." That speculation similarly fails to pass DQA standards and ESA muster.

FR Page 66486, Column 2. These habitat changes, together with the introduction of nonnative fish species (see factors C and E), have resulted in the extirpation of Spikedace and Loach Minnow throughout an estimated 80 to 90 percent of their historical ranges.

Comment: Though the proposed rule does not separate the introduction of nonnative fish species from water withdrawal that caused habitat changes, they make the above conclusion under the "Water Withdrawal" heading. However, the truth is that but for the introduction of nonnative fish species, the Spikedace and Loach Minnow would be thriving. The same cannot be said for water withdrawals – the fact is that water withdrawals did not cause the demise of native fish in Arizona, the introduction of nonnative fish caused the demise. The authors attempt to make an issue out of water withdrawals in seven places in the proposed rule instead of recognizing the true issue – predation and competition from nonnative fish, violates the ESA and Data Quality Act rigorous requirements for the best available science.

FR Page 66486, Column 2. However, should water be diverted from the river, there would be a diminished flow that could potentially result in direct and indirect loss and degradation of habitat for aquatic and riparian species. The San Francisco River has undergone sedimentation, riparian habitat degradation, and extensive water diversion and at present has an undependable water supply throughout much of its length. Groundwater pumping also poses a threat to surface flows in the remaining Spikedace and Loach Minnow habitat in Eagle Creek. Groundwater withdrawal in Eagle Creek, primarily for water supply for a large open-pit copper mine at Morenci, dries portions of the stream.

Comment: The authors of the proposed rule ignore science in favor of cut and pasting of words that mean nothing in relation to Spikedace and Loach Minnow habitat quality. The fact is that these two native fish do better with diminished flows and without riparian species. Implementation of the proposed rule would increase instream flows and riparian species to the benefit of nonnative fish, causing a direct and deliberate "take" of Spikedace and Loach Minnow, in clear violation of the ESA. As pointed out by Rinne "flood flows on the upper Verde River in 1993 immediately favored the native fishes (Rinne and Stefferud 1997). Subsequently, low or drought flows were paralleled by an increase in non-native species (emphasis added) (Rinne 2004).

Like its speculation about livestock presence that is discussed in detail below, the FWS's speculation that all water diversions and agriculture pose per se threats to the Spikedace and Loach Minnow and that all water diversions and water impoundments can be regarded as one and the same for purpose of threat evaluation, is as inaccurate as it is unsupported by the best scientific and commercial information available. Therefore, those conclusions fail to pass DQA standards and ESA muster as well.

This is because the best scientific and commercial information available – that pertaining to Spikedace and Loach Minnow presence on the U Bar Ranch in southwestern New Mexico, reveals that the largest known populations of both of these species occur in the presence of livestock or within their close proximity below the returns of water to the Gila River from upstream diversions made for agricultural use. This is the "stronghold" for these species in New Mexico mentioned by the FWS in this proposed rule (Federal Register Page 66486, Column 3). Obviously, the construction and use of water diversions on the U Bar Ranch has resulted in neither the reduction nor elimination of riffle habitat essential to Spikedace and Loach Minnow. Accordingly, the FWS's unsupported but contradicted speculation to the contrary – that all water diversions and agriculture threaten the Spikedace and Loach Minnow – also clearly fails to pass ESA muster (*Bennett v. Spear*, 520 U.S. at 176-7) and fails to meet DQA standards.

Moreover, designation of critical habitat based in part on the misidentification of all water diversions and agriculture as posing threats to the Spikedace and Loach Minnow along all of the rivers and streams proposed for critical habitat designation here would also have other highly negative consequences on the potential recovery of these and other native warm water fishes. This is because, as currently proposed here by the FWS, this critical habitat designation would preclude federally cooperative propagation of native warm water fishes on private lands within 300 feet from those rivers and streams by use of water directly diverted from those rivers and streams, obtained by pumping of their sub-flows, or even that water obtained by pumping from a groundwater well. That result is neither rational nor supported by the best scientific and commercial information available either.

FR Page 66487, Column 2 The Verde River is considered currently occupied by spikedace, and barrier construction and stream renovation plans are underway with the intention of using this historically occupied area for recovery of native fishes including loach minnow.

Comment: As explained above the Verde River cannot be deemed occupied by spikedace because they have not been found there since 1999. Also, as detailed below, the recent barrier construction and stream renovation (aka poisoning) of Bonita Creek in southeastern Arizona failed miserably. Chances are high that it would fail on the Verde River too. The fish barrier constructed on Bonita Creek destroyed the riffle habitat required by spikedace and instead created a deep pool over ½ acre in size that benefits predatory nonnative fish. Since removing pools from the analysis of fish assemblage structure dramatically and positively alters native/non-native fish ratios to the benefit of natives (emphasis added) (Rinne et al., 2005a); creating pools (as done with construction of the fish barrier on Bonita Creek) would dramatically and negatively impact native fish. In Bonita Creek, the fish barrier, poisoning of fish and the translocation of spikedace all failed in less than two years (see BOR press release, December 14, 2010, Attachment1). Accordingly, because the FWS's conclusion that aquatic "renovations" by use of multiple applications of deadly poisons and/or fish barriers will benefit the Spikedace and Loach Minnow in the Verde River is based on speculation and surmise contradicted by the best

scientific and commercial information available, that conclusion also fails to pass DQA standards and ESA muster here.

FR Page 66487, Column 2 Water Quality - In the past, the threat from water pollution was due primarily to catastrophic pollution events.

Comment: The authors of the proposed rule recommend poisoning waters in Arizona with rotenone and Antimycin as a fisheries management tool. Both substances are poisons that kill fish and fish food (aquatic macroinvertebrates) and potentially cause Parkinson's disease in humans (Erman and Erman 2006)..

The FWS seeks by use of proposed rule here to pollute the rivers and streams within this proposed critical habitat designation. They propose multiple, multi-year applications of the rotenone or Antimycin with diesel carriers – the very pollutants – petroleum products, pesticides and other toxic chemicals that the FWS also oppositely and specifically identifies as threats to the existence of the Spikedace and Loach Minnow in this same proposed rule (Federal Register Page 66488, Column 1). The FWS attempts to haphazardly implement this massive poisoning plan under the guise of ESA-sanctioned stream "renovations" called for in this proposed rule (Federal Register Page 66495, Column 1).

The proposed rule would create more water pollution and detrimental impacts to water quality that the activities FWS seeks to further restrict.

The best information available reveals that the poison concoctions of choice for the kind of "renovation" work the FWS is proposing here are neither naturally occurring, organic nor friendly to the environment.

Instead, the rotenone formulation of current choice for the purpose of aquatic "renovation," CFT Legumine, is, in fact, a synergized rotenone formulation which contains petroleum distillates and no less than five known environmental contaminants, and kills any organisms (other than a few nonnative fishes) that obtain oxygen from water. Other rotenone formulations are similarly loaded with toxic pollutants and deadly consequences to anything that obtains oxygen from water.

For example, another synergized rotenone formulation of popular and widespread use in so-called aquatic "renovation" "activities," Nusyn-Noxfish, has been shown to contain other toxic cube resins, such as deguelin and piperonyl butoxide, in percentages equal to rotenone. Deguelin, tephrosin and other rotenoids have been shown by scientific research to have the same properties as rotenone as an insecticide, and piperonyl butoxide has been shown to be highly and acutely toxic to macroinvertebrates (Erman & Erman, 2006, citing EPA, National Pesticides Telecommunications Network).

Paradoxically, this and every other poison formulation used for aquatic "renovation" has been shown by the best scientific and commercial information available to be highly toxic to the very macroinvertebrate assemblages

(Erman & Erman, 2006, 2007) on which the spikedace particularly depends (Federal Register Page 66500, Column 2). Further unmentioned by the FWS in this proposed rule is the fact that exposure to rotenone in extremely small amount has also been linked to the onset of Parkinson's disease in humans (Dhillon 2008). The other poison of choice for aquatic "renovation" work, also unmentioned by the FWS in this proposed rule, is Antimycin A, which is also highly toxic to most organisms that obtain oxygen from water and is also particularly destructive of aquatic invertebrates (Erman & Erman 2007, review of Antimycin A).

Neither does the FWS mention the further, relevant fact in this proposed rule that not one of the many so-called "renovations" it cites has led to any long term success in eliminating either non-natives or increasing native fishes. Instead, just the opposite has been the usual result (see attached information regarding Bonita and Silver King creeks), with devastating impacts on macroinvertebrate communities compounded by each application of these deadly poisons.

Nonetheless, the FWS singles out Fossill Creek in this proposed rule (Federal Register Page 66483, Column 2) as an example of successful native fish management by "augmentation" without mentioning its multiple poisonings prior to such, without mentioning that the strain of spikedace introduced to that creek thereafter is not indigenous to the Verde River at all, (despite the FWS's opposite presumption at FR Page 66483, Column 3, Federal Register Page 66486, Column 1, and Federal Register Page 66487, Column 2 that the Verde is currently occupied by an indigenous and specific form of spikedace), and without any mention of the further fact that several species of macroinvertebrates were locally extirpated in Fossill Creek by use of the poison Antimycin A (Dinger and Marks, 2007). The latter fact is of particular relevance here because, paradoxically, as stated previously, the spikedaces diet consists almost entirely of macroinvertebrates (Federal Register Page 66500, Column 2).

FR Page 66488, Column 3 Recreation - The impacts to Spikedace and Loach Minnow from recreation can include movement of livestock along streambanks, trampling, loss of vegetation, and increased danger of fire

Comment: The FWS, however, offers no scientific support that these recreational activities are ***actually*** negatively impacting the spikedace or loach minnow. Instead, the authors of the proposed rule speculate that because recreation "can" impact Spikedace and Loach Minnows, recreation must be severely restricted or eliminated on their alleged behalf. That leap to conclusion on the basis of speculation and surmise similarly fails to pass DQA standards and ESA muster as well.

Moreover, while the FWS also cites alleged increase of trail use at Fossill Creek as proof of its speculation that the spikedace is suffering negative impacts from the recreational use of hiking there, it fails to mention the fact that recreational use of the Fossill Creek trail is down substantially from the 2003 numbers it misrepresents as current because of use restrictions that are presently in place for the protection of Fossill Creek. Accordingly, the FWS's speculation that hiking threatens the spikedace with extinction fails to pass DQA standards and ESA as well.

FR Page 66488, Column 3 Roads and Bridges Roads impact Gila River Basin streams (Dobyns 1981, pp. 120–129, 167, 198–201), including spikedace, loach minnow, and their habitats.

Comment: The same situation – reliance on speculation and surmise – also characterizes the FWS's treatment of roads and bridges and the repair of such in this proposed rule (Federal Register Page 66488, Column 3 and Page 66489, Column 1). Here the FWS speculates, on the basis of in-house generated reports and in familiar absence of scientific support that existing roads and bridges have ongoing maintenance requirements that result in [negative] alterations to stream channels within Spikedace and Loach Minnow habitat. Just where and how those activities might have negatively impacted either the spikedace or the loach minnow, however, is unmentioned in this proposed rule.

FR Page 66489, Column 1 - In some areas, low water ford crossings exist within occupied Spikedace and Loach Minnow habitats and cause channel modification and habitat disruption.

Comment: Similarly, authors of the proposed rule also speculate that low-water crossings on general-use roads exist in a number of areas that may support Spikedace and Loach Minnows also negatively impact those species because those crossings frequently require maintenance following minor flooding, once again, the FWS fails to provide any scientific support for this further exercise in the use of speculation and surmise. Instead, once again, the FWS fails to mention the contradictory fact in this proposed rule that replacement of a low-water crossing with a bridge, on the alleged behalf of the Sonora Chub, resulted in the complete loss of the habitat for the chub that this project was supposedly meant to protect (Sycamore Creek, Atascosa Mountains, Hank and Yank Canyon, Santa Cruz County, Arizona). Accordingly, because the FWS's conclusions relative to roads, bridges, low-water crossings and the maintenance thereof are based on speculation and surmise contradicted by the best scientific and commercial information available, those conclusions similarly fail to pass DQA standards and ESA muster here.

FR Page 66489, Columns 1 & 2 - Livestock Grazing - Livestock grazing has been one of the most widespread and long-term adverse impacts to native fishes and their habitat (Miller 1961, pp. 394–395, 399), but is one of the few threats where adverse effects to species such as Spikedace and Loach Minnow are decreasing, due to improved management on Federal lands.

Comment: Similarly, while, the authors of the proposed rule speculate that livestock presence of any kind is a threat to the Spikedace and Loach Minnow, they do so by citation to studies they know or should know to be stale and of limited or no relevance to that issue. Additionally, the FWS fails to mention the imposing, contradictory body of recent scientific research relative to the benefits of controlled grazing, which, as it is also aware, is the only form of livestock grazing conducted on lands to which ESA jurisdiction applies (see citations to publications showing the benefits of controlled grazing, attached).

Moreover, the FWS further fails to mention in this proposed rule the highly relevant and uncontested fact that the only major federal action preceding the disappearance of the spikedace from the Verde River, and the precipitous decline of the remainder of its native warm water fish assemblage, was the federal government mandated exclusion of all livestock presence from then-occupied spikedace habitat. The FWS also fails to mention the further uncontested fact in this proposed rule that this major federal action was implemented by the USFS and the FWS in the absence of either NEPA analysis or benefit of scientific support.

Contrary to the numerous misrepresentations of controlled livestock grazing and its effects made by the FWS throughout this proposed rule, there was no evidence then and there is none now, based on sound science, showing that grazing by domestic livestock has an obvious and well-documented negative effect on native fish species (Rinne 2004). Moreover, there is no evidence, based on sound science, showing that controlled livestock presence is detrimental to either the spikedace or the loach minnow specifically, or that livestock exclusion has led to betterment of their habitat, as is also falsely speculated in the face of contrary experience by the FWS in this proposed rule (Federal Register Page 66489 Column 1).

> Instead, according to Rinne (2004):
>
> "Data on the upper Verde River, a warm water aquatic ecosystem in Arizona, do not corroborate the contention that livestock have a significant or even demonstrable effect on native fishes. Removal of livestock on the upper Verde River in 1997 has resulted in markedly improved riparian conditions in the form of increased vegetation and stream bank and channel alterations. . . . However, most native fish species, including the threatened spikedace, have declined in abundance and distribution in the upper Verde River. Most of the information addressing livestock grazing effects on fishes is 1) largely opinionated and conjecture, 2) based on qualitative, short term, non-replicated data, 3) primarily for salmonids, and 4) not based on sound science. Further, complicating and confounding factors make it difficult to produce definitive answers. The negative effect of grazing on native, cypriniform species for such variables as stream banks (Rinne and Neary 1997) and sediment levels (Rinne 2001) are not demonstrable. At present, there is no evidence, based on sound science, that grazing by domestic livestock has an obvious and well-documented negative effect on native fish species."

As this proposed rule plainly but painfully reveals, the FWS has ignored, and continues to ignore, Rinne's plea for scientific sanity relative to the treatment of livestock presence and native fishes. Instead, as the facts clearly reveal, this proposed rule continues to misrepresent the best science available relative to the benefits of controlled livestock presence over exclusion while zealously but unintelligently attempting to perpetuate precisely the same livestock exclusionary mismanagement action by use of this rule that has already directly resulted in the unlawful "take" of the Spikedace and the disappearance of its habitat from the upper Verde River and the unlawful "take" of the Gila Topminnow and its habitat from Redrock Canyon, by the USFS and the FWS in direct and continuing violations of both Sections 7 and 9 of the ESA.

Here, it is an uncontested fact that when the USFS and the FWS caused the exclusion of all livestock from the upper Verde River to occur, native warm water fishes then made up more than 80% of all fishes found in that stretch of the river, despite the imposing presence of non-natives. The upper Verde was then also occupied by the Spikedace (Rinne & Miller 2006).

In just two years, however, after controlled livestock were excluded from the Verde by the FWS and the USFS for its alleged benefit, the Spikedace had completely disappeared from the river, and by 2005, the remainder of the upper Verde's native warm water fishes had also precipitously declined under this continuing "management" prescription (Rinne & Miller 2006), or "major federal action," imposed on them by the FWS and the USFS in the absence of either NEPA analysis or scientific support. Today, the native warm water fish assemblage of the upper Verde is on the verge of total collapse, making up less than 15% of the aggregate of all fishes found there (RMRS monitoring data) under this ongoing "management" prescription.

Nonetheless, despite these uncontested facts, the FWS proposes to perpetuate the exclusion of controlled livestock presence from Spikedace and Loach Minnow "habitat" by use of this proposed rule. In support of that conclusion, the FWS speculates in the absence of citation to any study that livestock exclusion has resulted in improved habitat for the Spikedace despite the disappearance of the Spikedace from that "improved" habitat (Federal Register Page 66489, Column 1). Instead the best scientific information available shows that neither the Spikedace nor its habitat any longer exist in the upper Verde River under the "improved" habitat conditions described by the FWS in this proposed rule, and are not likely to exist there in the future, in the absence of controlled livestock presence (Rinne, 2008, addendum to RAT report to RMRS, attached).

Moreover, the FWS is also aware of similarly negative results, relative to the native Gila Topminnow, caused by implementation of its scientifically contradicted speculation that any and all livestock presence poses a threat to that species as well. Here, the facts show that the Gila Topminnow was holding its own in Redrock Canyon – despite the imposing presence of nonnatives and occurrence of previous droughts -- before the USFS and the FWS abruptly excluded all livestock presence then ongoing for more than 300 years from its occupied habitat in similar absence of either NEPA analysis or scientific support.

Less than ten years later, in 2005, the Gila Topminnow, like the Spikedace in the upper Verde before it, disappeared from Redrock Canyon (EA for Redrock Canyon Renovation Project, 2010). Further, the FWS is also aware of similar negative result to Gila Topminnows in upper Cienega Creek.

There, the facts similarly show that after twenty years of exclusion of all livestock presence from their habitat in upper Cienega Creek by the BLM and the FWS, Gila Topminnows had declined by 98%, while downstream, where controlled livestock presence still exists along the creek, Gila topminnow numbers remained relatively stable despite the advent of recent drought (Bodner, Gori and Simms, 2007). Again, livestock exclusion, as on the Verde and at Redrock Canyon, was and remains the only major federal action preceding the Gila Topminnow's disastrous population decline in upper Cienega Creek.

Thus, as the facts here clearly show, the FWS is in direct and continuing violation of the ESA here by attempting to implement the ESA haphazardly, on the basis of speculation and surmise contradicted by the best scientific or commercial information available to it, by concluding nonetheless that any and all livestock presence poses a per se threat to the existence of Spikedace and Loach Minnows -- not only along the numerous rivers and streams in Arizona and New Mexico it proposes for critical habitat designation here, but within any and all of the watersheds of those rivers and streams as well (Federal Register Page 66489, Column 1). As *Bennett v. Spear* clearly instructs, such haphazard implementation of the ESA based entirely on the use of speculation and surmise, as proposed by the FWS in this rule relative to livestock presence, also violates both the letter and intent of the ESA.

Moreover, here, as in *Bennett v. Spear,* needlessly severe economic dislocation would also be the result of such haphazard implementation of the ESA by the FWS. Here, the FWS is proposing, in total, approximately 726 miles of rivers and streams and 300 feet on either side of them as critical habitat for the spikedace, and approximately 709 miles of rivers and streams and 300 feet on either side of them as critical habitat for the loach minnow (Federal Register Page.66482, Column 1), where it speculates in the face of substantial scientific information to the contrary that any form of livestock presence and water diversion or agriculture, along with almost virtually every other human activity imaginable, threaten these species' existence (Federal Register Page 66489, Columns 2 & 3).

(b) Overutilization for commercial, recreational, scientific, or educational purposes;

FR Page 66489, Column 1 - We have determined that overutilization for commercial, recreational, scientific, or educational purposes is not a threat to spikedace or loach Minnow.

Comment: Agree.

(c) Disease or predation;

FR Page 66489, Column 1 The introduction and spread of nonnative species has been identified as one of the primary factors in the continuing decline of native fishes throughout North America and particularly in the Southwest.

Comment: Over the past century, federal and state fisheries management agencies have introduced many non-native species of fishes into southwestern rivers and streams (Rinne, 1996; Rinne et al., 2004). For example, about 100 species of non-native fish have been introduced into the waters of Arizona since the late 1800s and half of these species have become established (Rinne, 1994). Hundreds of stocking events involving millions of individual fishes have occurred on the Verde River (Rinne et al., 1998).

The authors cite Miller *et al.*(1989, pp. 22, 34, 36) in concluding that introduced nonnative species were a causal factor in 68 percent of fish extinctions in North America in the last 100 years, and Lassuy (1995) states that for the 70 percent of fish species that are still extant, but are considered to be endangered or threatened, introduced nonnative species are a primary cause of the decline. Yet, no mention is made in this proposed rule of the fact that the FWS is conversely involved, and will continue to be conversely involved, in the introductions of non-native fish species across the American Southwest. Until the FWS and cooperating state game & fish agencies cease to participate in the liberal introductions of non-natives in the American Southwest, it will be virtually impossible to control the introduction and spread of non-native fishes (Erman & Erman, 2006, 2007). Accordingly, the FWS has no business proposing this rule until addresses and corrects it current policy relative non-native fishes introductions.

FR Page 66489, Column 1 - Generally, when the species composition of a community shifts in favor of nonnative fishes, a decline in spikedace or loach minnow abundance occurs (Olden and Poff 2005, pp. 79–86).

Comment: Though this proposed rule acknowledges the fact that when nonnative fish increase in number, native fish decrease, the habitat management approach it advocates clearly favors nonnative fishes over natives. Examples include include the exclusion of controlled livestock presence, which has been proven to benefit nonnative fish over native fish (Verde River); fish barrier construction, which has been proven to increase the number of pools upstream of the barrier to the advantage of non-native fishes (Bonita Creek); and by halting of bridge and road repairs that could result in the undermining of bridge abutments and road surfaces by associated creation of large pools which also distinctly benefit non-native fishes over natives.

In order to comply with the ESA and Data Quality Act, the FWS must rely on the best scientific information available – the relevant fisheries data collected in Arizona and New Mexico (i.e., by the RMRS, Rinne, Rinne and Miller, and others). The FWS must also stop proposing the implementation of fisheries management techniques that do not work relative to small native fishes like the Spikedace and the Loach Minnow. Finally, in order to properly comply with the ESA and the DQA, the FWS cannot rely on Platts and other cold water salmonid (trout and salmon) literature because that literature is not relevant to conditions that warm water native cyprinids (minnows) such as the Spikedace and Loach Minnow in Arizona and New Mexico face.

FR Page 66491, Column 3 - Both Spikedace and Loach Minnow have been severely impacted by the presence of nonnative predators. Aquatic nonnative species have been introduced or spread into new areas through a variety of mechanisms, including intentional and accidental releases, sport stocking, aquaculture, aquarium releases, and bait-bucket release. Channel catfish, flathead catfish, and smallmouth bass appear to be the most prominent predators, although other species contribute to the decline of native fishes in the Southwest, including Spikedace and Loach Minnow. Spikedace and loach minnow have been replaced by nonnative fishes in several Arizona streams.

Comment: Nonnative predators and habitat mismanagement are proven causes of decline in native fishes. As described above, invasive nonnative species and habitat mismanagement are the only two factors that pass the "but for" test. The ESA and Data Quality Act require use of the best scientific information available. While the FWS acknowledges the gravity of the problem posed by introductions of non-native predators, it proposes by this rule to perpetuate the very habitat mismanagement action – exclusion of all livestock presence – that been shown to benefit non-native predators over native fishes and has also shown to have led to the disappearance of the Spikedace from the Verde River. Accordingly, because the best scientific information available contradicts the FWS's conclusions in this proposed rule relative to the management of habitat for the Spikedace and Loach Minnow relative to the presence of non-native predators, those conclusions similarly fail to pass ESA or DQA muster as well.

(d) The inadequacy of existing regulatory mechanisms;

FR Page 66491, Column 2 - Spikedace and loach minnow are currently listed as threatened under the Act and therefore are afforded the protections of the Act. Special rules were promulgated for Spikedace and Loach Minnow in 1986, which prohibit taking of the species, except under certain circumstances in accordance with applicable State fish and wildlife conservation laws and regulations. Violations of the special rules are considered violations of the Act (50 CFR 17.44(p) for spikedace and 50 CFR 17.44(q) for loach minnow).

Comment: As the facts plainly show, this proposed rule continues to misrepresent the best science available while zealously but unintelligently attempting to perpetuate mismanagement actions that have already directly resulted in the unlawful "take" of the Spikedace and the disappearance of its habitat from the upper Verde River and Bonita Creek in direct and continuing violations of both Sections 7 and 9 of the ESA. That approach to justifying the inadequacy of existing regulatory mechanisms obviously fails to pass ESA or DQA muster as well.

FR Page 66491, Column 2 - Available Conservation Measures

Comment: The FWS fails to mention or recognize the substantial water conservation efforts made by the City of Sierra Vista and the Department of Defense at Fort Huachuca for the benefit of Spikedace and Loach Minnows occurring in the San Pedro watershed. Instead the FWS speculates to the contrary in this proposed rule, and in direct violation of the ESA, that because all current groundwater pumping and surface water diversions used for municipal purpose "can" be, they therefore are per se threats to the existence of those species throughout the vast area the FWS is proposing to designate as critical habitat for them here, notwithstanding the City of Sierra Vista's and Fort Huachuca's substantial water conservation efforts (Federal Register Page 66487, Column 2). That approach similarly fails to pass ESA and Data Quality Act muster.

(10) Information on the projected and reasonably likely impacts of climate change on Spikedace and Loach Minnow and on the critical habitat areas we are proposing.

FR Page 66491, Column 2 - In addition, the warmer, drier, drought-like conditions predicted to occur due to climate change (Factor E) will further reduce available resources for Spikedace and Loach Minnow.

Similarly, the FWS bases its speculation relative to climate change and the negative effects of such on Spikedace and Loach Minnows on computer models projecting a widespread decrease in snow depth in the Rocky Mountains and earlier snow melt contained in the IPCC's 2007 report. Once again, however, the FWS neglects to mention the fact that the climate change models employed in the IPCC's 2007 report have been scientifically discredited. This is because those models were found by objective scientific review to be incapable of verification through replication (lack of available data) and therefore do not qualify as scientific evidence. Accordingly, because the FWS's conclusions relative to climate change and the effects of such on Spikedace and Loach Minnows are based entirely on speculation and surmise, rather than the best scientific and commercial information available, that conclusion also fails to pass ESA and Data Quality Act muster here.

Also see the attached comments titled **"ARIZONA & NEW MEXICO COMMENTS REQUESTED INFORMATION CONCERNING CLIMATE CHANGE."**

Conclusions

In sum, as shown clearly herein, the FWS is attempting by use of this proposed rule to implement the ESA haphazardly, on the basis of speculation and surmise rather than on the basis of the best scientific and commercial information available as required by the DQA and ESA. As also clearly shown herein, the FWS is also attempting, by use of speculation and surmise here, to produce needless and severe economic dislocation by prohibiting or severely restricting virtually every human economic and recreational activity in ten Arizona counties and three New Mexico counties, during the worst economic recession on record since 1929. Accordingly, the FWS must withdraw this proposed rule because it is in fundamental violation of the requirement that it use solely the best scientific and commercial information available in implementing ESA.

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Rinne, John N. 1994. Declining southwestern aquatic habitats and fishes: Are they sustainable? pp. 256-265, In: Sustainable Ecological Systems: Implementing and Approach to land Management. USDA Forest Service Gen. Tech. Rep. RM-247.

Rinne, J. N. and D. Miller. 2006. Hydrology, geomorphology and management: Implications for sustainability of southwestern native fishes. Reviews in Fisheries Biology.

Rinne, J.N.; Neary, D.G. 1997. Stream channel and fish relationships: Preliminary observations, Verde River, Arizona. In: American Water Resources Association: 475-482.

Rinne, J .N. Simms, J., Blasius. 2004. Changes in fish asssemblages in the Gila River, Arizona-New Mexico: Epitaph of a native fish fauna. In, Rinne, Hughes, Calamusso (eds). Changes in large river fish assemblages in North America: Implications for management and sustainability of native species. AFS-NAJFM special Publications.

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ATTACHMENT 1

Lower Colorado Region
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Released On: December 14, 2010

Agencies Propose Chemical Treatment to Eradicate Nonnative Fish in Bonita Creek

The Bureau of Reclamation, in cooperation with the Bureau of Land Management, the U.S. Fish and Wildlife Service, and the Arizona Game and Fish Department, proposes to reapply a piscicide, known as rotenone, to a 1.7-mile segment of lower Bonita Creek to remove nonnative fish that pose a threat to five species of federally listed fish. Bonita Creek lies within the BLM-administered Gila Box Riparian National Conservation Area, approximately 12 miles northeast of Safford, Ariz.

In 2007, Reclamation released an Environmental Assessment (EA) to evaluate a native fish restoration project that involved the construction of a fish barrier, application of rotenone, and reintroduction of several species of federally listed fish in lower Bonita Creek. The project was implemented in late 2008. In 2009, three species of nonnative fish were again detected in lower Bonita Creek. Biologists believe the continued persistence of these nonnative fish may jeopardize the existing native fish assemblage in Bonita Creek.

Reclamation has prepared a Revised Supplement to the 2007 EA to examine the environmental consequences of the proposed reapplication of rotenone in lower Bonita Creek. Based upon the Revised Supplement to the EA, Reclamation has made a preliminary determination that a Finding of No Significant Impact is appropriate for this proposed action, and an environmental impact statement is not required. However, no final decision will be made until all comments from the public are fully considered.

A copy of the Revised Supplement can be obtained by calling Reclamation's Environmental Resource Management Division at (623) 773-6251, by e-mailing jharagara@usbr.gov, or by downloading it from the Phoenix Area Office website at http://www.usbr.gov/lc/phoenix.

Comments should be mailed to John McGlothlen at the Bureau of Reclamation, Phoenix Area Office, PXAO-1500, 6150 West Thunderbird Rd., Glendale, AZ. 85306-4001or faxed to (623) 773-6481, no later than January 10, 2011. Questions may be directed to Mr. McGlothlen at (623) 773-6256.

ATTACHMENT 2

Attachment 3. Handout provided by John Rinne: Upper Verde River; Status of Information on Fishes, 1994-2006 (prepared Feb, 2007).

UPPER VERDE RIVER
STATUS OF INFORMATION ON FISHES, 1994-2006

John N. Rinne
RMRS

February, 2007

RMRS has been monitoring and studying fish assemblages and factors potentially affecting these assemblages in the upper 60 km of the Verde River since 1994. Information has been published in numerous outlets (Appendix A). Activities have included monitoring fishes and their habitats since flooding in winter 1992-93, mechanical removal of predators 1999-2003 and summer 2006, and spikedace monitoring. In spring 2007, there will be 14 years of data at seven fixed monitoring sites over the upper 60 km reach.

Important relationships and changes in fish assemblages have been documented and unfavorable trends in native fishes have a high probability of repeating themselves. These are:

1. Native fishes were abundant and dominated fish assemblages only for a short term post-flooding in 1994-96 and 2006-?
2. Spikedace were abundant only from 1994-1996, at the extreme upper end of sampling reach. The species has not been collected since 1997.
3. Nonnative fishes became dominant during the extended low flow, drought period (1996-2003); three species of native fishes (including the threatened spikedace) became markedly reduced ((70%) and have virtually disappeared in samples.
4. Pilot mechanical removal activities from 1999-2003 failed to accrue any benefit to native species. A modified removal approach was initiated in 2006, however, funding is currently inadequate to continue this program.
5. Nonnative species are markedly, and steadily increasing once again based on monitoring at the seven long term sites.
6. Flooding and the nature of the upper Verde River hydrograph has been the primary, positive factor to sustain native fishes.
7. Base, drought flows and attendant livestock grazing removal appears to be the primary activities that enhance nonnative fishes in the upper Verde.

In summary, in absence of significant flooding, continued base flows and livestock exclusion, native fishes will once again decline and in some cases disappear from the upper Verde River. By contrast, nonnatives species will increase and dominate the fish assemblage in the upper Verde. Spikedace re-appearance will have an increasingly lower probability.

APPENDIX A

Upper Verde Published Information

1. Stefferud J. A.; **Rinne J. N**. 1995. Preliminary observations on the sustainability of fishes in a desert river: The roles of streamflow and introduced fishes. Hydrology and Water Resources in Arizona and the Southwest 22-25: 26-32.

2. **Rinne J. N**.; Stefferud J. A. 1996. Relationships of native fishes and aquatic macrohabitats in the Verde River, Arizona. Hydrology and Water Resources in Arizona and the Southwest 26: 13-22.

3. Neary A. P.; **Rinne J. N**., Neary D. G. 1996. Physical habitat use by spikedace in the upper Verde River, Arizona. Hydrology and Water Resources in Arizona and the Southwest 26: 23-28.

4. **Rinne J. N**.; Stefferud J. A. 1997. Factors contributing to collapse yet maintenance of a native fish community in the desert Southwest (USA). pp 157-162. In, Hancock, D. A.; Smith, D. C.; Grant, A.; Beaumer, J. P. (eds). Developing and Sustaining World Fisheries Resources: The State of Science and Management. Second World Fisheries Congress, Brisbane, Australia. Jul. 28-Aug. 2, 1996.

5. **Rinne J. N**.; Neary D. G. 1997. Stream channel and fish relationships: Preliminary observations, Verde River, Arizona. pp 475-482. In, Proceedings of the American Water Resources Agency Symposium, Water Resources Education, Training, and Practice: Opportunities for the Next Century. Breckenridge, CO.

6. Neary D. G.; **Rinne J. N**. 1997. Base flow trends in the upper Verde River relative to Fish Habitat Requirements. Hydrology and Water Resources in Arizona and the Southwest. 27:57-63.

7. Sponholtz P.; **Rinne J**. **N.** 1997. Refinement of aquatic macrohabitats definition in the upper Verde River, Arizona. Hydrology and Water Resources in Arizona and the Southwest. 27: 17-24.

8. Sponholtz P.; Redondo D.; Deason B.P.; Sychowski L.; **Rinne J. N**. 1998. The influence of stock tanks on native fishes: Upper Verde River, Arizona, pp 156-179. In, Proceedings of the Symposium on Environmental, Economic, and Legal Issues Related to Rangeland Water Developments. Nov 13-15, 1997. Arizona State University, Tempe, AZ.

9. **Rinne J. N**.; Stefferud J. A.; Clark A.; Sponholtz P. 1998. Fish community structure in the Verde River, Arizona, 1975-1997. Hydrology and Water Resources in Arizona and the Southwest 28: 75-80.

10. **Rinne J. N**. 1999. The status of spikedace, *Meda fulgida*, in the Verde River, 1999. Implications for research and management. Hydrology and Water Resources in the Southwest 29:57-64.

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I. UPPER VERDE RIVER WATERSHED

Comments on the Evaluations by the Forest Service for Three Federally Listed Plant Species

In the

2019 Biological Assessment of the Coronado National Forest Livestock Grazing Program

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Submitted May 10, 2019

My comments are provided to the Forest Service staff of Coronado National Forest at the request of Jim and Sue Chilton, Chilton Ranch LLC, who are the current permittees of the Montana and Jarillas Allotments on Coronado National Forest. The address of Jim and Sue Chilton is: Box 423, 17691 W. Chilton Road, Arivaca, AZ, 85601. Phone: 520-398-9194. Email: tommurabi@aol.com.

Summary.
In my review of the February 2019 Biological Assessment of the Coronado National Forest Livestock Grazing Program, I provide field observations of the individual, population, and/or habitat attributes of the three endangered plant species that indicate to me that:

1) A consideration of individual plant (ramet) fates for the Huachuca water umbel, with cattle grazing and roads crossing streams, supports the may affect, likely to adversely affect determination. However, a consideration of the flood-scoured channel features and the clonal habit of this species where it occurs on CNF suggests a **may affect, but is not likely to adversely affect, the populations of HWU** on the west slopes of the Huachuca Mountains**.**

2) The CNF record (Falk 1996) of the Canelo Hills Ladies'-tress on CNF downslope from the Canelo Work Station in Turkey Canyon suggests the text for this species should have been presented in the Species Evaluations, not in Appendix D. In addition, a reasonable determination would have been **may affect, and is likely to adversely affect, CHLT** on CNF, even with only one documented sighting made more than twenty years ago.

3) A consideration of a striking population effect (a crash) on Pima pineapple cactus directly tied to the low to moderate grazing of Lehmann's lovegrass along Duquesne Road during the last ten to fifteen years and the programmatic continuation of this level of grazing suggests the species should have been presented in the Species Evaluations, not in Appendix D. In addition, when considered as a population, not as individual plants, the determination would have been may affect, and is likely to adversely affect, PPC on CNF. More accurately, the determination would have been **has affected, has certainly adversely affected, this now largely extirpated population of PPC.**

Introduction.
Three plants are included in the Biological Assessment (the BA): Huachuca water umbel (*Lilaeopsis schaffneriana* var*. recurva*), an orchid, Canelo Hills Ladies'-tress (*Spiranthes delitescens*), and a cactus,

Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*). All three are listed as endangered; the umbel and the orchid in 1997, the cactus in 1993.

Prior to writing comments to the Biological Assessment (the BA), I reviewed the published literature for each of the three species, looked at herbarium specimens of the species at University of Arizona and Arizona State University, visited with several of the land owners or stewards of the properties, and within the brief allotted time visited some of the localities of the plants on or nearby Coronado National Forest. I did not request locality information directly from the Heritage Data Management System, but asked for the HDMS data set that had been shared with the Forest Service. I was unable to visit the herbarium at the Desert Botanical Garden in large part because of no response by their staff to my emails sent over a seven-day period to several staff researchers. I did request unpublished reports from the Forest Service and US Fish and Wildlife Service that had been cited within the Biological Assessment or were pertinent to the three species. The reports included surveys funded at least in part with Section 6 funds and field notes (?) made by Julie Crawford (USFWS, Arizona Ecological Services). But I did not receive the requested literature within the short amount of time available for the agencies to respond.

Please Note: In this text, all statements copied verbatim from the Biological Assessment are in italics. Plant binomials are also in italics, by convention. The pages in Appendix D, The Informal Consultation Requests, of the BA are unnumbered.

On page 4-49 of the Final ESA Section 7 Consultation Handbook, March 1998, it states:
"If listed plant species are present in the action area, the following special provisions apply: Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act prohibits the removal and reduction to possession of Federally listed endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, …" (or in violation of any applicable State laws).

In a careful reading of the BA, particularly in the determinations considered in whether the action (1) may affect, and is not likely to adversely affect or (2) may affect, and is likely to adversely affect, there are two considerations that are pertinent to how the Forest Service might determine affects.* **The first consideration**, the one used in the BA, is whether even a single plant or vegetative off-shoot of a plant might be harmed by the action. ***The second consideration**, not used in the BA, is whether the action will affect the population dynamics as a whole, particularly in maintaining the populations on the CNF. I have introduced for both the Huachuca water umbel and Pima pineapple cactus the second consideration.

Huachuca Water Umbel (HWU).
One general observation of the Biological Assessment for the HWU is that it is borrowing concerns from other parts of the known range of the species and applying them to the known local populations on Coronado National Forest (the HWU HDMS mapped locations in Figure 14 of the BA). USFWS (1997) described the major threats to the species in the Final Listing. On page 13 of the BA, the threats are repeated as "*loss of wetland habitat due to growing water demands and associated diversions and impoundments, overgrazing by livestock, introduction of invasive non-native plant species, and sand and gravel mining*." None of these threats occur in the watered canyon systems with HWU mapped in Figure 14.

On May 6, 2019, I visited the population of HWU growing along Lone Mountain Canyon from the Highway 83 Bridge upstream to a point one hundred meters north of the small cattle exclosure the Forest Service constructed on Lone Mountain stream. The length of the stream I explored was ca 500 m, about half (222 m) within the cattle exclosure, half outside of the exclosure.
Although only a short exploration, several features of this explored reach are likely to be present along most of the 13 HWU HDMS locations in Figure 14 of the BA.

1. Cattle are currently grazing the stream-side and stream vegetation. The vegetation in and along the stream has recently been closely cropped by the cattle. Several sedge species, an *Equisetum*, and several grass species including *Muhlenbergia rigens* were the plants closely cropped. I carefully examined three relatively large HWU patches immediately adjacent to where the other species were so closely cropped. I saw no signs of the cattle having eaten the leaves of this plant. HWU was untouched by the cattle even though there were many sites where other plants had been cropped within 5 cm of HWU plants. I cannot say whether cattle consistently avoid eating HWU everywhere it occurs with cattle or if this was a seasonal avoidance; but very careful observations are needed in more places and throughout the growing season to determine whether cattle carefully avoid eating this plant. As a member of Apiaceae, a plant family that includes water hemlock and poison hemlock (both very poisonous to cattle), HWU may be poisonous to cattle. Research is needed to better document the apparent avoidance and to characterize the poisonous or at least repellent compounds in the plant.
2. Many of the HWU plants were growing in the narrow spaces between the cobblestones in the stream.
3. No non-native grasses such as Bermuda grass (*Cynodon dactylon*) or Johnson grass (*Sorghum halepensis*) were observed along this reach of Lone Mountain Canyon.
4. This stream channel is highly constrained by bedrock. The slopes above the channel are bedrock and the stream bottom is bedrock. Water is flowing at the surface in this channel because boulders, cobblestones, gravel and sand do not fill the channel. Some rate of transport from channel scouring prevents large areas of the channel from filling with material, but still results in segments of the channel with shallow cobblestone and gravel deposits. Upstream from the cattle exclosure is an alluvial basin with a large volume of sand, gravel, and cobblestones. Water flows out of this basin. As in other bedrock channels I have explored in Arizona, the sand and gravel deposits function to store and release water downstream. So the interplay of alluvial basins as sponges and bare bedrock channels downstream from the basinscontribute to the perennial or near-perennial surface flow observed in this channel.
5. The primary difference between the vegetation inside and the vegetation outside of the cattle exclosure is that *Muhlenbergia rigens* plants within the exclosure are full size, with a full complement of leaves and last year's inflorescences. Outside plants have been grazed to the point that grass blades are only a few centimeters in length. On this 500-m explored reach, the largest patches of HWU are outside of the exclosure. The HWU patch sizes and apparent vigor appear to be determined by the amount and distribution of larger clasts in the stream channel, the bedrock morphology, and the amount of sunlight reaching the patch.
6. I examined the geology map by P. T. Hayes and R. B. Raup [1968. Geologic map of the Huachuca and Mustang Mountains. USGS Misc. Geol. Investigations Map I-509]. It is not straightforward comparing the occurrence of HWU in Figure 14 of the BA with their map, but several patterns do emerge with respect to where HWU occurs on the west side of the Huachuca Mountains on Coronado National Forest. I emphasize here that across its range in Arizona and Sonora HWU occurs in wetlands on a range of substrates from deep valley alluvium to bedrock. But the Figure 14 HWU HDMS sites are restricted to a limited set of bedrock types. The seven patches in

the Wakefield allotment are all on Glance conglomerate (Kg) and the Morita Formation (Km) except for the patch on the north side of the east cattle exclosure which appears to be on a deposit of andesitic lava within the Glance conglomerate (Kga). Just north of the bridge on the Wakefield allotment are several faults that cross the channel; these may be conveying water into this portion of the channel. The Kellogg allotment patch is on Morita Formation. The two patches in Sunnyside Canyon are both on Glance conglomerate. The north patch in Scotia Canyon occurs on both Glance conglomerate and the Morita Formation; interestingly a series of transverse dikes and sills cross the upper portion of Scotia Canyon occupied by HWU and may contribute to the watering of the canyon by an influence of 'perched aquifers' fed laterally. The south segment of HWU in Scotia Canyon is on several types of bedrock. The gap between the north and the south patches in Scotia Canyon is where the channel crosses Tertiary quartz monzonite (Tqm). Two other exceptions to this spatial association of water umbel on Glance conglomerate and Morita Formation are (1) Sycamore Spring (Lone Mountain allotment) on an interlayered bedrock of rhyolite, lava tuff and sedimentary rock and (2) the patch in Merritt Canyon near Parker Canyon Lake (Collins Lake allotment) on Canelo Hills volcanics. This is only a rough description of the spatial association of HWU with specific bedrock types in the channels. The Glance conglomerate and Morita Formation occupy a fairly large area but there appears to be a spatial bias against HWU occurring on several other bedrock types, notably the JTch tuffs and lavas, Kc (Cintura Formation), and Tqm (Tertiary quartz monzonite).

7. The point in describing the bedrock types in the channel reaches occupied by HWU in Figure 14 is that throughout the segments of these channels with Glance conglomerate and Morita sandstones-mudstones-siltstones, flood events scour the bottoms of the canyons, maintaining very little volume of sediments, so that water flows on bedrock. In addition, the channel sides are bedrock, not alluvium, and are extremely stable. Probably as yet unexplored, the geohydrology of the canyon systems likely include input of water from lateral dikes, sills and transverse faults, as well as the strongly dipping fractured conglomerate and sandstone/siltstone/mudstones that are perpendicular to the channel cuts.
8. The patches of HWU occur in cobblestone fields within the shallow water. They appear to colonize sandy or silty substrates between floods, but the sand or silt colonizations are likely to be ephemeral , with the plants removed during each flood. The enduring or 'safe sites' for this clonal plant in these constrained bedrock channels appears to be the cobblestone fields themselves.

The species-specific conservation measures described for HWU (p. 10 and 11), the threats listed by USFWS (1997) and again by the Forest Service in the BA (p. 13), and the concern expressed (p. 13) for livestock impacts are essentially disconnected from the bedrock stream systems and the occurrence of HWU within the stream systems on the west side of the Huachuca Mountains (Figure 14). Cattle grazing could be increased or decreased, exclosures could be built or not built, and there would be little effect on HWU patches in the floodwater-impacted, bedrock canyons on the west side of the Huachuca Mountains. (Sycamore Spring is the exception and is likely to benefit from exclosures and other means to reduce impacts to both the HWU patches and the wet soil. But this spring is not directly part of a floodwater system.)

Specific comments to how the proposed action **may affect, and is likely to adversely affect**, HWU and its designated critical habitat (p. 16) are as follows:

- *Livestock herbivory to individual HWU in the action area may occur*. Based on my limited observations, cattle actively, assiduously avoid eating HWU. The more accurate statement

regarding herbivory to HWU is that livestock herbivory to individual listed HWU plants is not expected. (This is the same language for the first criterion in the May Affect, Not Likely to Adversely Affect for PPC, Appendix D.)

- *Livestock may trample and consume HWU*. Based on my limited observations, cattle will have (almost) no effect where HWU grows in cobblestone deposits in the streams. In the stream section I observed, cattle fed along the edge of the water but were not walking on the cobblestones. They may trample the HWU plants that have colonized open water (by means of long internodes), but these same colonizing plants are removed in the next flood event, whether trampled or not. Effects to HWU are expected to be discountable. Again, I found that the cattle in Lone Mountain stream were not eating HWU.
- *The suitability of HWU habitat in the action area may be adversely altered by grazing*. Suitability of HWU habitat will not be adversely altered by livestock grazing in the action area. The bedrock canyons on the west side of the Huachuca Mountains will be largely unaffected by grazing. The dominant factor in maintaining habitat for HWU is the occurrence of episodic floods that scour the channels and rearrange sand and cobblestone bars within the stream bed. Grazing will not adversely alter the suitability of these floodwater-determined habitats.
- *Listed plants may be physically damaged by livestock management activities*. To a limited degree it is possible that the plants could be physically damaged by management activities. Dirt roads do cross the watered stream beds. On the downstream side of the Lone Mountain Canyon cattle exclosure, a dirt road crosses the stream. HWU plants occur adjacent to the road where it crosses the stream. A number of vehicles, especially recreational ATVs, use this road as well as vehicles used by ranchers to transport materials as part of their livestock management activities (ex. repairing fences).
- *These impacts (all of the above) are not expected to be widespread or excessive…* My limited observations are in agreement with this statement.

Threats to the species.
On page 13 of the BA, the threats are repeated as "*loss of wetland habitat due to growing water demands and associated diversions and impoundments, overgrazing by livestock, introduction of invasive non-native plant species, and sand and gravel mining.*" Again, I would emphasize as a comment that none of these threats apply to the populations of HWU on the west side of the Huachuca Mountains. To my knowledge, no one is dewatering the canyons in Figure 14, so no one is directly impacting the hydrology of the canyons where HWU occurs. Diversions and impoundments have not been built within these canyons such that the canyons downstream have reduced water flow. I did not observe the non-native Bermuda grass or Johnson grass. The non-native *Nasturium* was present but was not over-topping or crowding the HWU patches. I am not aware of sand and gravel mining in the canyons on the west side of the Huachuca Mountains with HWU. Such mining would be evident on Google Earth, which I carefully examined for these flood channels.

Affects to HWU.
*First consideration. On an individual plant level (the ramet), the proposed actions (including livestock grazing) may result in the trampling by cattle or running over the plant by a vehicle crossing a stream on a forest road. Trampling and running-over of a ramet would result in a determination of may affect, likely to adversely affect.
*Second consideration. The HWU is strongly clonal with a single genet (genetic individual) producing long exploratory stolons on the surface of the water with nodes (plantlets) and internodes. A single genet is likely to occupy both (1) the spaces between the cobblestones where the genet is largely protected from flood scouring, and (2) the open shallow water where a large portion of the ramets of

this plant will be removed during episodic scouring. Using the second consideration, trampling by cattle and crushing by vehicles at dirt road crossings would result in a determination of may affect, not likely to adversely affect.

Canelo Hills Ladies'-Tresses (CHLT).

Botanists have observed or collected all flowering specimens of CHLT on private lands at four sites, with one exception (Falk 1996) on Coronado National Forest. The historic sites have been (1) private land on Turkey Creek, (2) CNF land on Turkey Creek, (3) Babocomari Ranch near the headquarters, and (4) Sheehy Spring on the San Rafael Ranch, and (5) the Canelo Hills Cienega Preserve, owned by The Nature Conservancy, in O'Donnell Canyon. During the time available, I visited The Nature Conservancy's Canelo Hills Cienega with Peter Leiterman (the manager for TNC Preserves in SE Arizona) on April 26, 2019. With permission from the owner of the private land along Turkey Creek, I visited the known orchid micro-sites with Jim Koweek on May 4, 2019. I did not have enough time to get permission from the Babocomari Ranch headquarters to visit the know site on their property. Ross Humphrey declined my request to visit Sheehy Spring on his property in the San Rafael Valley. There was not enough time for USFWS and the Forest Service to provide me with copies of unpublished survey reports for this species.

CHLT has been observed flowering as recently as 2017 and 2018 in the wet meadows along Turkey Creek (Jim Koweek, pers. comm. May 4, 2019). In TNC Canelo Hills Preserve, it was first collected by Paul Martin on July 7, 1968 (the first time the species was collected) and was seen and monitored for a number of years in the 1990s at the Preserve. However, it has not been observed flowering on the Preserve since the fire of April 30, 2002 (Doug Snow, volunteer at the TNC property, pers. comm. April 26, 2019). It has been searched for during the flowering period (July-August) for at least some of the years after 2002 on the TNC Preserve. [I am not suggesting the 2002 fire may have extirpated CHLT on the Preserve. Without any information on the fate of below-ground rhizomes of CHLT, the fire is simply a reference point.] A number of people participated in a survey for CHLT in the known historic sites for this plant near the Babocomari Ranch headquarters a few years ago. No plants were found in the survey (Julie Crawford, USFWS, Arizona, emailed pers. comm. May 6, 2019). Julie Crawford visited Sheehy Spring on Ross Humphrey's property once (?) within the last few years and did not see any CHLTs flowering (Julie Crawford, pers. comm. May 6, 2019). A few comments can be provided for the treatment within the BA for CHLT.

1. My understanding is that a brief field report exists in the Coronado National Forest Supervisor's Office (Tucson) of an observation made of 4 or 6 flower spikes of CHLT found on Coronado National Forest. This report (Falk 1996) described the flowering patch as being immediately north of the private land in Turkey Creek. This area is downslope from the Forest Service's Canelo Fire Station (labeled the Canelo Work Center on the 2017 Fort Huachuca BLM Surface Management Status 1:100,000-scale Topographic Map). The area fenced in around the Fire Station is not part of a grazing allotment. According to the neighbors, the fenced area that includes the Falk site has occasionally been used to hold horses for both the Forest Service and Border Patrol. Border Patrol has not recently kept horses in this fenced enclosure at the Fire Station.
2. The wet pasture in Turkey Creek where CHLT patches still occur is grazed for about 3 months each year. The owner (pers. comm. May 2019) said that he keeps a close watch on the utilization of the pasture by his cattle and moves them to a second adjacent pasture several times during the 3 months the pasture is grazed. The family has been the landowners of this property on Turkey Creek for about 110 years. The pasture with the CHLT in Turkey Creek has

been grazed at a similar level as seen today for that period of time (the owner, pers. comm. May 2019).

3. As a correction to the herbarium specimen locality for what is now TNC Canelo Hills Preserve, Paul Martin's collections on July 7, 1968 and July 10, 1968, identify the site as the "Knipe Ranch"; Paul Martin's thrid collection on August 27, 1969, refers to the orchid site as the "Knipe Cienega." According to the private landowner in Turkey Creek, the Knipe home site was never a ranch operation so should be considered only as the Knipe Place. The owner in Turkey Creek said that the Knipe family kept no more than a few cattle, perhaps only a cow and a calf. So the TNC Preserve is likely to have had a history of light grazing in the 1900s prior to its acquisition by TNC in 1969.

The Forest Service in the Effects Analysis for CHLT in the BA reached the determination that the "*proposed action **may affect but is not likely to adversely affect***," the orchid. The first rationale for determining may affect, not likely to adversely affect, is that "*currently, grazing does not occur in any occupied or potentially occupied habitat for CHLT on the CNF*." This statement is incorrect based on the Falk (1996) report. A patch of flowering CHLT was observed on the CNF in the SW ¼ of the NE ¼ of Section 4, T21S, R18E, below the Canelo Fire Station/Work Center. The site of the observed patch is not inside one of the grazing allotments but, as discussed above, has been grazed within the last decade by horses belonging to either the Forest Service or Border Patrol. Because horses occasionally are corralled within this small pasture, they may trample or consume CHLT. If we use three of the same criteria offered in the BA in the determination of effects for HWU (p. 16) but substituting CHLT for each criterion, we have:

- *Livestock herbivory to individual CHLT in the action area may occur.*
- *Livestock may trample and consume CHLT.*
- *The suitability of CHLT habitat in the action area may be adversely altered by grazing*.

Using these three criteria, the determination of effects for horses grazing at the Canelo Work Center pasture would be **may affect, and is likely to adversely affect**, CHLT.

Pima pineapple cactus (PPC).

I requested recent unpublished PPC monitoring and survey reports from the Forest Service. Given the short amount of time available, the Forest Service was unable to fulfill my request before this report was written.

Beginning in the mid-1990s, I have revisited PPC plants originally located during Forest Service surveys along Duquesne Road on Coronado National Forest and I have located a number of previously undocumented PPC plants between the mid-1990s and the present. From the mid-1990s to the mid-2000s, a dynamic population of about 50 to 100 PPC plants occurred within ¼-mile of Duquesne Road on Coronado National Forest (The area within this ½-mile corridor along Duquesne Road extends from the west half of Section 2 to include Sections 3 and 4, T24S, R15E). By dynamic, I mean that of the observed cohort of PPC plants, some died, additional juveniles and young adults were found, and the population appeared to be persistent in this time interval. My last visit to the Duquesne Road population was on April 1, 2019. At that time, there were two 'original' adults remaining within the two cattle exclosures (from the time the exclosures were built in the mid-1990s or establishing shortly thereafter). Today, one of the adults is vigorous, with a very good rate of vegetative growth and 11 secondary stems produced by the plant. The other adult has a dead apical meristem. It is no longer able to grow or flower. It has no secondary stems. In addition, there are 16 PPC plants within the west cattle exclosure that I seeded using seeds from (then) adjacent plants with fruits that had not naturally dispersed. Of these 16 plants,

three have reached sexual maturity. The two adult and 16 seeded plants are currently the only PPC plants I have seen on Coronado National Forest.

The statement is made in the third paragraph for PPC in the BA, "*There are approximately 100 known PPC on lands managed by the CNF. The majority of the cacti occur on the Sierra Vista RD (Alisos allotment, Huachuca EMA), but a few individuals are on the Nogales RD (Sopori and Proctor allotments, Tumacocori EMA). Most of these plants have been monitored sporadically for the last 5 to 10 years*." I have received copies of the monitoring reports up until ca 2010 from the Forest Service for PPC plants along Duquesne Road. To my knowledge, there are not "approximately 100 known PPC" along Duquesne Road that have been monitored during the last 5 to 10 years. I requested the GPS points for these plants and the PPC plants recently found by the Forest Service during their PPC surveys on the Sopori and Proctor allotments. There has not been enough time for the Forest Service to respond to my request. Unless a large number of plants have been discovered in the last decade, I am inclined to believe there are only two rather than approximately 100 known plants along Duquesne Road. If "two" is closer to the actual number of PPC along Duquesne Road, the "100" is a mischaracterization of the status of this population on Forest land.

I will add some observations relevant to the criteria addressed in the BA under the heading **May Affect, Not Likely to Adversely Affect.**

1. *Livestock grazing in the action area is managed in such a way that livestock herbivory to individual listed plants is not expected*. I agree with James Heitholt statement that herbivory to individual PPC has not been observed on the CNF. I have monitored a large number (several thousand) PPC plants since 1997 in at least 30 sites in Pima and Santa Cruz counties. I have never found evidence of cattle eating PPC. Cattle do eat cholla and prickly pear; in at least some areas and time of year, this observation is easily made. Jackrabbits and collared peccaries eat PPC. I have found many examples of their herbivory on PPC. The examples were found soon after the events, with hoof marks from the peccaries at the sites and gnawing and fecal pellets of *Lepus* at the other sites. In 2018, I recorded a video clip of *Lepus* gnawing on a secondary stem of a PPC. To my knowledge, it is an accurate statement that herbivory by cattle on PPC has not been documented after twenty years of monitoring PPC populations in Arizona.
2. *Livestock grazing in the action area is managed in such a way that trampling of individual listed plants is not expected*. I agree with the Forest Service's added comment that the majority of the known PPC on the CNF are excluded from livestock grazing (ie. they are the two plants that still occur within the two cattle exclosures along Duquesne Road). Of the several thousand PPC plants I have monitored, I have found only one example of a cow dislodging a PPC from the ground. This single event was beside a corral on State Trust land. It was evident from the density of cow hoof prints and their direction when I found the PPC plant upside-down that cattle had been herded in a dense formation ('stampeded'). In that situation, at least some cows could not see the ground to place their hooves. Given the number of PPC that occurred within this same pasture that were not stepped on or trampled by cattle, this singular case of a cow up-rooting a PPC in a stampede, suggests that the cow would have otherwise avoided stepping on the plant. On State Land in the Altar Valley south of Three Points, I have seen PPC plants growing in and immediately beside well-traveled cow paths. In each case, all of the spines and tubercles on the plants were undamaged; the plants were consistently avoided by the cattle. On the Buenos Aires National Wildlife Refuge in 2018, I accidently drove over a late-stage juvenile PPC that was growing on the edge of the dirt road. At another spot in 2018, a vehicle (possibly Border Patrol) drove over another late-stage juvenile PPC. Both plants in April 2019 are healthy and show no

damage from having been driven over with tires, aside from a few crushed spine clusters. The tubercles and the overall appearance of these plants are intact, healthy. Both in the Final Listing and in subsequent Biological Opinions, USFWS has expressed concern that PPC might be trampled and damaged by cows. Based on long-term monitoring of PPC, trampling by cattle is a very rare event and the two observations of no damage by being run over by the tires of vehicles suggests the plants, at least in the late juvenile or early adult stage, may be undamaged by being run-over.

3. *The suitability and sustainability of listed plant habitat will not be adversely altered by livestock grazing, in the action area. … While overgrazing has many negative effects to PPC habitat, low to moderate grazing may aid PPC through the creation of open areas free of competition from non-native grasses and reduced fuels (USFWS 2017); therefore, effects to PPC due to grazing are expected to be insignificant*.

   This is a point that is incorrect in several ways.

   1) The level of prescribed grazing of Lehmann's lovegrass on the Alisos allotment, set at 30-45% (Appendix A of the BA), has been demonstrably set too low for the continued presence of PPC along Duquesne Road. In the 1990s when I visited, I saw that cattle were grazing Lehmanns' lovegrass to within one or two inches of the base of the plants on the ridges in the area. I would estimate the grass utilization at that time to have been greater than 80%. The density of Lehmann's lovegrass (number of plants per meter-squared) was generally low on the ridges. Bare ground several to ten meters-squared were widely distributed across the ridges both in areas now within both enclosures and in at least five other large areas outside of the exclosures but within ¼-mile from Duquesne Road. Each of these sites supported PPC patches. Each and every one of these bare ridge systems is now covered with Lehmann's lovegrass. I met with James Heitholt, Chris Thiel, and Angela Dahlby on April 23, 2019, at the Supervisor's Office of Coronado National Forest. At the meeting, Mr. Heitholt said that Lehmann's lovegrass increased significantly across the rangelands of Coronado National Forest in the late 1990s and early 2000s. For Mr. Heitholt, this observed increase in densities of Lehmann's lovegrass was due in large part to its ability to produce seeds and establish seedlings in the drought. My observations on Duquesne Road match those of Mr. Heitholt - that the density of Lehmann's lovegrass has increased. How it has increased on the ridges along Duquesne Road is where we differ. For Mr. Heitholt, it is due to seedling recruitment. It has to be emphasized here that Mr. Heitholt has no data to support this assertion. Rangeland monitoring on Coronado National Forest uses methodologies that focus on plant biomass (Pace method) or plant composition and general densities. But the monitoring methods do not include observations of demography. Which Lehmann's lovegrass plants have established from seedlings and which plants have established clonally from the jointed nodes of flowering culms bending and rooting is not documented by the Forest Service in their rangeland assessments. Based on my observations from closely inspecting patches of Lehmann's lovegrass on the formerly bare ridges and from pulling Lehmann's lovegrass away from the PPC plants in the cattle exclosures, the majority of Lehmann's lovegrass have established vegetatively, by rooting post-flowering culms, not from seed. This phenomenon can still be measured or described today because the culm connection persists for several years after the plantlet has become established. Walking across patches of Lehmann's lovegrass today along Duquesne Road, there is a pronounced sensation of snagging the rooted culms as you move your feet through this grass. It is clonal spread by Lehmann's lovegrass that has covered the bare ridges in the last 20 years. If cattle grazing had been left at the same previous rate, it is very likely a majority of culms would have been eaten, greatly reducing the rate of establishment of Lehmann's lovegrass on the bare ridges. The

proportion of established Lehmann's lovegrass plants on the ridges that have established from rooting culms compared to those with no evidence of originating from rooting culms can and should be measured at a number of sites along Duquesne Road.

2) PPC fruits are dispersed by jackrabbits. I have recorded dispersal events (1) at about 12 sites and for several plants at each site in the Santa Cruz and Altar valleys in 2007 and again (2) for about 25 plants at multiple sites on the Buenos Aires National Wildlife Refuge in 2018. Jackrabbits at each site are the primary seed dispersers. I have recovered over 150 PPC seeds from jackrabbit dung and greater than 70% of the seeds germinate. The current USFWS Recovery Plan for PPC entirely ignored (my) documents in USFWS files that pertained to these observations. Jackrabbit pellets are consumed by *Gnathamitermes*; the seeds drop into the depression left after the removal of the pellet organic matter by the termites. Seedling establishment of seeds covered by 1 to 2 mm of soil on the clay-rich soils of the ridges along Duquesne Road is remarkably good, perhaps 20 to 40% initially. Jackrabbits prefer to rest (and defecate) on bare ridges. They also show an avoidance of dense, un-grazed or minimally grazed stands of Lehmann's lovegrass, both along Duquesne Road and on the Buenos Aires National Wildlife Refuge. As Lehmann's lovegrass increased during the last 15 years of reduced utilization by cattle along Duquesne Road, the stands have exceeded a threshold of acceptability by the jackrabbits. The jackrabbits have abandoned the ridgelines. In the late 1990s, ridge lines along Duquesne Road had an abundance of jackrabbit pellets. Today, I have searched a majority of these ridgelines, both within the exclosures and along the Duquesne 'corridor' and have found few or no jackrabbit pellets.
3) For PPC to recolonize the ridgelines along this 2-mile length of Duquesne Road within the Alisos allotment, grazing would need to be increased to former levels and sustained for a number of years. James Heitholt on a site visit to the Duquesne Road cattle exclosures on May 19, 2017, with Chris Thiel and me expressed a lively concern for increasing grazing utilization in the pasture along Duquesne Road to the levels seen in the mid-1990s. I do not believe his concern is justified. Gravel lag has stabilized the ridge surfaces in the past and will play a significant role again should Lehmann's be cropped short on the ridgelines. The major problems of erosion within ¼-mile of Duquesne Road arise from Forest dirt roads and wildcat roads that go 'straight up' hills, and water pull outs along Duquesne Road that were created/are maintained by the road grader without any provision for preventing head-cuts developing along the side channels where the water is diverted.
4) In less than 20 years, the Forest Service by its management actions (the construction of two cattle exclosures and the significant reduction of grazing utilization of Lehmann's lovegrass) has essentially extirpated PPC from the Alisos allotment along Duquesne Road. These actions very quickly reduced the amount of bare ground and the visibility and mobility afforded to jackrabbits on formerly well-grazed Lehmann's lovegrass stands. By loss of bare ground and the avoidance of these same areas by jackrabbits, PPC population recruitment stopped and the population is now represented by only two (?) known adult plants along Duquesne Road.

4. *Listed plants will not be physically damaged by livestock management activities.* I agree with the Forest Service's statement regarding its evaluation of potential impacts from range/water developments to PPC on the allotments. I would add one comment, that PPC plants less than about 5 cm are seldom located during a survey for this plant.

To reiterate, based on the long-term monitoring of PPC along Duquesne Road coupled with the recent 10 to 15 years in which low to moderate grazing occurred, this level of grazing **has not aided** "*PPC through the creation of open areas free of competition from non-native grasses and reduced fuels."* Only by not reporting in the BA the PPC population crash along Duquesne Road, the Forest Service has arrived at a glossed conclusion: *"therefore, effects to PPC due to grazing are expected to be insignificant*." **The Duquesne Road population of PPC monitored by the Forest Service has undergone a well-documented crash from about 100 plants to 2 plants today.**

PPC needs patches of bare ground to establish; jackrabbits need the same bare ground as safe areas. These bare areas have been lost to Lehmann's lovegrass between 1995 and 2019. They are no longer bare. To ignore these outcomes and instead to continue to subscribe to low to moderate grazing as something that *may aid PPC* disregards the intent of the Endangered Species Act by the Forest Service and USFWS. Effects to PPC by under-grazing in this specific case have been significant and swift along Duquesne Road**. Properly, this species should have been treated in the Species Evaluations, not in Appendix D.** The grazing program by CNF has indeed affected, and has adversely affect PPC along Duquesne Road because of insufficient forage utilization where Lehmann's lovegrass dominates.

A few final comments concerning these three species in the BA.

- The text for these three plants in the BA is written as if there is 'take' or harm to plants. My understanding is that the Endangered Species Act reserves 'take' for animals only. I was unable in the amount of time after my request to the Forest Service to obtain a copy of the "streamlined" guidance that the USFWS has required the Forest Service to use in developing their BAs. I do not know if the current guidance document addresses the issue of 'take' as it has been applied in the BA to plants. It is strange to arrive at a **may affect, likely to adversely affect** decision if cattle steps on a clonal mat of HWU when the mat is clonal, not made up of a set of independent genets.
- The BA, in considering whether an action **may affect**, is ignoring effects to population performance, demography, or life-history of the plants involved. This is brought home most clearly in the case of PPC. In order for PPC to persist along Duquesne Road, the Forest Service and USFWS must come to the realization that high, sustained forage utilization of Lehmann's lovegrass by cattle in this pasture (within the Alisos allotment) is the only way to set up conditions for recolonization of the ridges by PPC. Regarding the BA's determination of **may affect, not likely to adversely affect**, for PPC, I would strongly suggest the Forest Service move the section they have written for PPC out of Appendix D and into the Species Evaluations for Plants. The current and proposed levels of grazing utilization on the Alisos allotment within ¼-mile from Duquesne Road represents a level that demonstrably **has affected, has certainly adversely affected** the population of this PPC (the *Second Consideration) . The Forest Service staff (from what I learned during the April 23rd meeting) indicated that considerations of effects on populations would be assigned to species recovery and as such would not be included in a biological assessment. However, in an on-line February 6, 2019 Guidance for Preparing a Biological Assessment, issued by the USFWS Field Office for the Upper Midwest Ecological Services, the agency asks that the population status and trend be included in the document, if known. This appears to refer to the population status within the action area, not for the species as a whole.
- Increased transparency is important for an endangered species, even when that species occurs only or largely on private land. That CHLT has not been seen for over 15 years on the TNC

Preserve and has not been seen for years on the Babocomari and San Rafael ranches can be easily stated. That update would likely have resulted in the text not including the description of mowing on the TNC Preserve as if it were part of an active management program for an extant population (or at least would have cast mowing as largely aspirational at this point in time).

- For the HWU, the BA would have been a stronger document if it clearly separated the threats outlined for HWU along the San Pedro River and other alluvial systems from considered threats in the bedrock channels on the west side of the Huachuca Mountains. Bedrock channels that have all of the hallmarks of repeat scouring by flood events are really quite different systems with very different (and largely undescribed) elements from those systems elsewhere in Arizona where HWU occurs.