Toward Holism: Aligning the Science and Policy of Recovery Planning for the Endemic Fishes in the Upper Colorado River Basin

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The Colorado River is the dominant river of the southwestern United States. It stretches 1,400 miles from the Rocky Mountains to Mexico, and its flows vary considerably from year to year. Historically, the U.S. Bureau of Reclamation ("Bureau") built dams and reservoirs to assure reliable flows and fulfill legal obligations. This man-made infrastructure permanently transformed the River during the twentieth century. In contemporary times, climate change threatens river temperatures and flows. In concert, these threats impede the recovery of four fish species native to the Upper Basin of the Colorado River protected by the Endangered Species Act ("ESA"): the Colorado Pikeminnow, the Humpback Chub, the Bonytail Chub, and the Razorback Sucker. The U.S. Fish and Wildlife Service ("FWS") is the federal agency responsible for recovery planning in the Upper Basin. Critiques of the FWS recovery planning methodology are common and include failing to accomplish recovery in a timely fashion, becoming quickly outdated and, therefore, irrelevant; overlooking statutory mandates; and document inconsistency. Noting these problems, the FWS recently revised its recovery planning methodology. The FWS has not yet finalized a recovery plan under the revised methods for the endemic fishes in the Upper Basin. This article looks to a case study – the recovery planning process for the Humpback Chub – and, through careful analysis, offers recommendations for revised recovery plans for the ESA-protected fishes in the Upper Basin.

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I. INTRODUCTION

The Colorado River, "[d]espite its relatively modest water production, . . . is by far the dominant river of the southwestern part of the United States."[1] It provides municipal and industrial water for forty-million people across every major southwestern city within and adjacent to the Colorado River Basin.[2] With its headwaters in the Rocky Mountains of Colorado and its delta in the Gulf of

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[1] Lawrence J. MacDonnell, *Colorado River Basin*, 5 WATERS AND WATER RIGHTS 5, 5–16 (2009).

[2] Bradley Udall & Jonathan Overpeck, *The Twenty-First Century Colorado River Hot Drought and Implications for the Future*, 53 WATER RESOURCES RESEARCH 2404, 2405 (2017) (identifying cities supplied with water, which include Los Angeles, San Diego, Las Vegas, Phoenix, Tucson, Salt Lake City, Cheyenne, Denver, Albuquerque, and Santa Fe).

California in Mexico, the Colorado River stretches more than 1,400 miles.[3] In 2015, the River yielded an average annual flow of fourteen million acre-feet (maf) per year.[4] The Colorado's flow varies significantly from year to year; thus, the U.S. Bureau of Reclamation ("Bureau") built dams and reservoirs to ensure reliable water supply to end-users and fulfill compact and treaty obligations.[5] Without the Bureau's heavy influence, the Colorado River Basin would not have become the "cradle of [western] civilization" that it is today.[6]

The "Law of the River" is an ever-evolving collection of apportionments and obligations that legally designates rights to Colorado's water; the collection reflects a culmination of nearly a century's worth of time and effort.[7] The Law of the River today looks very different from the law in effect when infrastructure development first began in the Colorado Basin.[8] In addition, the Law of the River is made even more complex by the overlay of more recent environmental laws – such as the Endangered Species Act ("ESA")[9] – that were passed after a significant number of allocations and water development projects had been put into place within the Basin. For instance, under the ESA, section 7 now requires consultation to ensure a proposed water infrastructure development project will not jeopardize an ESA-protected species or adversely affect its critical habitat.[10] For this reason, if any of the historical water diversion projects in the Colorado River Basin were proposed today, their development would be guided, and perhaps constrained, by federal laws that require, at minimum, consideration of the potential impacts of the water development project on ESA-protected species.[11]

The construction of the system of reservoirs and dams throughout the Colorado River Basin "permanently altered the physical characteristics of the river and its tributaries."[12] This led to "perhaps the most dominant issue in the basin today", the protection of the four ESA-protected fish species that are endemic to the River: the Colorado Pikeminnow (*Ptychocheilus lucius*), formerly known as the Colorado Squawfish; the Humpback Chub (*Gila cypha*); the Bonytail Chub (*Gila elegans*); and the Razorback Sucker (*Xyrauchen texanus*).[13] The ESA gave federal protection to these fish species in 1973. It was

3 MacDonnell, *supra* note 1, at 5–16.

4 U.S. DEPT. OF INTERIOR, *Drought in the Colorado River Basin*, (follow tab "5" and see graph), https://www.doi.gov/water/owdi.cr.drought/en/ (last visited Apr. 2, 2019).

5 MacDonnell, *supra* note 1, at 6 (citing U.S. DEPARTMENT OF THE INTERIOR, QUALITY OF WATER, COLORADO RIVER BASIN PROGRESS REPORT NO. 16, 6 (1993); in 20th century, the recorded range was from less than 6 maf to more than 20 maf in one year).

6 MacDonnell, *supra* note 1, at 6.

7 *Id.* at 13–14.

8 *Id.* at 1.

9 *See* 16 U.S.C. §§ 1531 et seq. (1973).

10 16 U.S.C. § 1536(a)(2) (2017).

11 *See generally* National Environmental Policy Act of 1970 (42 U.S.C. §§ 4371 et seq.) and Endangered Species Act of 1973, as amended (16 U.S.C. §§ 1531 et seq.).

12 MacDonnell, *supra* note 1, at 39.

13 *Id.* at 36.

clear that the goals of water development and fish recovery could conflict; thus, the Upper Colorado River Endangered Fish Recovery Program ("Recovery Program") was established with the purpose of managing the issue in a collaborative, rather than combative, manner.[14] To avoid setting the ESA and the Law of the River in opposition, the Recovery Program embraces dual goals of accomplishing ESA recovery of the four protected fish species in the Upper Colorado River Basin[15] (hereafter Upper Basin), while supporting water development in accordance with federal, state, and tribal law.[16]

Studies document that rivers with reduced flow may see "up to 75% . . . of local fish biodiversity . . . headed toward extinction by 2070" due to changes caused by climate and water consumption.[17] Historically, recovery planning did not consider climate-change impacts on endemic fish species in the Upper Basin.[18] This is likely attributed to the fact that historic droughts occurred intermittently from 1900-2000 and were associated with a lack of precipitation.[19] However, the current twenty-first century drought is considered "unprecedented" because it is dominated by high temperatures that have led to "anomalously dry conditions."[20] Climate changes that are induced by human activity[21] impact the temperature and hydrology of the Upper Basin and, thus, the ecosystems of fishes in Upper Basin tributaries.[22] The storage capacity of the reservoirs of the Colorado River Basin is roughly four times the average annual flow of the river at Lee Ferry – the dividing line between the Upper and Lower Basins[23] – which *can* be a buffer for flow shortages, but not when perpetual drought threatens the basin due to a changing climate.[24]

Scientists no longer accept the theory that the variability of flows within a river system will remain within a historic range (or, "stationarity");

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14 UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM, http://www.coloradoriverrecovery.org/ (last visited Apr. 13, 2019); SAN JUAN RIVER BASIN RECOVERY IMPLEMENTATION PROGRAM, https://www.fws.gov/southwest/sjrip/GB_GOP.cfm (last visited May 5, 2019) (the Upper Colorado River Endangered Fish Recovery Program is responsible for the recovery of the four ESA-protected fish species in the Green and the Upper Colorado Rivers, while the San Juan River Basin Recovery Implementation Program is responsible for recovery of ESA-protected fish species in the San Juan River, which is technically still part of the Upper Basin (according to the Colorado River Compact). This article focusses only on the Upper Colorado River Endangered Fish Recovery Program, and not the San Juan River Basin Recovery Implementation Program).

15 See *infra* notes 40 and 41 (defining Upper and Lower Basin, respectively).

16 MacDonnell, *supra* note 1, at 39–40; UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM, *supra* note 14.

17 Marguerite A. Xenopoulos et al., *Scenarios of Freshwater Fish Extinctions from Climate-Change and Water Withdrawal*, 11 GLOBAL CHANGE BIOLOGY 1557, 1557 (2005).

18 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB RECOVERY PLAN (1990) https://www.fws.gov/southwest/es/arizona/Documents/RecoveryPlans/Humpback_Chub_1990.pdf.

19 Udall & Overpeck, *supra* note 2, at 2408.

20 *Id*.

21 Or, anthropogenic climate change. *See infra* note 25, defining "anthropogenic".

22 Udall & Overpeck, *supra* note 2, at 2408.

23 *Infra* notes 40 and 41.

24 Udall & Overpeck, *supra* note 2, at 2408.

contemporary anthropogenic[25] climate change has increased temperatures and decreased flows in the Colorado River Basin such that future flows are likely to be beyond the range of historic variability.[26] While conservation efforts in rivers that are flow-regulated attempt to balance water needs for both humans and threatened species, it is challenging "because over-allocation of freshwater resources continues to drive water scarcity" and threatens water security and biodiversity.[27] Because climate-change impacts to flow and temperature in the Colorado River Basin are likely to affect fish recovery under the ESA into the future, climate change must be explicitly incorporated into future recovery planning.[28]

The recovery planning process adds to the challenges climate change presents to recovering ESA-protected fishes in the Upper Basin.[29] Critics contend recovery plans take years to create, are static documents that are quickly outdated, and are not easily amendable.[30] Recovery plans are also not legally binding, which means that the U.S. Fish and Wildlife Service ("FWS") is not required to follow the criteria, actions, or time and cost estimates in recovery plans.[31] Furthermore, scientists typically prefer a level of flexibility and adaptability in recovery planning to account for regularly evolving data, while policy planners and decision-makers typically prefer static recovery actions and statistics that, once accomplished, confirm a species' recovery.[32] As a result of

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25 "Anthropogenic", as used here, refers to climate changes caused by human activity. DONALD J. WUEBBLES ET AL., EXECUTIVE SUMMARY In: CLIMATE SCIENCE SPECIAL REPORT: FOURTH NATIONAL CLIMATE ASSESSMENT 1, 12–34 (2017), https://science2017.globalchange.gov /chapter/executive-summary/ ("This report concludes that 'it is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century.' . . . The global, long-term, and unambiguous warming trend has continued during recent years. Since the last National Climate Assessment was published, 2014 became the warmest year on record globally; 2015 surpassed 2014 by a wide margin; and 2016 surpassed 2015. Sixteen of the warmest years on record for the globe occurred in the last 17 years (1998 was the exception).").

26 P.C.D. Milly et al., *Stationarity is Dead: Whither Water Management*, 319 SCI. 573, 573. (2008).

27 J. S. Kominoski et al., *Patterns and Drivers of Fish Extirpations in Rivers of the American Southwest and Southeast*, 24 GLOB CHANGE BIOL. 1175, 1175–85 (2018); Olden et al., *Are Large-scale Flow Experiments Informing the Science and Management of Freshwater Ecosystems?* FRONTIERS IN ECOLOGY AND THE ENV'T 12, 176–85 (2014); Dudgeon et al., *Freshwater Biodiversity: Importance, Threats, Status and Conservation Challenges*, BIOLOGICAL REVIEWS 81, 163–82 (2006); Vörösmarty, et al., *Global Threats to Human Water Security and River Biodiversity*, NATURE 467, 555–61 (2010)).

28 U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB 195–205 (2017), https://www.fws.gov/mountainprairie/pressrel/2018/HumpbackChub_ SSA_Final_19Mar2018 _wAppendixB&C.pdf.

29 David R. Smith et al., *Development of a Species Status Assessment Process for Decisions Under the U.S. Endangered Species Act*, 9 J. OF FISH & WILDLIFE MGMT 1, 302–20; U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLANNING AND IMPLEMENTATION (2017), https://www.fws.gov/ endangered/esa-library/pdf/RPI-Feb2017.pdf.

30 Smith et al., *supra* note 29.

31 Friends of Blackwater v. Salazar, 691 F.3d 428, 433–36 (D.C. Cir. 2012); Cascadia Wildlands v. Bureau of Indian Affairs, 801 F.3d 1105, 1114 (9th Cir. 2015).

32 E-Mail from Kevin McAbee, Deputy Director, Upper Colorado River Endangered Fish

the complications experienced during the recovery planning process, the FWS recently revised its recovery planning methodology.[33]

This article advocates for holistic recovery planning for the four ESA-protected fishes in the Upper Basin. Holistic recovery planning focusses on aligning the scientific and policy mechanisms used in recovery planning to achieve greater functionality. To begin, Part II reviews the development of the applicable law relevant to the ESA-protected fishes in the Upper Basin. Then, Part III assesses climate-change impacts in the Upper Basin that affect the temperature, hydrology, and ESA-protected fishes. Following this assessment, Part IV looks to a case study – the historic and present-day recovery planning process for the Humpback Chub. This Part evaluates the recovery planning process and closes with a prescription to align the policy and scientific recovery planning instruments for the four ESA-protected fishes in the Upper Basin. There are comparable deficiencies in recovery planning for the other three ESA-protected fish in the Upper Basin; thus, this article suggests the same prescription for the Bonytail Chub, the Razerback Sucker, and the Colorado Pikeminnow.[34]

II. THE STORY OF THE UPPER COLORADO RIVER BASIN

To humans, the Colorado River and its tributaries primarily provide water, and disputes largely concern ownership and use.[35] But to the endemic fishes that live in the Colorado River System, existence as a species is contingent on an adequate availability of this water.[36] In an effort to share amongst all users, the water provided by the Colorado River System is the object of legal doctrines and agreements, national and international policies, environmental regulations, and programs.[37] These legal mechanisms are collectively referred to as the Law of the River, which is a doctrine that attempts to achieve equilibrium amongst users, nations, species, and ecosystems.[38]

Recovery Program, (January 28, 2019, 01:27 PST).

33 Smith et al., *supra* note 29.

34 *See* U.S. FISH AND WILDLIFE SERVICE, BONYTAIL CHUB RECOVERY GOALS (2002), https://www.fws.gov/southwest/es/arizona/Documents/SpeciesDocs/Bonytail_Chub/Bonytail-August-02.pdf; U.S. FISH AND WILDLIFE SERVICE, BONYTAIL CHUB RECOVERY PLAN (1990), https://www.fws.gov/southwest/es/Documents/R2ES/BonytailChub.pdf; U.S. FISH AND WILDLIFE SERVICE, RAZORBACK SUCKER RECOVERY GOALS (2002), https://www.fws.gov/southwest/sjrip/pdf/DOC_Recovery_Goals_Razorback_sucker_2002.pdf; U.S. FISH AND WILDLIFE SERVICE, RAZORBACK SUCKER RECOVERY PLAN (1998), https://www.fws.gov/southwest/es/arizona/Documents/RecoveryPlans/Razorback_Sucker_98.pdf; U.S. FISH AND WILDLIFE SERVICE, COLORADO PIKEMINNOW RECOVERY GOALS (2002), https://www.fws.gov/southwest/sjrip/pdf/DOC_Recovery_Goals_Colorado_pikeminnow_2002.pdf; U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLANNING AND IMPLEMENTATION, *supra* note 29; 16 U.S.C. § 1533(f)(1)(B) (2017).

35 MacDonnell, *supra* note 1.

36 U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB (2017) *supra* note 28.

37 MacDonnell, *supra* note 1, at 1.

38 *Id*.

A. *The "Law of the River"*

The Law of the River was initiated by the Colorado River Compact negotiations in 1922.[39] Under the Colorado River Compact, the Colorado River Basin is divided into the Upper and Lower Basin[40] at Lee Ferry, Arizona (near Glen Canyon Dam).[41] Compact negotiations, which were instigated to a significant extent by California's need to develop irrigation and guarantee water supply to the Imperial Valley, endeavored to ensure water to the more slowly developing headwater states in the Upper Basin.[42] Interestingly, and today, problematically, drafters of the Compact based apportionment amounts on estimates of the Colorado River's flow that were calculated using one of the wettest periods in the last 450 years;[43] therefore, the Compact allocates a total amount of water that is rarely supplied.[44] Complicating matters, the Upper Basin has not yet used its full apportionment of water because its population has grown more slowly compared to the Lower Basin; thus, much of the Upper Basin's water still flows to the Lower Basin.[45]

After the Colorado River Compact was negotiated in 1922, the Lower Basin began building infrastructure for storage and use of its allocated water rights.[46] In 1946, the Bureau requested that the Upper Basin states clarify their respective entitlements of water so storage projects could also be developed in

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[39] Colorado River Compact, 1923 Colo. Sess. Laws 648, COLO. REV. STAT. § 37-61-101 (Articles II, III(a) & III(b), and IV).

[40] *Id.* (defining the Upper Basin as the parts of the states of Arizona, Colorado, New Mexico, Utah, and Wyoming from which waters naturally drain into the Colorado River System above Lee Ferry as well as areas beneficially served within these states by water diverted above Lee Ferry).

[41] Colo. Rev. Stat. § 37-61-101, Article II(g) (2016) (defining the Lower Basin as the parts of the states of Arizona, California, Nevada, New Mexico, and Utah from which waters naturally drain into the Colorado River System below Lee Ferry and as well as areas beneficially served within these states by water diverted below Lee Ferry. Each basin is given an apportionment of 7.5 million acre feet of water per year, with the Lower Basin permitted an additional 1 million acre feet for consumptive use. The Compact also contemplated an agreement with Mexico, whereby it would deliver treaty flows (surplus or otherwise) to the country.

[42] MacDonnell, *supra* note 1, at 14–15.

[43] Udall & Overpeck, *supra* note 2, at 2407 (citing C. A. Woodhouse, S. T. Gray, and D. M. Meko, *Updated Streamflow Reconstructions for the Upper Colorado River Basin*, 42 WATER RESOUR. RES. W05415, (2006), "The highest sustained flows in the entire record, 1520 to 1961, occurred in the early decades of the 20th century, a period that coincides with the negotiation of the 1922 Colorado River Compact and the resulting allocation of Colorado River flows. In effect, *water that was not likely to be in the river on a consistent basis was divided among the basin states*").

[44] *Id.*

[45] *See* MacDonnell supra note 1, at 17, 23–25; See also Colorado River Compact, supra note 39, at Article III(d) (The Colorado Compact imposes a hierarchical delineation of water uses. It places urban and agricultural uses above hydroelectric power generation, and hydroelectric power above navigation, but without impacting "present perfected rights" or Native American water rights. Article III(d) prevents the States of the Upper Division from depleting flows of the river at Lee Ferry below an aggregate of 75,000,000 maf for any period of ten consecutive years. It also prevents the Upper Basin from withholding water not used for domestic or agricultural purposes).

[46] MacDonnell, *supra* note 1, at 19.

the Upper Basin.[47] The Upper Basin states – Wyoming, Colorado, Utah, and New Mexico – negotiated and ratified the Upper Colorado River Compact in 1949.[48] This Compact proportionally divides the Upper Basin allocation into water apportionments for each state, and provides Arizona with 50,000 acre-feet per year to account for a small portion of Arizona falling within the Upper Basin.[49] In 1956, Congress passed the Colorado River Storage Project Act, which assured delivery of the Lower Basin's apportionment by planning for several mainstem Colorado River dams – dams that would also generate hydropower.[50] This Act sparked controversy from environmentalists[51] as the American public became increasingly aware of the "battles over the Bureau of Reclamation's proposed siting . . . dams in or adjacent to national parks in the Colorado River Basin."[52] Twelve years later, the Colorado River Basin Project Act of 1968 added five more projects that facilitated consumptive water use in the Upper Basin.[53]

B. *Changes in the Upper Colorado River Basin due to Infrastructure*

The dams and reservoirs constructed to support the development of Colorado Compact apportionments created ecological consequences throughout the Colorado River system and:

> [P]ermanently altered the physical characteristics of the Colorado River and many of its tributaries. The dams capture peak flows, greatly reducing seasonal inundation of riparian areas and changing the free-flowing nature of the river by creating a series of lake-like environments. As the flowing water moves into impoundments, sediments in the water fall out. Releases from the on-stream reservoirs are much clearer water – coming from the deeper strata in the reservoirs where the water is not warmed by exposure to the sun.[54]

47 *Id.*

48 *Id.*

49 *Id.* (Arizona was given fifty-thousand acre feet per year because a strip of the state is in the Upper Basin, and the four Upper Basin states were given allocations in percentages: Wyoming was given 14%, Colorado 51.75%, Utah 23%, and New Mexico 11.25%).

50 *Id.* at 19.

51 J. Robison et al., *Challenge and Response in the Colorado River Basin*, 16 WATER POL'Y 12–57, 19 (2014) (citing MARK W.T. HARVEY, A SYMBOL OF WILDERNESS: ECHO PARK AND THE AMERICAN CONSERVATION MOVEMENT (1994); Russell Martin(1999) A STORY THAT STANDS LIKE A DAM: GLEN CANYON AND THE STRUGGLE FOR THE SOUL OF THE WEST (1999)).

52 Robison, *supra* note 51.

53 MacDonnell, *supra* note 1, at 20 (The Act also amended the Colorado River Storage Project Act by setting long-range operation criteria for Glen Canyon and Hoover dams. Specifically, releases from Glen Canyon Dam would be made first to supply the Upper Basin's obligation to Mexico, and second for Upper Basin releases to meet the obligated 75 million acre feet in consecutive 10-year periods to the Lower Basin. After these releases, the Secretary of the Interior received instruction to balance potential additional downstream deliveries against risks to existing consumptive uses in the Upper Basin).

54 *Id.* at 38.

As early as the 1920s, dam development in the Lower Basin altered aquatic ecosystems with lasting effects; dam development extirpated the Colorado Pikeminnow in the area.[55] While in the 1960s unaltered portions of the Upper Basin contained populations of the four fish species,[56] today "two of eight documented populations of Humpback Chub are extirpated because of the construction of the Flaming Gorge (Hideout Canyon) and Hoover dams (Black Canyon)."[57]

"Aquatic habitat degradation resulting from anthropogenic disturbances [e.g., dam development] is a major source of freshwater biodiversity loss globally [and contributes] to population declines in imperiled fishes."[58] Dams are known to cause a variety of "effects on streams, inducing localized changes that alter the continuum of stream temperature, water chemistry, energy, and sediment . . . as well as . . . landscape-scale influences including stream network connectivity loss and system-wide changes in flow and temperature regimes".[59] Frequently, these localized and landscape-scale disturbances occur "in concert," and may cause cumulative effects to aquatic habitats.[60] Dam-induced flow modifications also alter physical habitats in riverine landscapes and disrupt biologic events of organisms that are triggered by flow events (e.g., spring floods).[61] These infrastructure changes create conditions that can impede survival of endemic big-river fishes,[62] which is compounded by the fact that freshwater ecosystems are extremely sensitive to changes in temperature and hydrology caused by climate change.[63]

If any of the past Colorado River development projects were proposed present-day, at minimum, an ESA section 7 consultation would need to be conducted.[64] Because many environmental laws were enacted before development in the basin, correcting the environmental impacts of historic

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55 *Id*. at 38–39.

56 *Id*. at 39 (citing FISH AND WILDLIFE SERVICE REGION SIX, U.S. DEPARTMENT OF THE INTERIOR, RECOVERY IMPLEMENTATION PROGRAM FROM ENDANGERED FISH SPECIES IN THE UPPER COLORADO RIVER BASIN (1993)).

57 U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB, *supra* note 28, at vi.

58 Arthur Cooper et al., *Assessment of Dam Effects on Streams and Fish Assemblages of the Conterminous USA*, 586 SCI. TOTAL ENV'T 879, 979–80 (2017).

59 Arthur Cooper et al., *supra* note 58, at 11–12 (citing Nilsson et al., *Fragmentation and Flow Regulation of the World's Large River Systems*, SCI. 308, 405–08 (2005)).

60 *Id*. (citing Degerman et al., *Classification and Assessment of Degradation in European Running Waters* 14 FISH. MGMT. ECOLOGY 417, 417–26 (2007); Schinegger et al., *Multiple Human Pressures and their Spatial Patterns in European Running Waters*, WATER ENVIRON. J. 26, 261–73 (2012)).

61 Cooper et al., *supra* note 58, at 11–12 (citing N. L. Poff et al., *The Natural Flow Regime: A Paradigm for River Conservation and Restoration*, 47 BIOSCIENCE, 769–84 (1997)).

62 *Id*.

63 Marguerite A. Xenopoulos et al., *supra* note 17, at 1562.

64 16 U.S.C. § 1536(a) (2017) (requiring federal agencies to consider whether the agency authorizing, funding, or carrying out the action jeopardizes species and adversely modifies habitat).

developments might now be accomplished through section 4 of the ESA by developing and implementing species recovery plans.[65]

C. *The Endangered Species Act & the Recovery Planning Process*

In the 1960s and 1970s, an environmental movement proliferated in the United States. In 1973, Congress passed the ESA almost unanimously and President Nixon later signed the Act into law, demonstrating the broad support for the environmental movement of the time.[66] Some credit the ESA with causing a "far-reaching" effect on water management in the Upper Basin due to the obligations it places on parties to protect the four endangered fish species.[67]

The ESA has a conservation goal "to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved and . . . a program for the conservation of such endangered . . . and threatened species."[68] It integrates three main regulatory components to accomplish this goal: (1) listing species as endangered or threatened, designating critical habitat,[69] and developing and implementing recovery plans (under ESA section 4); (2) requiring federal agencies to consider, through interagency consultation duties, whether the agency authorizing, funding, or carrying out its action will jeopardize species and adversely modify habitat (under ESA section 7);[70] and (3) forbidding certain actions that impact endangered and threatened species (also called the "take[71] prohibition" under ESA section 9).[72] Notably, the

65 16 U.S.C. § 1533(f) (2017).

66 The Endangered Species Act of 1973, US HOUSE OF REPRESENTATIVES: HISTORY, ART & ARCHIVES, https://history.house.gov/HistoricalHighlight/Detail/35155 (last visited Apr. 8, 2019).

67 MacDonnell, *supra* note 1, at 25 (citing Pub. L. No. 93-25, 87 Stat. 884 (1973) (codified at 16 U.S.C. § 1531 (1988)); 50 C.F.R. § 17.11.

68 16 U.S.C. § 1531(b) (2017).

69 16 U.S.C. § 1532(5)(A) (defining the term "critical habitat" for a threatened or endangered species as (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).

70 16 U.S.C. § 1536(a)(2) (stating that each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency (hereinafter in this section referred to as an "agency action") is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with affected States, to be critical, unless such agency has been granted an exemption for such action by the Committee pursuant to subsection (h) of this section. In fulfilling the requirements of this paragraph each agency shall use the best scientific and commercial data available).

71 16 U.S.C. § 1532(19) (defining "take" as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct).

72 16 U.S.C. § 1538 (2017).

FWS is the governmental agency responsible for implementing the ESA, including recovery planning, for terrestrial and aquatic species.[73]

This article focusses on the actions described under ESA section 4: Listing species as endangered or threatened, designating critical habitat, and implementing recovery plans.[74] Under section 4, a species may be classified as endangered or threatened.[75] The difference between threatened and endangered species is largely temporal: "Endangered" species are those that are in danger of extinction throughout all or a significant portion of their range, while "threatened" species are those that are likely to become endangered in the foreseeable future.[76] Section 4(c)(2)(B)(iii) of the ESA governs listing determinations. Under this section, the process for initially listing a species, changing a species' designation (e.g., downlisting from endangered to threatened), and delisting a species must follow sections 4(a)(1) and (b).[77] Section 4(a)(1) requires that the determination whether any species is an endangered species or a threatened species be based on any of the following "listing" factors:

> (A) the present or threatened destruction, modification, or curtailment of its habitat or range;
>
> (B) overutilization for commercial, recreational, scientific, or educational purposes;
>
> (C) disease or predation;
>
> (D) the inadequacy of existing regulatory mechanisms; or
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> (E) other natural or manmade factors affecting its continued existence.[78]

Section 4(b) requires that this determination is founded "solely on the basis of the best scientific and commercial data available . . . after conducting a review of the status of the species and after taking into account those efforts, . . . made . . . to protect such species."[79] Under section 4(a)(3)(A), critical habitat must be designated concurrently with a species classification.[80] The designation of critical habitat must be made on "the basis of the best scientific data available

[73] 16 U.S.C. § 1531 et seq.; *See also* NOAA Fisheries, Endangered Species Conservation, https://www.fisheries.noaa.gov/topic/endangered-species-conservation (last visited Apr. 6, 2019) (stating the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) is responsible for implementing the ESA for marine species).

[74] 16 U.S.C. § 1533 (2017).

[75] 16 U.S.C. § 1533(a).

[76] 16 U.S.C. § 1532(6) and (20); *See* Tennessee Valley Auth. (TVA) v. Hill, 437 U.S. 153 (1978) (explaining that as a legal matter, the economic concerns of listing a species may not influence decisions whether to list the species but *may* be considered in the decision whether to designate a geographical area as critical habitat).

[77] 16 U.S.C. § 1533(c)(2)(B)(iii).

[78] 16 U.S.C. § 1533(a)(1).

[79] 16 U.S.C. § 1533(b).

[80] 16 U.S.C. § 1533(a)(3)(A).

and after taking into consideration the economic impact, the impact on national security, and any other relevant impact" under section 4(b)(2).[81]

After a species is classified, a recovery plan is executed for the species unless "such a plan will not promote the conservation of the species."[82] Section 4(f)(1)(B)(i-iii) requires that recovery plans include:

> (i) a description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species;
>
> (ii) objective, measurable criteria which, when met, would result in a determination, in accordance with the provisions of this section, that the species be removed from the list; and
>
> (iii) estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal.[83]

Additionally, section 4(c)(2) of the ESA requires that the FWS conduct a review of all listed species "at least once every five years" to determine whether each species should "(i) be removed from such list; (ii) be changed in status from an endangered species to a threatened species; or (iii) be changed in status from a threatened species to an endangered species."[84] Section 4(c)(2)'s purpose is to assess each threatened and endangered species to determine whether its status has changed since the time of its listing, or its last status review, and whether it should be classified differently or removed from the list of threatened and endangered species.[85] Under this section, a list of all of the species classified as endangered and threatened must be published in the Federal Register with revisions made occasionally to reflect recent re-classification determinations.[86]

After the ESA was passed in 1973, the FWS determined that depleting flows of water in the Upper Basin any more than then-current conditions would place the existence of the four endemic Colorado River fish species in jeopardy.[87] In particular, the FWS determined that water depletions reduced the sediment transport capacity of the river; reduced flexibility to manage stream flows; reduced quantity and quality of habitats used for migration, spawning, and rearing young; and created river habitats favoring non-native fishes that compete with, or prey upon, endangered fishes.[88] Because of the adverse effects

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81 16 U.S.C. § 1533(b)(2).

82 16 U.S.C. § 1533(f)(1).

83 16 U.S.C. § 1533(f)(1)(B)(i–iii).

84 16 U.S.C. § 1533(c)(2).

85 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB 5-YEAR REVIEW 1 (2011), https://ecos.fws.gov/docs/five_year_review/doc4355.pdf.

86 16 U.S.C. § 1533(c)(1).

87 MacDonnell, *supra* note 1, at 39.

88 *Id.* (citing Richard S. Wydoski & John Hamill, *Evolution of a Cooperative Recovery Program for Endangered Fish in the Upper Colorado River Basin*, BATTLE AGAINST EXTINCTION,

of water depletions on the four ESA-protected fish species, in 1977 the FWS issued "jeopardy" Biological Opinions for any new water project in the Upper Basin.[89] The FWS suggested "reasonable and prudent alternatives" such as offsetting water depletions using existing storage or contributing monetary support to the recovery program in exchange for depleting water.[90] "Additional efforts by the FWS to establish minimum flow requirements for the fishes led to the formation in 1984 of a federal-state coordinating committee" that was charged with developing a recovery program to ensure reasonable and prudent alternatives for projects undergoing section 7 consultation in the Upper Basin; eventually this committee was designated as the Upper Colorado River Endangered Fish Recovery Program.[91]

D. *The Upper Colorado River Endangered Fish Recovery Program*

In 1988, the Governors of Colorado, Utah, and Wyoming, the Secretary of the Interior, and the Administrator of the Western Area Power Administration signed a cooperative agreement establishing the Recovery Program.[92] Crucial to its functionality, the Recovery Program is a partnership of diverse interests who work together to recover the four ESA-protected fish species in the Upper Basin, and pursue water development projects in accordance with the Law of the River.[93] Partners are grateful for inclusion in the Recovery Program because it offers an opportunity for collaborative water resource planning, especially due to the recent population boom in the Intermountain West.[94] The Recovery Program undertakes recovery actions for the endangered fishes through the general recovery elements of restoring and managing stream flows and habitat, boosting wild populations with hatchery-raised fish, and reducing negative interactions with non-native fish species to ultimately achieve wild self-sustaining populations of ESA-protected fish such that, ultimately, they no longer require protection under the ESA.[95]

NATIVE FISH MANAGEMENT IN THE AMERICAN WEST 124–25 (W. L. Minckley ed., 1991)).

89 MacDonnell, *supra* note 1, at 39.

90 *Id.* at 39–40.

91 *Id.* at 40.

92 UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM, *supra* note 14.

93 *Id.*

94 Telephone Interview with Steve Wolff, Management Committee Chair, Wyoming Partner Upper Colorado River Endangered Fish Recovery Program (Mar. 30, 2018) (explaining partners include representatives for *state interests* in wildlife, water law, and economic development in Colorado, Utah, and Wyoming; *federal water management interests*: the Bureau of Reclamation; *private water interests*: Colorado Water Congress, Utah Water Users Association, and Wyoming Water; *power and hydropower interests*: Colorado River Energy Distributors Association, and Western Area Power Administration; *federal multi-use lands interests*: National Park Service; *environmental stewardship interests*: The Nature Conservancy and Western Resource Advocates; and finally, the U.S. Fish and Wildlife service to ensure the ESA is implemented correctly).

95 UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM, *supra* note 14.

"The Recovery Program provides ESA compliance [under section 7] for continued operation of federal water and power projects . . . ."[96] This is accomplished via an annual review that determines if the Recovery Program is making "sufficient progress" towards recovery of the four listed fish species.[97] Under the sufficient progress review, the FWS determines whether the Recovery Program should continue serving as the mechanism to avoid the likelihood of jeopardy resulting from depletion impacts of historical and new projects.[98]

In order to guide the specific recovery actions that should be undertaken by stakeholders in the Recovery Program, the Recovery Implementation Program Recovery Action Plan ("RIPRAP") was developed by the Recovery Program in 1993.[99] The RIPRAP is a tool used by the FWS to determine whether the Recovery Program should continue to serve as a reasonable and prudent alternative for projects undergoing section 7 consultation in the Upper Basin.[100] It is an adaptive management instrument that provides specific actions and ideal time frames for recovery of ESA-protected fishes using the best, most current information for each species.[101]

Despite existing Recovery Program policies, climate change creates additional challenges to the Colorado River system and to recovering the four ESA-protected fishes in the Upper Basin.[102] For instance, climate-change impacts on the Colorado River's temperature and hydrology are already noticeable compared to the historical conditions of the river system.[103]

III. CLIMATE-CHANGE IMPACTS IN THE UPPER COLORADO RIVER BASIN

Climate change is measured by comparing variations in average climatic conditions, such as temperature, humidity, precipitation, etc., to long-term averages of those conditions.[104] These changes are identified using

96 *Id.*

97 *See, e.g.*, U.S. DEP'T OF THE INTERIOR, FISH AND WILDLIFE SERVICE MOUNTAIN-PRAIRIE REGION, 2016-2017 MEMORANDUM RE: SUFFICIENT PROGRESS UNDER THE UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM IN THE UPPER COLORADO RIVER BASIN (2017). http://www.coloradoriverrecovery.org/documents-publications/section-7consultation/sufficient progress/2017SuffProgFinalSigned.pdf.

98 *Id.*

99 MacDonnell, *supra* note 1; *See generally* UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM, RECOVERY IMPLEMENTATION PROGRAM SECTION 7 CONSULTATION, SUFFICIENT PROGRESS AND HISTORICAL PROJECTS AGREEMENT AND RECOVERY IMPLEMENTATION PROGRAM RECOVERY ACTION PLAN (RIPRAP) (2017), 2, http://www.coloradoriverrecovery.org/documents-publications/foundational-documents/RIPRAP/RIPRAP03-21-12.pdf.

100 UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM, RIPRAP, *supra* note 99, at 2–3.

101 *Id.* at 1.

102 U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB, *supra* note 28, at 195–205.

103 Udall & Overpeck, *supra* note 2, at 2408.

104 Nat'l Aeronautics and Space Admin., *Climate Change, How Do We Know*?, GLOBAL CHANGE, VITAL SIGNS OF THE PLANET, https://climate.nasa.gov/evidence/ (last visited Apr. 6, 2019); *How is Climate Change Directed?*, U.S. FOREST SERVICE, https://www.fs.fed.us/science-

measured data (i.e., thermometers); proxy data (i.e., tree-ring measurements); and statistical tests that are attributed, directly or indirectly, to human activity (i.e., the release of greenhouse gases); and natural variability (i.e., volcanic activity).[105] Anthropogenic climate change impacts the temperature and hydrology of the Upper Basin[106] and, thus, the ecosystems of fishes in Upper Basin tributaries.

A. *Climate-change Impacts to Temperature & Hydrology*

The storage capacity of the reservoirs of the Colorado River Basin is roughly four times the average annual flow of the river at Lee's Ferry, which can be a buffer for flow shortages, but not when perpetual drought threatens the basin due to a changing climate.[107] Historically, precipitation in the Upper Basin (especially winter snow)[108] was the main determinant for high-flow periods (1920s and 1980s) and low-flow periods (1930s and 1950s).[109] The early twenty-first century drought, however, is unprecedented in that increased average air temperatures, rather than changes in precipitation, are decreasing flows.[110] The "drought is defined by the lowest average annual flows for any 15-year period in the historical record."[111]

Average annual air temperature in the Upper Basin is presently 0.98 degrees Celsius (or 1.76 degrees Fahrenheit) above the 1896–1999 average, which is the highest in the gauged record.[112] Scientific literature suggests there is a "high likelihood that the impacts of continued atmospheric warming will overwhelm any future increases in precipitation because prolonged dry periods lasting multiple decades are likely to negate the beneficial impacts of additional precipitation during other times."[113]

Temperature-driven droughts are characterized by higher-than-normal average air temperatures, which stress water resources, increase the likelihood

technology/climate-change/how-is-climate-change-detected (last visited Apr. 6, 2019); Nat'l Oceanic and Atmospheric Admin., *Science and information for a Climate-Smart Nation*, NOAA CLIMATE.GOV, https://www.climate.gov/maps-data/primer/measuring-climate (last visited Apr. 6, 2019).

105 Nat'l Aeronautics and Space Admin., *supra* note 104; U.S. FOREST SERVICE, *supra* note 104; Nat'l Oceanic and Atmospheric Admin., *supra* note 104.

106 Udall & Overpeck, *supra* note 2, at 2404.

107 *Id.*

108 *See* Mu Xiao et al., *On the Causes of Declining Colorado River Streamflows*, 54 WATER RESOURCES RESEARCH 1, 1 (2018).

109 Udall & Overpeck, *supra* note 2, at 2407.

110 *Id.* at 2408.

111 *Id.* at 2407.

112 *Id.*

113 Udall & Overpeck, *supra* note 2, at 2407 (citing T. R. Ault et al., *Assessing the Risk of Persistent Drought Using Climate Model Simulations and Paleoclimate Data*, 27 J. CLIM. , 7529–49 (2014); B. I. Cook et al., *Unprecedented 21st Century Drought Risk in the American Southwest and Central Plains*, 1 SCI. ADV. 1, (2015); T. R. Ault et al., *Relative Impacts of Mitigation, Temperature, and Precipitation on 21st-century Megadrought Risk in the American Southwest*, 2 SCI. ADV. (10), (2016)).

that droughts will occur, and cause modest droughts to become severe droughts.[114] Elevated temperatures increase the moisture demand within ecosystems, leading to evaporation from water bodies, soil, and elongated growing seasons during which evapotranspiration occurs,[115] as well as increased snowmelt or earlier-than-normal runoff.[116] Positive feedbacks that enhance further warming are also "possible in the form of lower humidity and less evaporative cooling, decreased cloudiness and increased radiation, as well as decreased snow cover and more radiative heating." [117] For instance, increased radiative forcing can occur from the increased concentration of greenhouse gases in the atmosphere that trap heat.[118]

Scientists suggest that stable twentieth-century Colorado River flows may not reoccur for many centuries because the climate system needs to readjust to the climate impacts associated with elevated atmospheric concentrations of greenhouse gases.[119] Ultimately, as the "observed and projected temperature-

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114 *Id*., at 2408 (citing D. D. Breshears et al., *Regional Vegetation Die-off in Response to Global-change-type Drought*, 102 PROC. NAT'L. ACAD. SCI. U.S.A. (42), 15, 144–48 (2005); J. T. Overpeck, *Climate Science: The Challenge of Hot Drought*, 503 NATURE (7476), 350–51 (2013)).

115 *Id*. at 2408 (citing A. J. Pitman, *The Evolution of, and Revolution in, Land Surface Schemes Designed for Climate Models*, 23 INT. J. CLIMATOLOGY 5, 479–510 (2003); J. L. Weiss et al., *Distinguishing Pronounced Droughts in the Southwestern United States: Seasonality and Effects of Warmer Temperatures*, 22 J. CLIM. 22, 5918–32 (2009); S. I. Seneviratne et al., *Investigating Soil Moisture- Climate Interactions in a Changing Climate: A Review*, 99 EARTH SCI. REV., 125–61 (2010); R. Seager et al., *Causes of the 2011–14 California Drought*, 28 J. CLIM. , 6997–7024 (2015a)).

116 I. R. Stewart et al., *Changes toward Earlier Streamflow Timing across Western North America*, 18 J. OF CLIMATE 1136, 1144 (2005).

117 Udall & Overpeck, *supra* note 2, at 2408, 2414–15 (stating additional known threats to stream flows due to climate change-driven elevated temperatures include potential large-scale loss of conifers, and dust-covered snow decreasing the albedo of snow and thus increasing the speed of snowmelt) (citing Thomas H. Painter et al., *Response of Colorado River Runoff to Dust Radiative Forcing in Snow,* 107 PROC. NAT'L. ACAD. SCI. U.S.A. 17125, 17125–30 (2010); J. S. Deems et al., *Combined Impacts of Current and Future Dust Deposition and Regional Warming on Colorado River Basin Snow Dynamics and Hydrology*, 17 HYDROL. EARTH SYST. SCI. 4401, 4401–13 (2013); A. K. Betts et al., *The Land Surface-atmosphere Interaction: A Review Based on Observational and Global Modeling Perspectives*, 101 J. GEOPHYS. RES. , 7209–25 (1996); K. L. Brubaker & D. Entekhabi, *Analysis of Feedback Mechanisms in Land-Atmosphere Interaction*, 32 WATER RESOURCES RES. 1343, 1343–57 (1996); Daniel R. Cayan et al., *Future Dryness in the Southwest US and the Hydrology of the Early 21st Century Drought,* 107 PROC. NAT'L. ACAD. SCI. U.S.A., 21272, 21271–76 (2010); David D. Breshears et al., *Regional Vegetation die-off in Response to Global-change-type Drought*, 102 PROC. NATL. ACAD. SCI. U.S.A., 15144, 15144–48. (2005); Henry D. Adams et al., *Temperature sensitivity of Drought-induced Tree Mortality Portends Increased Regional Die-off Under Global-change-type Drought*, 106 PROC. NATL. ACAD. SCI. U.S.A.7063, 7063–66 (2009); C. D. Allen et al., *A Global Overview of Drought and Heat-Induced Tree Mortality Reveals Emerging Climate Change Risks for Forests*, 259 FOR. ECOL. MANAGE.660, 660–84 (2010); C. D. Allen et al., *On Underestimation of Global Vulnerability to Tree Mortality and Forest Die-off From Hotter Drought in the Anthropocene,* 6 ECOSPHERE 1, 129 (2015)).

118 Nat'l Aeronautics and Space Admin., *supra* note 104; U.S. FOREST SERVICE, *supra* note 104; Nat'l Oceanic and Atmospheric Admin., *supra* note 104.

119 Udall & Overpeck, *supra* note 2, at 2415 (citing Susan Solomon et al., *Irreversible Climate Change Due to Carbon Dioxide Emissions*, 106 PROC. NAT'L. ACAD. SCI. U. S. A. 1704, 1704–09

induced Colorado River flow declines, the inability of linked climate-hydrology models to simulate persistent droughts, and the increasing likelihood of hot drought and megadrought, all imply the risk is high for climate-change reductions to the Colorado River water supply."[120] Though, even the concept of "stable" flows has been dismissed as an aspirational understanding of hydrology and water management in light of anthropogenic hydroclimate changes.[121]

In the developed world, systems for water management are designed and operated under the assumption of stationarity.[122] "Stationarity – the idea that natural systems fluctuate within an unchanging envelope of variability – is a foundational concept that permeates training and practice in water-resource engineering."[123] Under the stationarity theory, while errors are acknowledged, they are assumed to be reducible by utilizing additional observational, estimator, or historic-regional data.[124] The reality is that "[t]he stationarity assumption has long been compromised by human disturbances in river basins."[125] There was a period when climate projections were not yet considered credible[126] and the hydroclimate did not demonstrably exit the "envelope of natural variability or the effective range of optimally operated [water] infrastructure."[127] Climate model projections are now bolstered by their retrodictive capability and demonstrate a global pattern of observed annual streamflow trends that are unlikely to have arisen from only unforced natural variability[128] and are likely to occur beyond the range of historical behaviors.[129]

In light of the current observable anthropogenic-hydroclimatic changes, "stationarity is dead and should no longer serve as a central, default assumption in water-resource risk assessment and planning".[130] It is not a new finding that anthropogenic climate change affects the water cycle and water supply.[131] Furthermore, even with "aggressive mitigation," continued warming is very

(2009); Matthew Collins et al., *Long-term Climate Change: Projections, Commitments and Irreversibility, in* CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS (T. F. Stocker et al. eds. 2013)).

120 *Id*. at 2414–15.

121 Milly et al., *supra* note 26, at 573.

122 *Id*.

123 *Id*.

124 *Id*.

125 *Id*.

126 *Id*. (citing to K.E. Schilling & E.Z. Stakhiv, *Global Change and Water Resources Management*, in 112 WATER RESOURCES UPDATE, Universities Council on Water Resources, Carbondale, IL, (1998); Z.W. Kundzewicz & L. Somlyódy, 11 WATER RESOURCES MGMT 407 (1997)).

127 *Id*. at 573 (citing Schilling & Stakhiv, *supra* note 125; N C. Matalas, *Global Change and Water Resources Management*, in 112 WATER RESOURCES UPDATE, Universities Council on Water Resources, Carbondale, IL, (1998)).

128 *Id*. at 573 (citing P.C.D. Milly, et al., 438 NATURE 347 (2005)).

129 *Id*. (citing R. Seager et al., 316 SCIENCE 1181 (2007)).

130 *Id*.

131 *Id*. (citing S. Manabe & R.J. Stouffer, 34 J. GEOPHYSICAL RES. 5529 (1980); P.S. Eagleson, *in* SCIENTIFIC BASIS OF WATER-RESOURCE MANAGEMENT, (National Academy Press, (1982)).

likely given the residence time of atmospheric CO_2 and the thermal inertia of the Earth system.[132] While it is accepted that the "[i]ncreasing demand, coupled with decreasing supplies, will certainly exacerbate imbalances throughout the Basin",[133] the future effects of climate change on endemic fishes in the Colorado Basin is likely to make recovery more difficult.[134]

B. *Climate-Change Impacts to Fishes*

Endemic fishes in the Upper Basin were historically more numerous, wider-ranging, longer-lived, and larger than they are under today's conditions. In the words of Tim Merchant, referring to fishing for Colorado Pikeminnow in a stretch of the Green River, now covered by Flaming Gorge Reservoir: "They was [sic] as big as a junior high school kid, 90 pounds. That's a big fish."[135] In fact, the Colorado Pikeminnow is one of the largest minnows in North America.[136] However, as discussed earlier, the "[m]ainstream and major tributary rivers of the Colorado River Basin . . . have been altered by more than a dozen major dams . . . [that] have contributed to declines and endangerment of indigenous, 'big-river' fishes . . . by blocking migration routes and altering temperature, discharge, and sediment-transport patterns."[137]

Notably, "climate-induced changes in freshwater environments interact with hydrologic alterations by dams to affect the persistence of aquatic life[,] . . . and impact[] riverine flow regimes, fundamentally altering physical habitat and putting at risk numerous threatened and endangered fish species."[138] The complex interactions between climate change and other anthropogenic stressors

132 *Id.* at 573 (citing U.N. Env't Programme and World Meteorological Org., Intergovernmental Panel on Climate Change (IPCC), IPCC Fourth Assessment Report, Climate Change 2007: The Physical Science Basis 1–18 (S. Solomon et al. eds., 2007) (contribution of Working Group 1); U.N. Env't Programme and World Meteorological Org., IPCC, IPCC Fourth Assessment Report, Climate Change 2007: The Physical Science Basis 1–24 (B. Metz et al. eds., 2007) (contribution of Working Group 3)).

133 U.S. DEP'T OF THE INTERIOR, BUREAU OF RECLAMATION, RECLAMATION MANAGING WATER IN THE WEST, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY TECHNICAL REPORT B–WATER SUPPLY ASSESSMENT, at 9 (2012).

134 U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB, *supra* note 28, at 195–205; A.J. Lynch et al., *Climate Change Effects on North American Inland Fish Populations and Assemblages*, 41:7 FISHERIES 346, 346–61, 353 (2016).

135 FRED QUARTARONE, UPPER COLORADO RIVER BASIN ENDANGERED FISH RECOVERY PROGRAM, HISTORICAL ACCOUNTS OF UPPER COLORADO RIVER BASIN ENDANGERED FISH, 8 (rev. ed. 1995), http://www.coloradoriverrecovery.org/general-information/general-publications/Historicalaccounts.pdf.

136 UPPER COLORADO RIVER BASIN ENDANGERED FISH RECOVERY PROGRAM, *Colorado pikeminnow* (*Ptychocheilus lucius*), http://www.coloradoriverrecovery.org/general-information/the-fish/colorado-pikeminnow.html (last visited Apr. 6, 2019).

137 Robert W. Clarkson & Michael R. Childs, *Temperature Effects of Hypolimnial-Release Dams on Early Life Stages of Colorado River Basin Big-River Fishes*, 2000 COPEIA 402 (2000) (citing P.B. Holden, *Ecology of Riverine Fishes in Regulated Stream Systems with Emphasis on the Colorado River*, *in* THE ECOLOGY OF REGULATED STREAMS 57–74, (J.V. Ward and J.A. Stanford eds., 1979)).

138 Kominoski et al., *supra* note 27, at 1176.

make it difficult to ascertain the relative effects of each stressor and compound the cumulative effects felt by inland fishes.[139]

An increase in the severity and frequency of droughts associated with climate change are forecasted to "further increase aridity and reduce streamflow" in the Colorado River Basin.[140] Studies show that "[i]n rivers with reduced discharge, *up to 75% . . . of local fish biodiversity [will] be headed toward extinction by 2070* because of combined changes in climate and water consumption"[141] and "fishes are uniquely vulnerable to climate-mediated changes in temperature and precipitation because they are confined to aquatic habitats, and their movement to alternative habitats is often more restricted than in terrestrial systems (e.g., fragmented stream networks)."[142]

A recent study identified 31 publications that "empirically documented effects of climate change on North American inland fish populations (e.g., changes to distribution, phenology, abundance, growth, recruitment, and genetics) and assemblages structure (i.e., species richness, evenness, and composition).[143] While none of the publications focused on fish populations in the Colorado River Basin, the study provides useful information regarding climate-change trends observed on North American inland fish populations and assemblages structure, as well as future research needs given current data gaps.[144] This study found that, due to long-term increases in annual average temperatures, the thermal regimes in rivers and streams are changing.[145] In most cases, the resulting "milder winters, earlier spring warming, and warmer summers" have led to earlier migration and spawning.[146]

Population dynamics, such as rates of survival, abundance, growth, and recruitment, have also been directly influence by climate change.[147] Species' ranges are shifting, which is changing the structure of some North American fish assemblages and resulting in novel species interactions, such as altered predator-

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139 A. J. Lynch et al., *supra* note 134, at 346–61.

140 Kristin L. Jaeger et al., *Climate-Change Poised to Threaten Hydrologic Connectivity and Endemic Fishes in Dryland Streams*, 38 PNAS 111, at 13894 (2014) (citing Seager R., et al. *Projections of Declining Surface-Water Availability for the Southwestern United States*, 3 NATURE CLIMATE CHANGE 482, 482–86 (2013)).

141 Xenopoulos et al., *supra* note 17, at 1557 (emphasis added).

142 Lynch et al., *supra* note 134, at 349 (citing Whitney et al., *Physiological Basis of Climate Change Impacts on North American Inland Fishes*, 41 FISHERIES 332, 332–345 (2016)).

143 *Id.*

144 *Id.* at 349.

145 *Id.* at 349 (citing Kaushal et al., *Rising Stream and River Temperatures in the United States* 8 FRONTIERS IN ECOLOGY AND THE ENVIRONMENT 461, 461–66 (2010); Rice & Jastram, *Rising Air and Stream-Water Temperatures in Chesapeake Bay Region, USA.*, 128 CLIMATIC CHANGE 127, 127–38 (2015); Arismendi et al., *The Paradox of Cooling Streams in a Warming World: Regional Climate Trends do not Parallel Variable Local Trends in Stream Temperature in the Pacific Continental United States*, 39 GEOPHYSICAL RESEARCH LETTERS 1, 1–7 (2012)).

146 *Id.* at 350.

147 *Id.*

prey dynamics.[148] Prolonged droughts stress populations of endemic fishes due to the combined effects of lost habitat and predation by non-native fish.[149]

For instance, the Humpback Chub evolved in an environment relatively free of predators so it is not well adapted[150] to living with the many nonnative fish species that have been introduced into the Colorado River System.[151] While "non-native fish management is ongoing in the [U]pper [B]asin to reduce the impact of nonnative predators" and competition with native fishes, around "50 species of nonnative fish have been introduced into the upper Colorado River System in the last 100 years, with 18 nonnative fish species inhabiting the same areas as Humpback Chub populations."[152] Furthermore, nonnative predatory species may still expand in the Upper Basin, especially Smallmouth Bass, under future conditions (e.g. prolonged drought) that cause establishment or expansion of nonnative species.[153] Specifically, "[w]arm summer base flow from low snowpack [or higher air temperatures] increases Smallmouth Bass production system-wide, whereas higher spring and summer flows decrease Smallmouth Bass production"; therefore, it is likely that climate change will exacerbate negative interactions between the Humpback Chub and the Smallmouth Bass.[154]

IV. MODIFYING RECOVERY PLANS TO ACHIEVE ALIGNMENT AND UTILITY

Climate change is projected to continue[155], which means droughts are likely to persist in the Colorado River Basin.[156] This will make attaining recovery more difficult to achieve for the four ESA-protected endemic fishes.[157] Complicating matters further, recovery plans are not binding on the FWS in terms of actionable recovery responsibilities; therefore, thus far, they do not offer considerable utility to attain species recovery.[158] Additionally, there is a

148 *Id.* at 348.

149 Jaeger et al., *supra* note 140, at 13895.

150 *See* U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB, *supra* note 28, at 42–43 (explaining the Humpback Chub is a soft-rayed fish with no defense mechanisms, such as sharp scales, teeth, or spines for protection from predators).

151 *Id.*

152 *Id.*

153 *Id.* at 217.

154 *Id.* at 42–43.

155 Udall & Overpeck, *supra* note 2.

156 Cayan et al., *supra* note 117, at 21271 (stating: "The early 21st century drought has been the most extreme in over a century of Colorado River flows, and might occur in any given century with probability of only 60%. However, hydrological model runs from downscaled Intergovernmental Panel on Climate Change Fourth Assessment climate change simulations suggest that the region is likely to become drier and experience more severe droughts than this. In the latter half of the 21st century the models produced considerably greater drought activity, particularly in the Colorado River Basin, as judged from soil moisture anomalies and other hydrological measures.").

157 *See* U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB, *supra* note 28, at 195.

158 Friends of Blackwater v. Salazar, 691 F.3d 428, 433–36 (D.C. Cir. 2012) ("The[] arguments . . . that interpreting the recovery plan as non-binding would render [section] 4(f) of the Act a nullity [are] . . . not correct. . . . [section] 4(f) obliges the Secretary to 'develop and implement plans' for the

"divergence of opinions" between certain stakeholders: Scientists typically prefer a level of flexibility in and adaptability in recovery planning to account for regularly evolving data and adaptability in recovery actions, while policy and funding stakeholders typically prefer specific recovery actions and data that, once accomplished, will be sure to guarantee comprehensive recovery.[159] The FWS has reformed its recovery planning process in an effort to streamline and simplify the recovery planning process.[160] A revised recovery plan for the Humpback Chub will be developed under these new methods and is expected to begin in 2020.[161] In anticipation of this recovery plan and due to the Humpback Chub's recently proposed downlisting, a careful analysis of the fish's historical recovery planning process is timely and prudent. The status of the scientific and legal framework is very similar for the other four ESA-protected fishes in the Upper Basin;[162] therefore, there are comparable deficiencies in the recovery planning process for the three other ESA-protected fishes.

A. *Case Study: The Humpback Chub*

1. Species Background & Historical Presence

The Humpback Chub is a species native to the Colorado River that evolved around 3.5 million years ago.[163] Collections of the fish were first

recovery of any species designated as endangered. 16 U.S.C. § 1533(f)(1). If the Secretary wants to change the plan, then he first must let the public comment. Id. § 1533(f)(4). It does not follow, however, that with each criterion he includes in a recovery plan the Secretary places a further obligation upon the Service. *A [recovery] plan is a statement of intention, not a contract. If the plan is overtaken by events, then there is no need to change the plan; it may simply be irrelevant." "We hold the Secretary reasonably interpreted the Endangered Species Act as not requiring that the criteria in a recovery plan be satisfied before a species may be delisted pursuant to the factors in the Act itself.*") (emphasis added); Cascadia Wildlands v. Bureau of Indian Affairs, 801 F.3d 1105, 1114 (9th Cir. 2015) ("*It is undisputed that, generally, FWS recovery plans are not mandatory. The Endangered Species Act does not mandate compliance with recovery plans for endangered species.*") (emphasis added).

159 McAbee, *supra* note 32.

160 Smith et al., *supra* note 29.

161 U.S. FISH AND WILDLIFE SERVICE, NEWS & RELEASES MOUNTAIN PRAIRIE REGION, *After Scientific Review, the U.S. Fish and Wildlife Service to Propose Reclassification of the Humpback Chub from Endangered to Threatened*, https://www.fws.gov/mountain-prairie/pressrel/2018/03222018_After_Scientific_Review_the_U.S._Fish_and_Wildlife_Service_to_Propose_Reclassification_of_the_Humpback_Chub_from_Endangered_to_Threatened.php (last visited Apr. 6, 2019); E-Mail from Kevin McAbee, Deputy Director, Upper Colorado River Endangered Fish Recovery Program (May 6, 2019, 07:03 PST).

162 *See generally* U.S. FISH AND WILDLIFE SERVICE, BONYTAIL CHUB RECOVERY GOALS, *supra* note 34; U.S. FISH AND WILDLIFE SERVICE, BONYTAIL CHUB RECOVERY PLAN, *supra* note 34; U.S. FISH AND WILDLIFE SERVICE, RAZORBACK SUCKER RECOVERY GOALS, *supra* note 34; U.S. FISH AND WILDLIFE SERVICE, RAZORBACK SUCKER RECOVERY PLAN, *supra* note 34; U.S. FISH AND WILDLIFE SERVICE COLORADO PIKEMINNOW RECOVERY GOALS, *supra* note 34.

163 U.S. FISH AND WILDLIFE SERVICE, FISH AND AQUATIC CONSERVATION, HUMPBACK CHUB, https://www.fws.gov/fisheries/freshwater-fish-of-america/humpback_chub.html (last visited Apr. 7, 2019).

discovered in conjunction with infrastructure planning along the Colorado River in the middle of the twentieth century.[164] Historically, the Humpback Chub inhabited the whitewater reaches of remote, deep, and rugged canyons of the main stem of the Colorado River (in Arizona, Utah, and Colorado) and the Green and Yampa Rivers (in Utah and Colorado),[165] so it was the last species of the Colorado River to be described in scientific literature.[166] The Humpback Chub is currently found in the Grand Canyon (the Little Colorado River and adjacent portions of the Colorado River), Cataract Canyon (Colorado River, Utah), Westwater Canyon (Colorado River, Utah), Black Rocks (Colorado River, Colorado), and Desolation Canyon (Green River, Utah).[167]

While the ESA protects the Humpback Chub today,[168] reports from early prospectors suggest that the fish was once in plentiful supply.[169] For instance, in 1892, one prospector stated:

> After the snow melts the Colorado backs up into some of those small canons and the fish come in millionsFalse They are so thick that you can lean over the water's edge and pull them out by the tail two at a timeFalse They are about twenty inches long and have a flat hump on their back just behind the head.[170]

Present-day Humpback Chub are usually about ten inches long, but can grow up to fifteen inches in length, and while the fish can live up to approximately thirty years, they reach sexual maturity at two-to-three.[171]

Humpback Chub spawn over boulder, sand, and possibly gravel substrates at depths of five feet eleven inches to twelve-and-a-half feet and water velocities of 0.15 to 0.3 m/sec (5.9 to 11.8 in/sec).[172] Spawning season occurs when water temperatures are between fifty-seven point two, to negative eleven degrees Fahrenheit, which is typically May through July,[173] but climate driven increases in temperature (such as the twenty-first century drought[174]) reduce flow, and colder temperature dam releases[175] alter the seasonal water flow and temperatures. Hatching success is also temperature dependent, occurring at 68

164 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB RECOVERY PLAN, *supra* note 18, at 1.

165 *Id.* at vi.

166 U.S. NATIONAL PARK SERVICE, HUMPBACK CHUB, https://www.nps.gov/grca/learn/nature/fish-humpback-chub.htm (last visited Apr. 6, 2019).

167 U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB, *supra* note 28, at vi.

168 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB RECOVERY PLAN, *supra* note 18, at 1.

169 U.S. NATIONAL PARK SERVICE, *supra* note 166.

170 *Id.*

171 U.S. FISH AND WILDLIFE SERVICE, FISH AND AQUATIC CONSERVATION, *supra* note 163.

172 U.S. FISH AND WILDLIFE SERVICE, FISH AND AQUATIC CONSERVATION, *supra* note 163.

173 *Id.*

174 U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB, *supra* note 28, at 203.

175 *Id.* at 61–63.

degrees Fahrenheit.[176] The fish's diet is not well-known, but stomach contents of Humpback Chub have included algae, plant debris, fish remains, and terrestrial insects.[177]

2. Chronology of Legal Protection & Previous Recovery Plans

i. Federal & State Protection

The Humpback Chub was first listed as endangered by the FWS in 1967.[178] After the ESA was passed in 1973, the species was given full federal protection as an endangered species.[179] Subsequently, the Humpback Chub received state protection, under Utah Law in 1973 and under Colorado law in 1976.[180] The 1990 Humpback Chub Recovery Plan was amended by the 2002 Humpback Chub Recovery Goals; however, present actions to conserve, restore, and protect the fish follow the 1990 Recovery Plan, because the 2002 Recovery Goals were withdrawn by court order.[181]

ii. The Humpback Chub 1990 Recovery Plan

On September 19, 1990, the Regional Director of the FWS approved a revised recovery plan for the Humpback Chub, which remains the recovery plan for the species today.[182] Section 4(f)(1)(B)(i-iii) of the ESA commands that recovery plans include:

> (i) a description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species;
>
> (ii) objective, measurable criteria which, when met, would result in a determination, in accordance with the provisions of this section, that the species be removed from the list; and
>
> (iii) estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward

176 *Id.*; U.S. FISH AND WILDLIFE SERVICE, FISH AND AQUATIC CONSERVATION, *supra* note 163.

177 U.S. FISH AND WILDLIFE SERVICE, FISH AND AQUATIC CONSERVATION, *supra* note 163.

178 U.S. FISH AND WILDLIFE SERVICE, FISH AND AQUATIC CONSERVATION, *supra* note 163.

179 *Id.*

180 U.S. FISH AND WILDLIFE SERVICE, FISH AND AQUATIC CONSERVATION, *supra* note 163.

181 *Id.*; U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB RECOVERY PLAN, *supra* note 18; U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB 5-YEAR REVIEW (2018), at 3, https://www.fws.gov/southwest/docs/ HumpbackChub5-yrFinalsigned3-19-18Compliant.pdf (citing Grand Canyon Trust et al. vs. Gale Norton et al., No. 04–CV–636 PHX FJM, 2006 WL 167560 (D. Ariz., 2006). See *also* Part IV(A)(2)(iii) (describing how the FWS still uses the 2002 Recovery Goals in tandem with the 1990 Recovery Plan, despite the court ruling).

182 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB RECOVERY PLAN, *supra* note 18, at i (explaining the original recovery plan was approved August 22, 1979, and the first revision was approved May 15, 1984).

that goal.[183]

The objectives of the 1990 Recovery Plan are to protect or restore five viable, self-sustaining populations of Humpback Chub within the Colorado River Basin and the habitat used by the fish.[184] The 1990 Recovery Plan is comprised of three main parts.[185] Part I discusses the history of the species including the Humpback Chub's distribution and abundance (historically and in 1990), life history, habitat preference, reproduction, food habits, and known reasons for decline.[186] Part II describes the objectives of the Recovery Plan and provides both a step-down outline and a narrative outline of site-specific management actions necessary to achieve the objective.[187] Finally, Part III provides an implementation schedule, which serves as a guide for accomplishing the actions laid out in Part II.[188]

The 1990 Recovery Plan states thatdownlisting will occur when five, viable self-sustaining humpback chub populations have been located or reestablished, and delisting will be considered when five viable, self-sustaining populations and their habitats are protected.[189]

The downlisting and delisting criteria provided were preliminary and open to revision on the basis of new information.[190] When the 1990 Recovery Plan was drafted, "[w]hat constitutes a viable, self- sustaining population of Humpback Chub [was] unknown" and the Recovery Plan included a task to identify what a self-sustaining population would look like.[191] The Plan optimistically estimates the time and cost to carry out recovery in the Upper Basin as thirteen years (2003) and fifty-nine million dollars, respectively.[192] While the Recovery Plan itself did not provide "objective, measurable criteria which, when met, would result in a determination, in accordance with the provisions of this section, that the species be removed from the list"[193] as mandated by section 4(f)(1)(B) of the ESA, Task 8 (one of the management actions) requires this biological criteria be determined.[194] Because the 1990 Recovery Plan for the Humpback Chub has not been updated and the Recovery Goals have been withdrawn, the Recovery Plan *itself* does not include "objective and measurable criteria" as required by ESA section 4(f)(1)(B).

183 16 U.S.C. § 1533 (f)(1)(B)(i–iii) (2017).

184 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB RECOVERY PLAN, *supra* note 18, at iv.

185 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB RECOVERY PLAN, *supra* note 18.

186 *Id*. at 1–13.

187 *Id*. at 14–28.

188 *Id*. at 36–41.

189 *Id*. at iv.

190 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB RECOVERY PLAN, *supra* note 18, at 17.

191 *Id*.

192 *Id*. at iv.

193 16 U.S.C. § 1533(f)(1)(B)(ii) (2017).

194 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB RECOVERY PLAN, *supra* note 18, at 28 (citing, task "8. [states:] Determine biological criteria/objectives for downsizing/delisting the humpback chub.").

iii. The Humpback Chub 2002 Recovery Goals

The Humpback Chub 2002 Recovery Goals document serves as an amendment and a supplement to the 1990 Recovery Plan;[195] the goals focus specifically on the requirements of section 4(f)(1)(B) of the ESA.[196] The Recovery Goals "assimilate current information on the life history of the species and status of populations to develop recovery goals associated with the five listing factors,"[197] and "incorporate into each plan site-specific management actions; objective, measurable criteria; and estimates of the time and cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal."[198] Notably, the Humpback Chub 2002 Recovery Goals are more than double the length of the 1990 Recovery Plan and provide a comprehensive examination of recovery.[199]

The Recovery Goals are divided into five parts. Part I discusses the purpose and scope of the Goals as well as the conservation programs affiliated with recovery actions.[200] Parts II and III describe the recovery process[201] and population viability and self-sustainability,[202] respectively. Part IV details the threats to the Humpback Chub, by listing factor (described below),[203] and Part V addresses recovery requirements divided geographically between the Upper and Lower Basins.[204] Specifically, Part V discusses objective, measurable criteria for down-listing and delisting.[205]

The Recovery Program serves as a means for accomplishing the Recovery Goals in the Upper Basin and is responsible for developing recovery implementation plans (e.g., management actions and demographic criteria for downlisting and delisting) for Upper Basin populations of the ESA-protected fish species.[206] The 2002 Recovery Goals based the recovery criteria and management actions on the section 4(a)(1) "listing" factors, which guided actions in a specific site:

Factor A.—Adequate habitat and range for recovered populations

195 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB RECOVERY GOALS 1 (2002), https://www.fws.gov/southwest/es/arizona/Documents/SpeciesDocs/HumpbackChub/Humpback%20chub-August-02.pdf.

196 *Id.*

197 *Id.* at 19–28 (explaining the five listing factors are: Present or threatened destruction, modification, or curtailment of habitat or range; overutilization for commercial, recreational, scientific or educational purposes, disease or predation; inadequacy of existing regulatory mechanisms; and other natural or manmade factors affecting continued existence).

198 *Id.* at 1–2.

199 *Id.*; U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB RECOVERY PLAN, *supra* note 18.

200 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB RECOVERY GOALS, *supra* note 195, at 1–3.

201 *Id.* at 4–8.

202 *Id.* at 8–18.

203 *Id.* at 18–30.

204 *Id.* at 30–52.

205 *Id.*

206 UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM, *supra* note 14.

provided.

Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes.

Factor C.—Adequate protection from diseases and predation.

Factor D.—Adequate existing regulatory mechanisms.

Factor E.—Other natural or manmade factors for which protection has been provided.[207]

Under section 4(a)(1) of the ESA, "when delisting a species, the Service must determine that the five listing factors no longer apply, e.g., the habitat is no longer threatened with destruction or modification, the current abundance and range is adequate, and the habitat needed to sustain recovered populations is present".[208]

On January 18, 2006, the Recovery Goals were "withdrawn and declared of no force and effect by court order for lack of recovery timelines and estimated costs; [nevertheless, t]he recovery goals were otherwise found to be scientifically sound and still serve as the [FWS]'s quantifiable and measurable recovery criteria".[209] While revised recovery goals were drafted in 2008, they were never finalized.[210] Because the 2002 Recovery Goals still serve as the quantifiable and measurable recovery criteria for the FWS (despite their withdrawal by court order),[211] it remains uncertain whether the 1990 Recovery Plan was reinstated as a result of the withdrawal of the Recovery Goals, and, more importantly, to what extent the recovery plan offers utility for species recovery if the FWS is not legally bound by the document.[212]

3. The Contemporary Status of Humpback Chub's Recovery

i. FWS Revised Recovery Planning Method

The FWS recently revised its approach to recovery planning. To develop this revised method, an experienced team of scientists from the FWS and the US Geologic Survey evaluated the critiques of recovery planning to

207 *Id*. at 35–51; 16 U.S.C. § 1533(a)(1) (2017).

208 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB RECOVERY GOALS, *supra* note 195, at 6.

209 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB 5-YEAR REVIEW (2018), *supra* note 181 (citing Grand Canyon Trust et al. vs. Gale Norton et al., No. 04–CV–636 PHX FJM, 2006 WL 167560 (D. Ariz.2006)).

210 *Id*.

211 *Id*. at 12.

212 Friends of Blackwater v. Salazar, *supra* note 158; Cascadia Wildlands v. Bureau of Indian Affairs, *supra* note 159; *Grand Canyon Trust*, 2006 WL 167560 at *11–12 (holding, "The Recovery Goals fail to comply with the ESA, and accordingly, defendants are ordered to withdraw them. We declare them of no force and effect").

create a new assessment process.[213] The new process is referred to as the Recovery Planning and Implementation approach (RPI), and is framed around a Species Status Assessment (SSA).[214] Recovery planning was revised because recovery plans took years to create, were static documents that became quickly outdated, and were not easily amendable.[215]

A recovery plan is now "just one piece of a 3-part framework."[216] The SSA informs a 5-year review recommendation decision.[217] It also serves as the scientific foundation of the recovery plan and "includes much of the information and analyses previously included in the 'background' section of a recovery plan".[218] The recovery plan is then implemented via a Recovery Implementation Strategy ("RIS").[219] The Recovery Program Director's Office staff are often responsible for authoring official documents by leading teams in document development and presenting final documents to FWS for final decisions.[220] Typically, staff work with a Science Advisory subgroup to vet the scientific analyses contained in a SSA and present the SSA to FWS Regional Directors.[221] Regional Directors agree to a recommendation for the 5-year review, and the Recovery Program staff author the 5-year review.[222]

The SSA, includes "a systematic and explicit analysis of a species' future response to stressors and conservation."[223] It is a scientific report, distinct from policy application, that can inform any number of ESA related policy decisions.[224] Furthermore, "the SSA is species focused rather than threat focused"; threats are now a potential explanation for a species' current and future condition, rather than the endpoint of an assessment.[225] A SSA looks to the best available scientific literature and provides an assessment of the listed

213 Smith et al., *supra* note 29, at 303; U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLANNING AND IMPLEMENTATION, *supra* note 29.

214 Smith et al., *supra* note 29, at 303; U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLANNING AND IMPLEMENTATION, *supra* note 29.

215 Smith et al., *supra* note 29, at 303; U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLANNING AND IMPLEMENTATION, *supra* note 29.

216 Smith et al., *supra* note 29, at 303; U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLANNING AND IMPLEMENTATION, *supra* note 29.

217 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB 5-YEAR REVIEW (2018), *supra* note 181.

218 U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLANNING AND IMPLEMENTATION, *supra* note 29, at 1.

219 *Id*.

220 E-mail from Kevin McAbee, Deputy Director, Upper Colorado River Endangered Fish Recovery Program (May 8, 2018, 06:39 PST) (citing examples of the Recovery Program Director's Office staff official documents including the SSA, the recovery plan, the RIS, and the 5-year review).

221 *Id*.

222 *Id*.

223 Smith et al., *supra* note 29, at 302.

224 Smith et al., *supra* note 29, at 303.

225 Smith et al., *supra* note 29, at 302, 315.

species in both current and future time periods[226] structured around the principles of conservation biology (the three R's): resiliency, representation, and redundancy.[227] Multiple future scenarios of environmental and management conditions are discussed as they pertain to the viability of a species in the future to consider the full range of uncertainty in predicting future conditions,[228] and a Science Advisory subgroup then evaluates these scenarios.[229] In turn, independent peer reviewers and partner representatives review the SSA before it is used as the scientific basis to support FWS policy decisions, such as a 5-year review recommendation and development of a recovery plan.[230]

Under the FWS revised approach to recovery planning, recovery plans are streamlined to "provide a road map with detailed site-specific management actions" that provide "guidance on how best to help listed species achieve recovery [e.g., delisting]."[231] The body of a recovery plan includes recovery criteria, recovery actions, threats, and estimates of the time and costs to achieve the goals.[232] Recovery criteria are based on the species' needs regarding population dynamics, range, composition, and other qualities identified in the SSA, and measure progress toward and achievement of the desired recovered state, expressed in terms of the three R's.[233] Recovery actions, are (1) "prioritized to address the most significant threats first"; (2) focused on a "visionary" level but still "maintain a site specific connection required under the ESA"; and (3) specify the actions necessary to bring each threat from its current state to the state described by the recovery criterion for that threat.[234] Estimates of time and cost to achieve the actions and criteria remain unchanged by the revised RPI approach.[235] It should be noted that recovery plans are not regulatory documents and do not have the force of law.[236] Instead, they establish

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226 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB 5-YEAR REVIEW (2018), *supra* note 181, at 2.

227 U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB, *supra* note 28, at 3–4; Smith et al., *supra* note 29, at 306 (defining resiliency as "the ability of individuals and populations to withstand environmental or demographic catastrophic events in a way that spreads risk to minimize potential loss of the species is called redundancy."; To achieve redundancy, multiple resilient populations must exist across the range of a species. Representation describes the ability of a species to adapt as environmental conditions change over time and is dependent on genetic and environmental diversity within and among populations).

228 Smith et al., *supra* note 29, at 306–15.

229 McAbee, *supra* note 220.

230 Smith et al., *supra* note 29, at 307.

231 U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLANNING AND IMPLEMENTATION, s*upra* note 29, at 1.

232 *Id*. at 2.

233 U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLANNING AND IMPLEMENTATION, s*upra* note 29, at 2 (explaining the three R's describe the biological state of recovery, the ameliorated or mitigated state of the threats that facilitate achievement of the biological criteria, and the long-term persistence of these conditions).

234 *Id*.

235 *Id*.

236 Friends of Blackwater v. Salazar, 691 F.3d 428, 432–34 (D.C. Cir. 2012); Cascadia Wildlands v. Bureau of Indian Affairs, 801 F.3d 1105, 1114 (9th Cir. 2015).

goals for long-term conservation, define criteria that are designed to indicate when the threats facing a species have been removed or reduced to such an extent that the species may no longer need the protections of the ESA, and detail actions that may be employed to achieve reaching the criteria.[237] On-the-ground activities that aim to implement recovery actions are included in the separate RIS.[238]

The RIS is a short-term adaptable document that focuses on implementing recovery actions.[239] Its flexibility allows for consideration of species' biological conditions, threats to existence, and understanding how these stressors can change frequently and significantly.[240] The RIS permits adaptation to changing circumstances and more resilient recovery strategies, which is expected to significantly reduce the time, costs, and amount of revisions necessary during the recovery planning process.[241] However, under the revised RIP method, "[t]aking advantage of the flexibility of the RIS does not absolve the [FWS] from revising recovery plans, should new information indicate a need to revise statutory elements such as the recovery criteria or the over-arching actions in the plan."[242]

ii. The Humpback Chub 2017 Species Status Assessment

While there is no direct ESA mandate to create SSAs, section 4(b) of the ESA arguably implies that one must be completed.[243] Section 4(b)(1) states that listing or reclassification determinations should be made "solely on the basis of the best scientific data available . . . *after conducting a review of the status of the species* and after taking into account those efforts . . . made . . . to protect such species . . ."[244] Additionally, section 4(b)(2) states that designations of critical habitat, and revisions thereto, should be made "on the basis of the best scientific data available and after taking into consideration the economic impact, the impact on national security, and any other relevant impact . . ."[245]

The Humpback Chub's Species Status Assessment is comprehensive.[246] Six sections, nearly forty figures, twenty tables, and three appendices are included in the 240-page assessment.[247] It assesses the biological status of a

237 *Friends of Blackwater*, 691 F.3d at 432–34; *Cascadia Wildlands*, 801 F.3d at 1114.

238 U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLANNING AND IMPLEMENTATION, *supra* note 29.

239 *Id*.

240 *Id*.

241 *Id*.

242 *Id*.

243 *See* 16 U.S.C. § 1533(b) (2017).

244 16 U.S.C. § 1533(b)(1) (emphasis added).

245 16 U.S.C. § 1533(b)(2).

246 *See generally* U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB, *supra* note 28.

247 U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB, *supra* note 28.

species in three stages; it evaluates species' needs, species' current condition, and species' future condition, as well as the species' viability.[248] While the ESA requires listing determinations to identify the factors causing endangerment (or the section 4(a) factors), the ESA does not specify how these factors should be considered in the recovery planning process.[249] The SSA does not expressly evaluate the section 4(a) factors; instead "[t]he SSA approach *within each stage of the assessment* is to hypothesize and evaluate the causal relationships between the [ESA section 4(a)] factors and the species' response."[250] For instance:

> Stage 1 describes the influence of habitat (factor A) and other natural factors (e.g., factor C: disease and predation) on the species' ecology. Stage 2 identifies and evaluates any of the factors that researchers have hypothesized to have led to the current condition of the species. Stage 3 incorporates the factors, which researchers have hypothesized to have population-level effects, into scenarios used to forecast the species' future condition. The SSA considers not just the presence of the factors, but assesses to what degree they influence risk. Because the SSA uses metrics for demographics, distribution, and diversity, the effect of multiple stressors is inherent in the assessment and helps to assess how populations and ultimately the species responds cumulatively to the interactive effects of stressors and conservation efforts included in the future scenarios.[251]

Part I provides an overview of the framework for the SSA.[252] Part II expresses the purpose: The SSA "is not a decisional document."[253] It is "independent of the application of policy or regulation" and, instead, is an analytical tool that "provides a consistent, scientifically-based and conservation-focused assessment of the biological status of a species."[254] Furthermore, the SSA "provides a framework for the development of recovery criteria in the species recovery plan."[255]

Part II provides an overview of the Humpback Chub describing the range, distribution, evolutionary history, genetics and hybridization, and the fish's legal protections and status.[256] "The current range of the Humpback Chub is sixty-two percent of its historical range, which was inferred from paleontological evidence, reports, and photographs by early explorers, and historical fish collections."[257] "This historical range includes the Colorado River

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248 *Id.* at 2.

249 Smith et al., *supra* note 29, at 307.

250 *Id.* (emphasis added).

251 *Id.*

252 U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB, *supra* note 28, at 1–5.

253 *Id.* at 2.

254 *Id.* at 2–3.

255 *Id.* at 3.

256 *Id.* at 5–14.

257 *Id.* at 6 (citing Final Rule Determination of Critical Habitat; 59 Fed. Reg. 13374) (stating the historical range is an estimated 2,180 km of river).

from the Black Canyon near present-day Hoover Dam, AZ/NV, upstream to Debeque Canyon, CO; the Green River to the Blacks Fork River, WY; and the Yampa River through Cross Mountain Canyon, CO."[258]

Part III provides a summary of the Humpback Chub's needs.[259] The species' seven life stages – spawning, eggs, larvae, age-0, juveniles, sub-adults, and adults, and the conditions required for species success to each next life stage – characterize the Humpback Chub's needs.[260] The most important categories of resource conditions for species success include:

> 1. Diverse rocky canyon river habitat for spawning, nursery, feeding, and shelter.
>
> 2. Suitable river flow and temperature regimes for spawning, egg incubation, larval development, and growth.
>
> 3. Adequate and reliable food supply, including aquatic and terrestrial insects, crustaceans, and plant material.
>
> 4. Habitat with few nonnative predators and competitors that allow the young to survive and recruit to maintain self-sustaining populations.
>
> 5. Suitable water quality with few contaminants and little risk of spills of petroleum products and other toxic materials.
>
> 6. Unimpeded range and connectivity that allow free movement and access to habitats necessary for all life stages.
>
> 7. Persistent populations, each with reproductive potential, recruitment, and adult survival, to ensure redundancy.
>
> 8. High genetic diversity within and across populations to maintain and ensure adaptive traits.[261]

Part IV elaborates on the current condition of the Humpback Chub in the Upper and Lower Basins.[262] It evaluates resource conditions, ongoing management actions, and population monitoring for each of the six established populations of Humpback Chub in the Colorado Basin.[263] For the Upper Basin, most of the resource categories are in "good to neutral" condition.[264] This is because, generally, these populations have "high quality rocky canyon habitat, suitable temperature, adequate food base, unimpeded connectivity, and high genetic diversity."[265] Though there is concern and uncertainty for the fish regarding adequate flow regimes, the existence of nearby populations of

[258] *Id.*
[259] *Id.* at 15–33.
[260] *Id.* at vi–vii.
[261] *Id.*
[262] *Id.* at 34–124.
[263] *Id.* at vi–vii.
[264] *Id.*
[265] *Id.*

nonnative fish, and intrinsic growth rates that do not indicate population growth.[266] The most up-to-date population-monitoring data in the Upper Basin demonstrates that adult abundance and population trajectories vary and estimates are insufficient to reach a reliable conclusion about adult populations in the Upper Basin.[267]

Part V evaluates the future condition of the Humpback Chub.[268] To determine future condition, the SSA considers future resource conditions, which are based on species' need categories identified in Part III, for each population of Humpback Chub in the Colorado Basin, during a biologically meaningful timeframe, and under three future scenarios.[269] The SSA developed scenarios to assess how management actions will impact future resource needs and uncertain future conditions for the Humpback Chub.[270] "The scenarios include varying levels of implementation of recovery actions and effectiveness of active and adaptive management."[271] For instance, each of the future scenarios assume that the risk from nonnatives will increase and water availability will be lower.[272] "Scenarios explore the response of . . . species to environmental stressors (including climate change) and interventions by conservation efforts that could ameliorate the stressors" and "[t]he combination of variation among scenarios and uncertainty in forecasts within scenarios is used to explore . . . the plausible range in [a] species' response to future stressors and conservation efforts."[273]

Scenario 1 assumes that environmental stressors increase and new or discretionary extralegal actions (such as stakeholder actions to mitigate decreased water availability, future water development, or nonnative fish) are eliminated.[274] However, Scenario 1 also assumes that conservation actions

266 *Id*.

267 *Id*. at ix.

268 *Id*. at 125–53.

269 *Id*. at x (For calculation purposes, the SSA evaluates the future condition of the Humpback Chub at a biologically meaningful timeframe of sixteen years. This timeframe of sixteen years corresponds to approximately two generation times in the Upper Basin (< 2 in the Lower Basin because of higher adult survival.)).

270 *Id*. at 134–35.

271 *Id*. at 134.

272 *Id*.

273 Smith et al., *supra* note 29, at 306 (citing to Peter N. Duinker and Lome A. Greig, *Scenario Analysis in Environmental Impact Assessment: Improving Explorations of the Future*, 27 ENVIRONMENTAL IMPACT ASSESSMENT REVIEW 206, 206–19 (2007) 206–19; D.A. Fordham et al., *Adapted Conservation Measures are Required to Save the Iberian Lynx in a Changing Climate* 3 NATURE CLIMATE CHANGE 1, 1–5 (2013); Robin Gregory, Joseph Arvai, and Leah R. Gerber, *Structuring Decisions for Managing Threatened and Endangered Species in a Changing Climate*, 27 CONSERVATION BIOLOGY 1212, 1212–21 (2013); [IPBES] INTERGOVERNMENTAL SCIENCE-POLICY PLATFORM ON BIODIVERSITY AND ECOSYSTEM SERVICES, *Summary for Policymakers of the Methodological Assessment of Scenarios and Models of Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*; L. Phillips-Mao et al., *Model-Based Scenario Planning to Develop Climate Change Adaptation Strategies for Rare Plant Populations in Grassland Reserves*, 193 BIOLOGICAL CONSERVATION 103, 103–14 (2016)).

274 U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB, *supra* note 28, at 134–35.

codified under binding agreements or laws (such as NEPA) continue.[275] Scenario 2 assumes that "legally mandated management actions and additional adaptive management actions occur, but are ineffective . . . to mitigate impacts of drought, future water development, nonnative fishes, or other threats." [276] Scenario 3 assumes that "legally mandated management actions and additional proactive and adaptive stakeholder agencies' management practices occur into the future for the species[, and] these actions are sufficient to mitigate impacts of drought, future water development, nonnative fishes, or other threats."[277] The future condition of the Humpback Chub is estimated under each scenario based on the estimated effect of the future management condition to the Humpback Chub's resource needs categories in each distinct population of Humpback Chub.[278] The process of evaluating future likely scenarios elucidates the value and importance of Recovery Program and Stakeholder engagement for the success of management actions.

In Part 5.2, the SSA acknowledges that "several risks and uncertainties [exist, and may impede] . . . the Humpback Chub [from] . . . maintaining redundancy, resiliency, and representation for a biologically meaningful time frame."[279] These risks and uncertainties include: less stream flow; higher water temperatures; predation and competition from non-native fish; reduced genetic diversity; unreliable population trajectories; efficacy and intensity of management actions; and reduced water availability.[280] Each are discussed below in further detail.

The SSA explains that episodic droughts increase air and water temperature and cause more evaporative losses and reduce stream flow.[281] Decreases in stream flow reduce habitat, stress food supply, and exacerbate species interactions that may cause increased predation/ competition and an increased likelihood of competition and hybridization with Roundtail Chub.[282] While the Upper Basin has developed, applied, evaluated, and revised a flow regime beneficial to the native fishes to provide the fish with more natural and consistent flow conditions, uncertainties remain concerning the ability of stakeholders to provide current flow management actions into the future.[283] An

[275] *Id*.; U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB 5-YEAR REVIEW (2018), *supra* note 181, at 9 (explaining the unresolved future of the collaborative partnership in the Upper Basin (the UCREFRP) in scenario 1 results in many of the predictions for degraded resource conditions; whereas a continued commitment to the partnership in scenarios 2 and 3 maintain more adequate resource conditions).

[276] U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB, *supra* note 28, at 134–35.

[277] *Id*.

[278] *Id*. at 134.

[279] U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB, *supra* note 28, at 126–33.

[280] *Id*.

[281] *Id*. at 127–28.

[282] U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB, *supra* note 28, at 127–28.

[283] *Id*.

increase in demand on Colorado Basin Compact water and a decreased supply and a lack of legal protection for flows to benefit native fish could decrease stakeholder ability to meet flow recommendations, which thereby decreases the certainty of flow management projections.[284]

Warming stream temperatures, as the SSA describes, have been evident in the Colorado River System for the past six decades and are likely to negatively impact the Humpback Chub indirectly because they increase the risk of nonnative fish establishment among Humpback Chub populations.[285] Whether nonnative fish respond positively, and expand range into Humpback Chub range, or respond negatively, and become constrained by temperature increases, remains uncertain.[286]

Regarding predation and competition by nonnative fish, the SSA states that there are eighteen species of nonnative predators and competitors that currently co-occur with the Humpback Chub.[287] Despite the fact that nonnative fish management actions are guided by robust scientific evaluation, funded and implemented at near-maximum capacity, and accomplished at an immense geographic scale, their effectiveness is unknown.[288] Furthermore, the canyons inhabited by Humpback Chub may not be as resistant to colonization of Smallmouth Bass as they are thus far believed to be.[289]

While the genetic diversity of five of the six populations of Humpback Chub appears to be relatively high and stable, the SSA explains that the "Glen Canyon Dam has separated the [U]pper [B]asin populations from the lower basin since 1963, with no chance of natural movement or exchange of individuals or genetic material."[290] Small populations are subjectable to loss of genetic diversity, while co-existence of the Humpback Chub with Roundtail Chub and Bonytail in the Upper Basin could make the Humpback Chub more susceptible to hybridization and an associated loss of adaptive traits.[291]

The SSA concludes that Humpback Chub's population trajectory is uncertain for the Upper Basin populations because adult abundance estimates are too few and varied for a reliable projection of population trajectory or are incomplete.[292] "For a long-lived species such as Humpback Chub, evaluating population changes as either meaningful indices of change or as natural variability often requires long, robust datasets."[293] Without prolonged monitoring, the SSA cannot determine with certainty whether populations are

284 *Id.*
285 *Id.* at 127.
286 *Id.*
287 *Id.* at 128–29.
288 *Id.*
289 *Id.*
290 *Id.* at 128–31.
291 *Id.*
292 *Id.* at 132.
293 *Id.* at 131–32.

responding to management actions or experiencing natural variation in population dynamics.[294]

Conservation of the Humpback Chub is coordinated by three principal programs that consist of stakeholders from federal, state, private, and tribal interests; for instance, the Upper Colorado River Endangered Fish Recovery Program (Recovery Program) coordinates recovery for the Colorado Pikeminnow, Humpback Chub, Razorback Sucker, and Bonytail in the Upper Basin.[295] The Program is currently funded through September 30, 2019, although it is anticipated that funding will be extended through 2023.[296] The SSA details concerns that continued implementation of management actions will be hampered if funding of these conservation programs is not continued for the entire biologically meaningful timeframe analyzed. For this reason, the efficacy and intensity of management actions are uncertain.[297]

Additionally, the SSA explains that one of the biggest uncertainties for the hydrology of the Colorado River System is projecting future manifestations of reduced water availability:[298] "[s]hifts in hydrology and temperature in the last few decades . . . have resulted in warmer water temperature, increased evaporation, reduced stream flow, and a shift from winter snow storage to spring snow/rain mix. All projections indicate that this pattern is likely to continue."[299] An increased frequency of droughts will be characterized by multiple consecutive years of low spring flow that is likely to reduce reproduction and recruitment in Humpback Chub populations and allow expansion of nonnative fish and Roundtail Chub into Upper Basin populations.[300]

Part VI evaluates Humpback Chub species viability.[301] After "considering population traits, the current condition of resource needs, and the potential future condition of resource needs, the Science Advisory Team evaluated expected condition of resiliency, redundancy, and representation at the biologically meaningful timeframe under the three potential future scenarios described by the [FWS]."[302] Based on this evaluation, the SSA found stream flow, stream temperature, and nonnative fish populations (notably, these are climate-change driven conditions) are the significant resource conditions impacting future Humpback Chub resiliency, representation, and redundancy.[303] The report further describes the Upper Basin populations' viability as more tenuous than Lower Basin populations' viability:[304] "In the [U]pper [B]asin, scenario 1 provides bad conditions for Humpback Chub, while scenario 2

294 *Id*.
295 *Id*.
296 *Id*.
297 *Id*.
298 *Id*. at 133.
299 *Id*.
300 *Id*.
301 *Id*. at 154–63.
302 *Id*. at xiv.
303 *Id*. at 134.
304 *Id*. at xv.

provides poor to neutral conditions, and scenario 3 provides fair conditions that support the species."[305]

iii. The Humpback Chub 2018 5-Year Status Review

As a brief review, section 4(c)(2) of the ESA requires that the FWS conduct a review of all listed species every five years, at minimum, to determine whether each species should "(i) be removed from such list; (ii) be changed in status from an endangered species to a threatened species; or (iii) be changed in status from a threatened species to an endangered species."[306] The purpose of this mandate is to "assess each threatened and endangered species to determine whether its status has changed since the time of its listing, or its last status review, and whether it should be classified differently or removed from the list of threatened and endangered species."[307] Under section 4(c)(2)(B)(iii), the process for changing a species' designation (e.g., downlisting from endangered to threatened, or delisting and removing ESA protections) must follow sections 4(a)(1) and 4(b).[308] Section 4(a)(1) requires that the determination whether any species is an endangered species or a threatened species be based on any of the following factors:

> (A) the present or threatened destruction, modification, or curtailment of its habitat or range;
>
> (B) overutilization for commercial, recreational, scientific, or educational purposes;
>
> (C) disease or predation;
>
> (D) the inadequacy of existing regulatory mechanisms; or
>
> (E) other natural or manmade factors affecting its continued existence.[309]

And, Section 4(b) requires that this determination be "solely on the basis of the best scientific and commercial data available . . . after conducting a review of the status of the species and after taking into account those efforts, . . . made . . . to protect such species."[310]

The Humpback Chub's 2011 5-Year Status Review considers the five listing factors in section 4(a) in conjunction with any new scientific or commercial data on the species for subsequent reclassification or delisting decisions.[311] The document evaluates whether a final, approved revised recovery

305 *Id*.
306 16 U.S.C. § 1533(c)(2) (2017).
307 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB 5-YEAR REVIEW (2011), *supra* note 85, at 1.
308 16 U.S.C. § 1533(c)(2)(B)(iii).
309 16 U.S.C. § 1533(a).
310 16 U.S.C. § 1533(b).
311 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB 5-YEAR REVIEW (2011), *supra* note 85.

plan containing objective, measurable criteria, exists for the species; the adequacy of recovery criteria; whether or not the recovery criteria reflect the best available information about the biology of the species and its habitat; if all of the five listing factors are addressed in the recovery criteria; and whether each recovery criterion has or has not been met.[312] In contrast, the 2018 5-year Review is a relatively short document.[313] The 2018 Review is based on the analyses provided in the 2017 SSA, and supports the 2017 recommendation to reclassify the Humpback Chub as threatened.[314] Specifically, the main body of the more recent 5-year Review provided a summary of the SSA's findings,[315] stating that:

> [b]ased on the current condition of the Humpback Chub described in the SSA report and summarized above in terms of resiliency, redundancy, and representation, we conclude that the current risk of extinction is low, such that the species is not in danger of extinction throughout all of its range . . . [and] the potential extirpation of multiple populations is not likely to occur now and in the short-term. . . . Therefore, we conclude that the Humpback chub does not meet the definition of an endangered species. . . . Because . . . there is enough risk to the species under scenarios 1 and 2 in 16 and 40 years into the future[,] . . . we conclude that this species meets the definition of a "threatened" species.[316]

The 2018 5-year Review determines present ecological conditions mostly satisfy three of the four measurable and objective demographic criteria (included in the 2002 Humpback Chub Recovery Goals) required for downlisting the Humpback Chub.[317] Consequently, the 5-year Review recommended the FWS proceed with a proposed rule to formally downlist the Humpback Chub and revise the Humpback Chub's recovery plan accordingly (anticipated in the coming year).[318]

B. *Problems with the Recovery Planning Process*

Noting the differences and challenges among the Humpback Chub's recovery plans, 5-year reviews, and recovery goals through previous decades illuminates that achieving recovery in a timely fashion is challenging.[319] For instance, in the 1990 Recovery Plan the FWS anticipated to achieve recovery by

312 *Id.* at 1.

313 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB 5-YEAR REVIEW (2018), *supra* note 181.

314 *Id.* at 2 (The SSA report represents the best available scientific information evaluating three future scenarios of environmental and management conditions to discuss the viability of the species in the future "as the scientific basis to support our 5-year review decision-making process.").

315 *Id.* at 3–11.

316 *Id.* at 311–12.

317 *Id.* at 12–13 (providing the measurable and objective demographic criteria required for down-listing).

318 *Id.* at 13; McAbee *supra* note 161.

319 *See supra* Part IV(A).

2003[320] but only released the Recovery Goals in 2002. Additionally, previous recovery documents contain various types of information in various formats.[321] For instance, the Humpback Chub 1990 Recovery Plan itself did not provide "objective, measurable criteria which, when met, would result in a determination, in accordance with the provisions of this section, that the species be removed from the list" as mandated by section 4(f)[322] of the ESA.[323] The Humpback Chub 2002 Recovery Goals, which were intended to amend the recovery plan, included objective and measurable criteria, but because the Recovery Goals did not detail recovery timelines and estimated costs, they were withdrawn and declared of no force and effect by court order in 2006.[324]

The recovery planning process was also criticized due to a lack of consistency and transparency, and for its sole focus on threats and omittance of discussions regarding how to respond to those threats.[325] The process also lacked "clear distinctions between science input and policy application."[326] The FWS itself acknowledged that recovery plans were static, un-amendable documents that took years to create and became quickly outdated, and, as a result, has revised its recovery planning process.[327] The FWS efforts to do so, as well as the results, are commendable.

Nevertheless, the FWS revised recovery planning method does not completely ameliorate the difficulties revealed by the recovery planning process for the Humpback Chub. While the FWS streamlined the recovery process, questions remain. First, of what purpose and utility does the recovery plan offer to the recovery planning process if the document is not legally binding? Second, does the revised method ensure recovery plans meet the adaptability needed by scientists and ecologists and the certainty needed by the policy planners and decision-makers? Both the 1990 Recovery Plan and the revised recovery planning method intend for recovery plans to be open to revision based on new information;[328] however, twenty-nine years later, the 1990 Recovery Plan still stands, without an update.[329]

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320 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB RECOVERY PLAN, *supra* note 18, at 23.

321 *See supra* Part IV(A).

322 16 U.S.C. § 1533 (f)(1)(B)(ii) (2017).

323 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB RECOVERY PLAN, *supra* note 18, at 28.

324 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB 5-YEAR REVIEW (2018), *supra* note 181, at 3.

325 Smith et al., *supra* note 29, at 302–03; 315 (citing Andelman et al., *A Review of Protocols for Selecting Species at Risk in the Context of U.S. Forest Service Viability Assessments*, 26 ACTA OECOLOGICA 75, 75–83 (2004)).

326 *Id*. at 302.

327 U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLANNING AND IMPLEMENTATION, s*upra* note 29.

328 U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLANNING AND IMPLEMENTATION, s*upra* note 29; U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB RECOVERY PLAN, *supra* note 18, at 14.

329 U.S. FISH AND WILDLIFE SERVICE, HUMPBACK CHUB RECOVERY PLAN, *supra* note 18; U.S.

The FWS has not yet finalized a revised recovery plan based on a corresponding SSA under the revised framework for recovery planning for any of the ESA-protected fishes in the Upper Basin, though "[a] revised recovery plan for the Humpback Chub will be developed under these new methods and the recovery planning process is expected to being in 2020."[330] In anticipation of this revised recovery plan and due to the difficulties experienced with recovery planning in the past, this article recommends that forthcoming recovery plans be drafted under the following revised methodology.

C. *Finding Alignment Through Holistic Recovery*

This article advocates for holistic recovery planning for the four ESA-protected fish species in the Upper Basin. Holistic recovery planning focusses on the alignment between, and the functionality of, the scientific and policy mechanisms used in recovery planning. To accomplish this, recovery documents must first clearly acknowledge statutory provisions specific to recovery planning. Statutory mandates must be indisputably met, in both an actionable and a documentable way, throughout the recovery planning process for each species. Second, for the recovery plan to effectuate its goals of attaining long-term conservation of listed species (or define criteria designed to indicate the removal or reduction of threats, develop actions that may be employed to achieve criteria, and estimate time and costs necessary to achieve the criteria and actions), the document *must* be adaptable. Adaptability entails relatively short documents that can be concurrently revised with every version of a species' SSA.

1. Explicitly Acknowledging the Statutory Provisions of the ESA

The statutory provisions specific to the recovery planning process include section 4(a), which governs how to determine whether a species deserves ESA protection; section 4(b), which specifies the type of data that should serve as the basis for a determination that a species deserves ESA protections; section 4(c), which controls listing classification determinations; and section 4(f), which administers recovery plans.[331]

The FWS revised recovery planning method explicitly addresses each statutory mandate, except for the factors in section 4(a)(1).[332] For instance, under the revised recovery planning method, the recovery plan and the RIS must develop recovery criteria, recovery actions, and on-the-ground implementations based on the framework and scientific findings contained in the SSA.[333] By requiring the SSA to be the foundational document for the rest of the recovery

FISH AND WILDLIFE SERVICE, HUMPBACK CHUB 5-YEAR REVIEW (2018), *supra* note 181, at 13.

330 McAbee, *supra* note 161.

331 16 U.S.C. §§ 1533 et seq. (1973).

332 U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLANNING AND IMPLEMENTATION, s*upra* note 29.

333 *Id*.

planning documents,[334] decisions are more likely to be made "solely on the basis of the best scientific and commercial data available" as sections 4(a) and 4(b) require.[335] While the SSA, which is the scientific basis for all of the other recovery documents,[336] is supposed to be based on the listing factors contained in section 4(a)(1),[337] the Humpback Chub's 2018 SSA does not expressly list or refer to the factors.[338] Because the factors in section 4(a)(1) are statutorily mandated to be considered in listing decisions and listing decisional documents are now to be based on the SSA, it would be more appropriate for the SSA to expressly consider the section 4(a)(1) factors.[339] Because the SSA is in fact meant to incorporate the section 4(a)(1) factors,[340] expressly pointing out where the factors are considered is a simple change that will eliminate superfluous legal challenges to the sufficiency of each species' recovery planning process.

2. The Succinct & Adaptable Recovery Plan

Expressly meeting the statutory mandates of the ESA is just one part of the solution; recovery plans themselves must be adaptable to the rest of the recovery process. Separating the recovery plan and the RIS, which are arguably policy applications of the science, from the SSA, or the science, achieves some of this necessary adaptability for recovery planning to be more functional.[341] This is because now, intentionally, the science will not be muddled with the policy actions.[342] Additionally, the SSA does a notable job considering likely future outcomes for the Humpback Chub based on climate change, the continued presence of recovery actions, and uncertainty.[343] But recovery plans are not currently flexible documents, and they must be to offer more utility to the recovery process.

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[334] Smith et al., *supra* note 29, at 305, Figure 1 ("Each decision can be informed by the SSA, which has been adapted to account for decision context and updated to include new data and information").

[335] 16 U.S.C. § 1533(a)(b) (2017) (sections 4 (a) and 4(b) require that the listing determination and the critical habitat designation are founded "solely on the basis of the best scientific and commercial data available").

[336] Smith et al., *supra* note 29, at 305.

[337] *Id*. at 307.

[338] U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB, *supra* note 28.

[339] 16 U.S.C. § 1533(a)(1) (2017).

[340] Smith et al., *supra* note 29, at 307 (stating, "The ESA requires that a listing determination identify the factors causing endangerment, but the law does not *specify* how the factors should be considered. . . . The SSA considers not just the presence of the factors, but assesses to what degree they influence risk. Because the SSA uses metrics for demographics, distribution, and diversity, the effect of multiple stressors in inherent in the assessment and helps to assess how populations and ultimately the species responds cumulatively to the interactive effects of stressors and conservation efforts included in future scenarios.").

[341] *Id*.

[342] *Id*. at 302.

[343] U.S. FISH AND WILDLIFE SERVICE, SPECIES STATUS ASSESSMENT FOR THE HUMPBACK CHUB, *supra* note 28; Smith et al., *supra* note 29.

Recovery plans are also not legally binding.[344] In fact, "the FWS recovery plans are not mandatory"[345] and "the criteria in a recovery plan [need not] be satisfied before a species may be delisted pursuant to the [section 4(a)] factors in the Act itself."[346] Arguably, the reason recovery plans were found to not be legally binding is because they were inflexible documents that could not be adapted as scientists learned more about a species and as new data was collected. In the D.C. Circuit's words, "A [recovery] plan is a statement of intention, not a contract. If events overtake the plan, then there is no need to change the plan; it may simply be irrelevant."[347] But, this result begs the question: if new data or events make the recovery plan irrelevant, why should the FWS be statutorily mandated to spend time and resources creating the recovery plan? Requiring recovery plans to adapt to new information will give the document more functionality in the recovery planning process, as opposed to creating needless paperwork that "may simply be irrelevant" soon after the recovery plan is developed.[348]

Because "[c]onflating the roles of science and policy can create unnecessary confusion within the agencies charged to make ESA decisions and with the public and partners who are affected by those decisions", "it is important to distinguish the roles of science and policy."[349] The revised recovery planning method does this by separating the science document (SSA) from the policy decisional documents (recovery plan, RIS, 5-year review, etc.), yet ". . . it is [also] *essential* that the scientific information matches the decision context."[350] If a recovery plan is not amended after each iteration of a SSA, the scientific information will not match the decisional context. A recovery plan's goal is to "provide a road map with detailed site-specific management actions" that provide "guidance on how best to help listed species achieve recovery [i.e., delisting];"[351] consideration of current data enables accurate and relevant recovery plans.

Finding alignment between the adaptability needed by scientists and the certainty needed by policy planners and decision-makers requires succinct and adaptable recovery plans. The FWS should further amend the RPI approach to recommend page allocations for each section – criteria, actions, and time and

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344 *Friends of Blackwater*, 691 F.3d at 432.

345 *Cascadia Wildlands*, 801 F.3d at 1114 n. 8.

346 *Friends of Blackwater*, 691 F.3d at 437.

347 *Friends of Blackwater*, 691 F.3d at 434.

348 *Id*.

349 Smith et al., *supra* note 29, at 303 (citing K. Robbins K, *Strength in Numbers: Setting Quantitative Criteria for Listing Species Under the Endangered Species Act*, 27 J. OF ENV'T L. 1, 1–37 (2009); G.F. Wilhere, *Inadvertent Advocacy*, 26 CONSERVATION BIOLOGY 39, 39–46 (2011); R.S. Waples et al., *A tale of Two Acts: Endangered Species Listing Practices in Canada and the United States*, 63 BIOSCIENCE 723, 723–34 (2013); C. Boyd et al., *Consistent Extinction Risk Assessment Under the U.S. Endangered Species Act,* CONSERVATION LETTERS (2016)).

350 Smith et al., *supra* note 29, 315 (emphasis added).

351 U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLANNING AND IMPLEMENTATION, *supra* note 29; 16 U.S.C. § 1533(f)(1)(B) (2017).

cost estimates – to ensure the document remains concise. Additionally, the FWS should further amend the RPI approach to require revisions to recovery plans after every version of a SSA.[352]

IV. CONCLUSION

While the FWS revised recovery planning method aspires to look to all available data – including climate change – that may impact a species presently and under multiple future scenarios,[353] ensuring compliance with statutory mandates, in practice and on paper, will limit needless litigation. Aligning the scientific and policy documents, such that the "scientific information *matches* the decision context," assures recovery plans offer utility to the recovery planning process and comply with statutory mandates.[354] Therefore, recovery plans must be succinct and amended after conducting or updating each SSA so that they offer utility to the recovery planning process, meet statutory directives, and do not merely serve as irrelevant and time-consuming paperwork.

[352] U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLANNING AND IMPLEMENTATION, *supra* note 29; 16 U.S.C. § 1533(f)(1)(B).

[353] Smith et al., *supra* note 29.

[354] *Id*. at 315.