U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT
AND LISTING PRIORITY ASSIGNMENT FORM
July 7, 2023

SCIENTIFIC NAME: *Macrhybopsis gelida* and *Macrhybopsis meeki*

COMMON NAME: Sturgeon Chub and Sicklefin Chub

LEAD REGION: Region 6

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DATE INFORMATION CURRENT AS OF: July 7, 2023

STATUS/ACTION

___Species petitioned for listing which we have determined is not a listable entity

_X_ Species petitioned for listing which we have determined does not warrant listing (does not meet the definition of a threatened or endangered species)

___Non-listed species for which we have not received a petition but for which we have undertaken a species status assessment on our own initiative and which we have determined does not warrant listing (does not meet the definition of a threatened or endangered species)

___Listed species petitioned for delisting which we have determined does not warrant delisting

____Listed species petitioned for downlisting which we have determined does not warrant downlisting

____Listed species petitioned for uplisting for which we have made a warranted-but-precluded finding for uplisting (this is part of the annual resubmitted-petition finding)

____Listed species petitioned for uplisting which we have determined does not warrant uplisting

____New candidate
____Continuing candidate
Date when the species first became a candidate (as currently defined): N/A

____Listing priority number change
Former LPN: ____
New LPN: ____

____Candidate removal: Former LPN: N/A
____Taxon does not meet the Act's definition of "endangered species" or "threatened species" because it is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
____Taxon does not meet the Act's definition of "endangered species" or "threatened species" because it is not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.
____Taxon does not meet the Act's definition of "species."
____Taxon mistakenly included in past notice of review.
____Taxon believed to be extinct.

Petition Information:
____Non-petitioned
_X_ Petitioned; Date petition received: August 15, 2016
90-day "substantial" finding FR publication date; citation: December 20, 2017; 82 FR 60362

PREVIOUS FEDERAL ACTIONS:

On August 15, 2016, we received a petition dated August 11, 2016, from WildEarth Guardians requesting that the sturgeon chub and sicklefin chub be listed as endangered or threatened and that critical habitat be designated for these species under the Act. On December 20, 2017, we published a 90-day finding (82 FR 60362) that the petition contained substantial information indicating that listing may be warranted for these species. We were later challenged by WildEarth Guardians for our failure to complete a 12-month finding for these species. Based on this litigation, we are now required by Court Order (September 30, 2021) to submit our 12-month finding for these species to the Federal Register by September 30, 2023.

ANIMAL GROUP AND FAMILY: Fish, Leuciscidae

ANALYTICAL FRAMEWORK

To assess the viability of sturgeon and sicklefin chubs, we conducted a species status assessment (SSA) using the three conservation biology principles of resiliency, redundancy, and representation (Shaffer and Stein 2000, pp. 306–311). Briefly, resiliency supports the ability of the species to withstand environmental and demographic stochasticity (for example, wet or dry, warm or cold years, variation in demographic rates), redundancy supports the ability of the species to withstand catastrophic events (for example, droughts, large pollution events), and representation supports the ability of the species to adapt to both near-term and long-term changes in its physical and biological environment (for example, climate change, disease). A species with a high degree of resiliency, representation, and redundancy is better able to adapt to novel changes and to tolerate environmental stochasticity and catastrophes. In general, species viability will increase with increases in resiliency, redundancy, and representation (Smith et al. 2018, p. 306). Using these principles, we identified the species' ecological requirements for survival and reproduction at the individual, population, and species levels, and described the beneficial and risk factors influencing the species' viability.

We use the SSA framework to assemble the best scientific and commercial data available for these species. The SSA framework consists of three sequential stages. During the first stage, we evaluate the species' needs. The next stage involves an assessment of the historical and current condition of the species' demographics and habitat characteristics, including an explanation of how the species arrived at its current condition (i.e., how threats and conservation actions have influenced the species). The final stage of the SSA framework involves assessing the species' plausible range of future responses to positive and negative environmental and anthropogenic influences. The SSA framework uses the best available information to characterize viability as the ability of a species to sustain populations in the wild over time and is used to inform our regulatory decision.

The SSA report does not represent a decision by the Service on whether the sturgeon and sicklefin chubs should be listed as threatened or endangered species under the Act. However, it does provide the scientific basis that informs our regulatory decisions, which involve the further application of standards within the Act and its implementing regulations and policies. The Species Status Assessment Report for the Sturgeon and Sicklefin Chub, April 2023, Version 1.0 (SSA Report) is a summary of the information we have assembled and reviewed and incorporates the best scientific and commercial data available for this species. Excerpts of the SSA Report are provided in the sections below. For more detailed information, please refer to the SSA Report (Service 2023, entire).

BIOLOGICAL INFORMATION

The sturgeon chub is a small minnow adapted to benthic riverine habitats with a slender streamlined body that inhabits turbid mainstem sections of the Missouri River and Mississippi River and some of their tributaries. The species has a widespread distribution across 12 States and currently occupies 53 percent of its historical range (Figure 1) (Service 2023, p. 17).

The sicklefin chub is a small minnow that inhabits large, turbid rivers, including the mainstem Missouri and Mississippi Rivers. Like sturgeon chub, sicklefin chub have also evolved specific adaptations to turbid, riverine habitats. Sicklefin chub is distinguished from the sturgeon chub by long, sickle-shaped pectoral fins and the absence of ridge-like projections on its scales (Steffensen *et al*., 2014., p. 50-51). This species also has a widespread distribution across 13 States and currently occupies 75 percent of its historical range (Figure 2) (Service 2023, p. 20).

A rangewide genetics assessment was recently conducted across the range of both chub species to determine potential population structure (Heist *et al*. 2022, entire). Results from the sturgeon chub population structure analysis indicated three fairly distinct genetic clusters (Heist *et al*. 2022, pp. 3-6; hereafter referred to as populations). Population 1 is from the Upper Missouri River basin, including a segment of the Missouri River and lower Marias River above Fort Peck Reservoir, the Missouri River below Fort Peck Reservoir and above Lake Sakakawea, and segments of the Yellowstone, Powder, Tongue and Bighorn rivers (Figure 1). Population 2 is from three tributaries to the Missouri River in South Dakota; the Cheyenne, White and Little White rivers (Figure 1). Population 3 is from segments of the lower Missouri river and Mississippi rivers, namely Gavins Point Dam on the Missouri River downstream to the confluence with the Mississippi River, then further downstream the Mississippi River to approximately northern Arkansas/Tennessee (Figure 1). Populations are separated by inhospitable habitat (reservoirs) while within populations habitat is largely connected.

Results from the sicklefin chub population structure analysis indicated two populations, which were less distinct than for the sturgeon chub (Heist *et al*. 2022, pp. 6-9). Population 1 is from the Upper Missouri River basin, including a segment of the Missouri River above Fort Peck Reservoir, the Missouri River below Fort Peck Reservoir and above Lake Sakakawea, and a segment of the Yellowstone River (Figure 2). Population 2 is from segments of the lower Missouri river and Mississippi rivers, namely Gavins Point Dam on the Missouri River downstream to the confluence with the Mississippi River, then further downstream the Mississippi River to approximately Louisiana (Figure 2). Populations 1 and 2 for the sicklefin chub are not the same as Populations 1 and 2 for the sturgeon chub (Figures 1 and 2). Populations are separated by inhospitable habitat (reservoirs) while within populations habitat is largely connected.

Sicklefin chub primarily utilize mainstem river habitats, whereas sturgeon chub utilize both mainstem river and tributary habitat in both the Missouri and Mississippi River basins. Populations of both species need large enough areas of connected riverine habitat to fulfill their life history needs (e.g., spawning, egg/larval drift distances, suitable water temperatures, feeding/sheltering habitat) and provide refugia from habitat-altering stochastic events (e.g., extreme flows from intense, sustained drought or increased variability in precipitation) (Service 2023, p. 14). Eggs are spawned in the water column during the summer months and develop (mediated by water temperature) into larva. Both species are capable of having multiple spawns every year (batch spawning) (Service 2023, p. 67). Larval chubs continue to drift in river currents and swim vertically in the water column, with energy provided by the egg yolk sac.

Sturgeon chub and sicklefin chub larvae need unfragmented reaches of river as they develop from vertical swimmers to horizontal swimmers. Length of unfragmented reaches needed for larval development varies and is dependent on water temperature, flow velocity, and habitat complexity, among other variables (Platania and Altenbach 1998, entire; Dieterman and Galat 2004, p. 584; Albers and Wildhaber 2017, p. 14). If larvae drift into a reservoir or still water habitat before they are a horizontal swimmer, it is presumed they settle to the bottom and experience high mortality (Dieterman and Galat 2004, p. 584; Albers and Wildhaber 2017, p. 15). Neither species occupies the large stretches of reservoir habitat produced by dams along the Missouri River system.

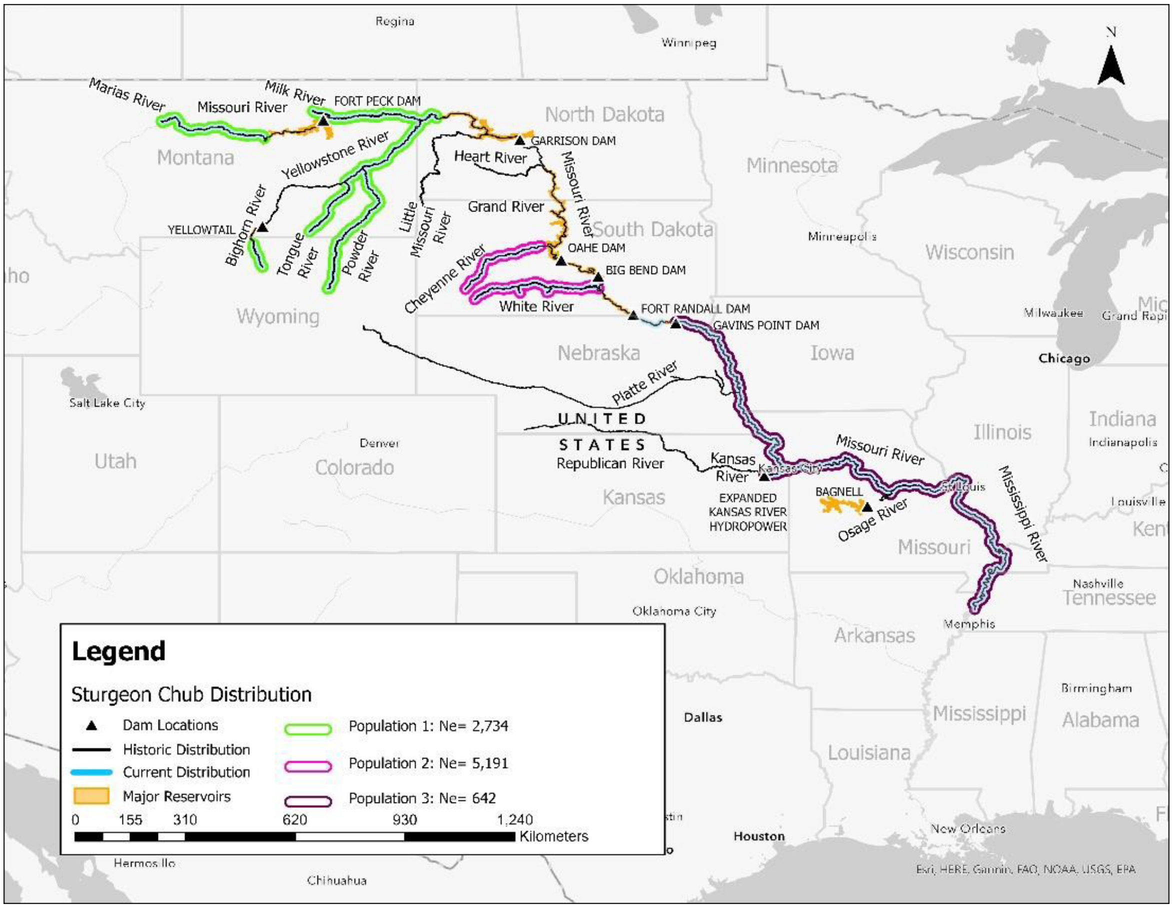

Figure 1. Sturgeon Chub Distribution and Populations.

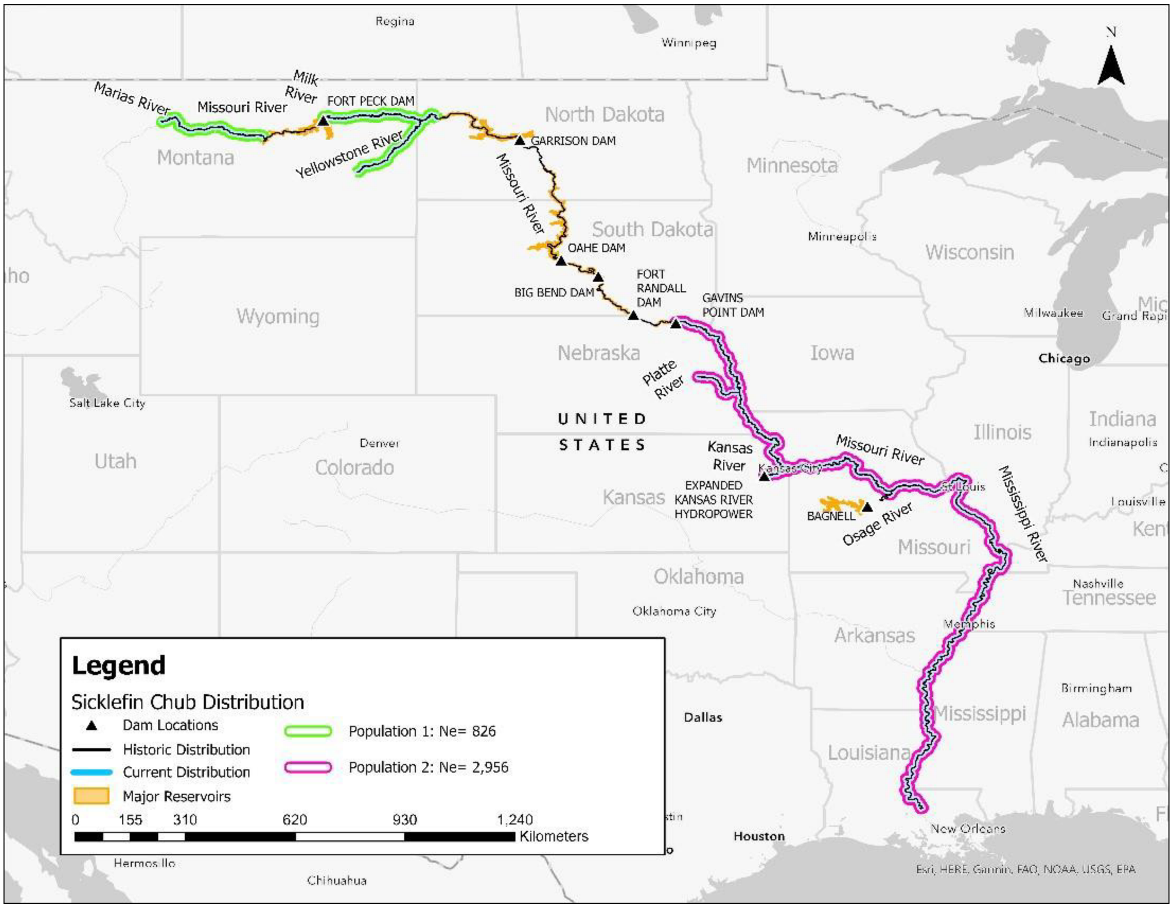

Figure 2. Sicklefin Chub Distribution and Populations.

For additional information on the species description, taxonomy, habitat/life history, historical and current range/distribution please refer to pp. 8-11 and 16-20 of the SSA report. For additional information on population and species needs, please refer to pp. 14-15 of the SSA report.

FACTORS INFLUENCING THE STATUS

The Act directs us to determine whether any species is an endangered species or a threatened species because of any factors (or threats) affecting its continued existence (i.e., whether it meets the definition of a threatened species or an endangered species). We use the term "threat" to refer in general to actions or conditions that are known to or are reasonably likely to negatively affect individuals of a species. The term "threat" includes actions or conditions that have a direct impact on individuals, as well as those that affect individuals through alteration of their habitat or required resources. The term "threat" may encompass—either together or separately—the source of the action or condition, or the action or condition itself.

However, the mere identification of any threat(s) does not necessarily mean that the species meets the statutory definition of an “endangered species” or a “threatened species.” In determining whether a species meets either definition, we must evaluate all identified threats by considering the expected response by the species, and the effects of the threats—in light of those actions and conditions that will ameliorate the threats—on an individual, population, and species level. We evaluate each threat and its expected effects on the species, then analyze the cumulative effect of all of the threats on the species as a whole. We also consider the cumulative effect of the threats in light of those actions and conditions that will have positive effects on the species—such as any existing regulatory mechanisms or conservation efforts. The Secretary determines whether the species meets the definition of an “endangered species” or a “threatened species” only after conducting this cumulative analysis and describing the expected effect on the species now and (if evaluating whether a species is a threatened species) in the foreseeable future.

Threats, Conservation Measures, and Existing Regulatory Mechanisms

Since the sturgeon and sicklefin chubs largely inhabit the same habitats with overlapping ranges and have similar life histories, we assessed the potential stressors to these species together. We identified stressors from the petition, as well as stressors identified by our conservation partners during stakeholder meetings in early 2022, and stressors identified in scientific research, published literature, and technical reports. We evaluated each potential stressor based on the best available information for sturgeon chubs and sicklefin chubs. Often, information was scarce for many of the potential stressors identified. In these cases, we relied on scientific theory, documented impacts of similar potential stressors to similar fish species, or professional judgement.

Missouri River Mainstem Dams/Reservoir Operations

From 1933 to 1964, six dams were built on the mainstem Missouri River to store water for hydroelectric power generation, irrigation, and recreational uses. The construction, operation, and reservoir management associated with mainstem dams on the Missouri River has reduced the current range of sturgeon chubs and sicklefin chubs from historical levels. On the mainstem Missouri River, over 30 percent of riverine habitat within the range of both sturgeon chubs and sicklefin chubs has been transformed from riverine to reservoir habitat due to the six large mainstem dams (Service 2023, p. 46). Additionally, over 20 percent of remaining river habitat before the channelized portion of the Missouri River has been altered due to downstream effects of the mainstem dams (Service 2023, p. 47). These activities have resulted in numerous physical, chemical, hydrological, biological and ecological changes to the Missouri and Mississippi rivers. Some of the many changes include channel morphology, water temperature, turbidity, nutrients, and flow regimes.

Major influences on sturgeon and sicklefin chub habitat due to the construction of these mainstem dams include reduction of sediment transfer and loads, regulated flow downstream of dams, deep cold-water releases below dams and the presence of reservoir habitat instead of riverine habitat. The combination of dam placement and the influence of altered hydrology has fragmented these species' habitat, which is one of the largest stressors to sturgeon and sicklefin chubs (Service 2023, p. 47). Since construction of the dams and associated reservoirs, sturgeon and sicklefin chubs have been extirpated from portions of the mainstem Missouri River including much of South Dakota and North Dakota.

Ultimately, the construction of mainstem Missouri River dams and associated reservoirs is the main population/species level stressor that has led to the largest reduction in habitat for both species. While this stressor has led to a large reduction in habitat, both species are still present above, in between, and below the six mainstem dams (Service 2023, p. 47). Unlike sicklefin chub, sturgeon chub also utilizes tributaries throughout its range. This adaptation has provided refuge for sturgeon chub in areas where the Missouri River is now in a reservoir state. The removal of mainstem Missouri River dams is not planned or expected to happen anytime in the near future. The stressor of mainstem dams, reservoir habitat and associated habitat fragmentation will likely remain on the landscape for decades; however, there are no current plans to construct any new dams on the mainstem Missouri River. The largest effects on both chub species and their habitats from these dams have already occurred, and the impacts of these dams are reflected and incorporated into the current conditions of both chub species (Service 2023, p. 47). Thus, based on the best available information, we do not expect large magnitude population-level effects on either chub species from the continued presence and operation of the Missouri River mainstem dams and reservoirs, beyond what has already occurred.

Climate Change

The broad range in latitude, longitude, elevation, and drainage area across the ranges of both chub species result in wide variations in historical climate conditions. Despite extreme weather events and increased variation in annual weather patterns, reductions in stream discharge have been observed across the range of both chub species. Reductions in stream discharge are positively correlated with declines in chub distribution and abundance (Perkin *et al*. 2010, pp. 8-9). The mechanism for decline is unclear but could be related to mortality from desiccation of some stream segments, increased predation in areas with large congregations of fish, lack of thermal refugia or other biotic or abiotic factors. However, regardless of the mechanism, it appears that historical discharge reductions due to climate change have primarily affected sturgeon chub and sicklefin chub populations in the smaller tributaries in their range rather than mainstem sections of the Missouri and Yellowstone Rivers (Perkin *et al*. 2010, entire).

Mainstem habitats appear to be more climate resilient than those found in smaller tributaries (e.g. upper reaches of the Powder River), likely due to the greater consistency of flows in mainstem habitats from current operations of the Missouri River Reservoir system, and the greater buffering capacity (to water temperature increases, for example) of large volumes of water in mainstem habitats relative to smaller volumes of water in tributaries (Service 2023, p. 50). We currently expect climate change to impact both species at an individual level, but not likely at the population level because of the large proportion of both chub species occupying mainstem river habitats that appear more climate resilient than smaller tributary habitats (Service 2023, p. 50). For Population 2 (Figure 1) of sturgeon chubs, which occurs solely in tributary habitats, we would expect to observe some effect in the population if climate change was operating at the population level. However, it is clear from the rangewide genetic assessment that Population 2 of sturgeon chubs is genetically robust, thus we have no indication that alterations to the habitat that have occurred due to climate change thus far are having population level impacts (Service 2023, p. 50). The rangewide genetic assessment used genetic samples of chubs throughout the range to determine potential population structure and estimate effective population size (Service 2023, p. 25). Climate change and the predicted effects to stream hydrology is one stressor with the most potential for population-level effects to both chub species in the future. Thus, climate change was carried forward into our analysis of Future Conditions and was the focus of analysis for potential future effects to both chub species and their habitats (Service 2023, p. 50 and Chapter 4).

Other Threats Considered

We also looked at the potential negative impact to sturgeon and sicklefin chubs from channel modification, water quality, tributary barriers, pollutants, impingement and entrainment, predation, and hybridization. These threats are likely impacting both species at an individual level but are not occurring at a scope or scale that would impact entire populations of these species either individually or cumulatively. For more information on these threats refer to the SSA report (Service 2023, pp. 45-54).

Channel Modification

Sturgeon and sicklefin chub evolved in dynamic, turbid, braided riverine ecosystems where channel morphology was diverse. Dynamic riverine habitats created differential flow patterns with deep, fast flowing water and associated slow, shallow water side channels that provided spawning and nursery habitat. In conjunction with the establishment of mainstem Missouri River dams and associated reservoirs, channelization of the Missouri River from Sioux City, Iowa to the confluence with the Mississippi River near St. Louis, Missouri has reduced the quantity and quality of instream habitat for both chub species (Service 2023, p. 48). Reductions in access to shallow water nursery habitat and other diverse habitats used by both chub species has likely reduced occupancy and relative abundance of both chub species relative to historical levels. However, despite the habitat changes associated with channelization, both chub species are occupying a large portion of their historical range in these areas and channelization may only be impacting both species at an individual level at some locations throughout their range rather than at a population level (Service 2023, p. 48). The best available information does not show that channel modification is affecting the continued existence of the sicklefin and sturgeon chubs.

Water Quality

Water quality in portions of the Missouri and Mississippi Rivers is currently different from the conditions in which sturgeon and sicklefin chub evolved. Both species require similar water quality to thrive and carry out natural life functions. One major stressor related to water quality that is shown to be essential to healthy populations is the presence of turbidity. Historically both the Missouri and Mississippi Rivers were turbid rivers that transported large amounts of sediment. Reduction in sediment transport and deep-water releases from mainstem dams have created water that is much less turbid. Sturgeon and sicklefin chub utilize benthic environments where turbidity helps decrease interactions with other fish, specifically predators. Interactions between native predators are likely to have increased in areas where turbidity has decreased. Furthermore, sturgeon and sicklefin chub have developed a specific feeding strategy that favors turbid environments. The impacts of decreased turbidity on feeding for these species is an area of uncertainty.

Overall, changes to water quality may be affecting sturgeon and sicklefin chubs. Turbidity and sediment transport are directly correlated. Large decreases in sediment transport due to the mainstem dams has likely had a large impact on sturgeon and sicklefin chub by potentially increasing interactions with predators and reducing the effectiveness of feeding strategies in this new environment (Service 2023, p. 49). It is worth noting that since the dams have been in place both sturgeon and sicklefin chubs still occupy a large portion of their historical ranges and are present in large numbers in areas where turbidity is still present, such as the White River in South Dakota (Magruder 2022, p. 35). We conclude water quality is a stressor that may be impacting both species at an individual level now and into the future. The best available information does not show that water quality is affecting the continued existence of the sicklefin and sturgeon chubs.

Tributary Barriers

Low-head dams (smaller overflow type dams spanning the full width of the river), and road stream crossings have altered stream morphology, flow regimes, and connectivity and can lead to decreased recruitment and survival of aquatic organisms resulting in aquatic biodiversity loss. Because this species uses smaller tributaries where low-head dams are more likely to be found, the life history needs and habitat connectivity for specifically the sturgeon chub are likely impacted by these structures. Low-head dams can prevent sturgeon chubs from accessing upstream habitats within tributaries. Connectivity of habitats can be reduced under low flow conditions caused by drought, thereby reducing the ability of this species to move to more favorable habitats and ultimately recolonize once conditions improve. Tributary barriers and habitat fragmentation are likely impacting sturgeon chub at an individual level now and into the future. The best available information does not show that tributary barriers are affecting the continued existence of the sicklefin and sturgeon chubs.

Pollutants

Hundreds of pollutants are consistently flushed through the Missouri and Mississippi River, and it is difficult to determine the effects on sturgeon and sicklefin chub from these pollutants. Research has documented how pollutants can harm freshwater fishes (Service 2023, pp. 51-52), but there is no information to suggest that pollution has directly contributed to population declines that have led to the reduction of sturgeon and sicklefin chubs' ranges. This stressor is likely impacting both species at the individual level currently, at least at specific point sources. If a major pollutant release does occur within the Missouri or Mississippi River Basins, this stressor could affect a larger portion of these species' ranges. However, the presence of multiple populations of each species and geographically large segments of occupied river provides redundancy throughout their range to prevent a collapse of either species from a large-scale release of a pollutant. The best available information does not show that pollutants are affecting the continued existence of the sicklefin and sturgeon chubs.

Impingement and Entrainment

Power plant intakes along the Missouri River have the potential for impingement and entrainment of fishes including sturgeon and sicklefin chubs. Entrainment of fishes occurs when fish pass through a designated device such as a screen surrounding a water intake. Impingement occurs when the fish makes physical contact with a device such as a screen and is unable to remove itself from the screen due to intake velocities being greater than the velocity the fish can swim. Both entrainment and impingement can be fatal to fishes at all life stages.

Due to the large volume of flow in these river systems, power plant intakes withdraw a fraction of total volume passing the facility. However, the cumulative effects of multiple facilities have not been studied. Further research is needed on impacts to sturgeon and sicklefin chub in smaller tributaries where power plants are present, since the volume of water passing through may not be as large as the Missouri and Mississippi Rivers. As of 2015 there were 15 active power plants that occur within the range of both species on the Missouri River from Sioux City, Iowa to St. Louis, Missouri. Combined effects of water intakes in these systems are likely impacting both species at an individual level now and into the future. The best available information does not show that impingement and entrainment is affecting the continued existence of the sicklefin and sturgeon chubs.

Predation

Sicklefin and sturgeon chub populations evolved with piscivorous fish in the Missouri River Basin and the Mississippi River. The best available information indicates that predation by piscivorous fish is currently occurring but is not currently quantifiable, and we do not know the scope of this impact. Future diet studies of piscivourous fish in this area may help quantify this stressor and identify individual level effects between each population of sturgeon and sicklefin chub. The best available information does not show that predation is affecting the continued existence of the sicklefin and sturgeon chubs.

Hybridization

Hybridization of sturgeon and sicklefin chub is not a common occurrence. While hybrids have been documented, the best available information does not show that hybridization is occurring in significant enough levels to impact sturgeon and sicklefin chub populations now or into the future.

Conservation Measures and Existing Regulatory Mechanisms

We are not aware of any species-specific conservation measures or regulatory mechanisms developed for the sturgeon and sicklefin chub.

Authorization of the Rivers and Harbors Act between 1912 and 1945 established a program to channelize the Missouri River. In addition, the Missouri River Bank Stabilization and Navigation Project (BSNP) was proposed in 1934 and was enacted to promote navigation from Sioux City Iowa to the mouth of the Mississippi River. To create a uniform narrow channel that facilitated navigation, the U.S. Army Corps of Engineers (hereafter, Corps) used wing dikes to create a self-dredging channel and armored the outside banks of the river to prevent erosion. The BSNP was completed in 1981, extends from Sioux City, Iowa, to the mouth of the Missouri River 1,183 river km (735 river mi.) and maintains a 2.7-meter (m) deep (9-feet (ft.) deep) by 91-m wide (300-ft wide) channel (U.S. Army Corps of Engineers 2018, pp. IV-28). Channelization of the Missouri River greatly reduced channel width and significantly reduced access to the historical floodplain (U.S. Army Corps of Engineers 2010, p. 8; U.S. Army Corps of Engineers 2017, p. 108). The BSNP accounted for a loss of nearly 211,000 hectares (522,000 acres) of floodplain habitat and over 1,127 river km (700 river mi.) of river channel (U.S. Army Corps of Engineers 2010, p. 8).

Since 1974, the Corps has implemented measures to modify the channel maintenance structures and improve fish and wildlife habitat. The Corps has restored some side-channel connections and increased habitat diversity in the channelized Lower Missouri River by notching dikes or otherwise modifying channel structures. The Corps estimates that approximately 2,100 modifications to dikes and habitat structures have been constructed (U.S. Army Corps of Engineers 2017, p. 109). Notching dikes or revetments can increase channel width and diversity to create shallow water/sandbar complexes. More recently the Corps has implemented the BSNP Fish and Wildlife Mitigation Project that aims to compensate for losses of fish and wildlife habitat lost due to channelization. These efforts likely benefit the sturgeon and sicklefin chubs to some degree, although to what extent is uncertain.

Cumulative Effects

We note that, by using the SSA framework to guide our analysis of the scientific information documented in the SSA report, we have analyzed the cumulative effects of identified threats and conservation actions on the species. To assess the current and future condition of the species, we evaluate the effects of all the relevant factors that may be influencing the species, including threats and conservation efforts. Because the SSA framework considers not just the presence of the factors, but to what degree they collectively influence risk to the entire species, our assessment integrates the cumulative effects of the factors and replaces a standalone cumulative-effects analysis.

ANALYSIS

To assess the status of sturgeon chubs and sicklefin chubs, we collaborated with our many conservation partners to conduct a rangewide genetic assessment (Heist *et al*. 2022, entire) for both chub species. This effort allowed for the collection and interpretation of several important genetic metrics to gauge the current status of both chub species. We also gathered survey data on chub collections throughout the range over time to assess trends in occupancy and distribution. Sources of information included peer-reviewed literature, unpublished data, species surveys and information gathered from State, Federal, and other partners during monthly calls and several online stakeholder meetings. We characterized the current and future condition of both species in terms of resiliency, redundancy, and representation using a population condition category model. For more information see the SSA report (Service 2023, pp. 16-70).

CURRENT CONDITION

To assess resiliency of the sturgeon and sicklefin chub populations, we used a condition category model and ranked genetic and demographic factors (effective population size and occupancy trends) and habitat factors (unfragmented stream length) for each population. Resiliency is the ability of a species to withstand stochastic events and is often measured by metrics such as abundance, or the size and growth rate of populations. In this case, we have estimates of genetic effective population size, occupancy frequencies, and CPUA (catch per unit area) and CPUE (catch per unit effort) (both of which are indexes to abundance and often referred to as relative abundance) data from standardized benthic trawling surveys. Thus, we used these metrics to describe the genetic and demographic resiliency of both chub species across their ranges. We also assessed the resiliency of populations of both chub species by using unfragmented stream length as a habitat metric. Unfragmented stream length is an important predictor of population status for fish species, like sturgeon chub and sicklefin chub, whose eggs and larvae drift in the water column while developing.

Resiliency of all populations of sturgeon chubs and sicklefin chubs was ranked high for effective population size (Service 2023, Table 12). Effective population size estimates were greater than

500 for all populations and indicate ample numbers of breeding individuals to preclude any loss of genetic variation through time. We note that the effective population size estimates incorporate the effects of many of the potential stressors from a historical sense. Given that both chub species have short generation times, population level effects from stressors are expected to be manifested within the populations relatively quickly. While estimates of effective population size are a “snapshot in time”, they do incorporate effects from historical stressors acting at the population level. There was little genetic differentiation observed among samples within regions for both chub species. For example, in Populations 1 of sturgeon chub and sicklefin chub, the presence of Fort Peck Dam and Yellowtail Dam were not detectable from the genetic results, despite both being likely barriers to chub movement. This result is indicative of significant historical gene flow among locations within a region and lack of genetic divergence since the construction of Fort Peck and Yellowtail dams. Given the amount of habitat fragmentation that occurred historically, the presence of robust genetic effective population estimates despite that level of fragmentation, is encouraging and indicative of higher resilience.

Resiliency of sturgeon chub populations with respect to trend data (Occupancy, CPUA, CPUE) was mixed. We observed declining occupancy and CPUA, but stable to increasing CPUE within different segments of Population 1. Therefore, we categorized resiliency as moderate for Population 1 (Service 2023, Table 12; Figure 3). We had stable trend information on Population 2, thus resiliency is high (Service 2023, Table 12; Figure 3). Resiliency of Population 3 was ranked high for trend information, due to increasing occupancy through time (Service 2023, Table 12; Figure 3).

Resiliency of Population 1 of sicklefin chubs was ranked moderate, due to stable occupancy, but there were mixed trends in relative abundance (Service 2023, Table 12; Figure 3). Resiliency of Population 2 of sicklefin chubs was ranked high, due to stable trends in both occupancy and relative abundance through time (Service 2023, Table 12; Figure 3).

Figure 31. Current condition resiliency analysis.

Species	Population	Genetic and Demographic Factors		Habitat Factors
		Effective Population Size	***Occupancy, CPUA, CPUE trends***	***Unfragmented Stream Length (km)***
Sturgeon Chub	1	**High**	**Moderate**	**High**
	2	**High**	**High**	**High**
	3	**High**	**High**	**High**
Sicklefin Chub	1	**High**	**Moderate**	**High**
	2	**High**	**High**	**High**

Resiliency of all populations for both chub species was ranked high when considering unfragmented stream length (Service 2023, Table 12; Figure 3). All populations of both species occupy habitats with one or more stream fragments meeting or exceeding the minimum thresholds estimated in the scientific literature (i.e., >297km (185 miles (mi)) for sturgeon chubs and >301 km (187 mi) for sicklefin chubs) to support chub viability (Service 2023, Tables 13 and 12). The lower Missouri River and parts of the Mississippi River provide primarily one long stream fragment for Population 3 of sturgeon chubs and Population 2 of sicklefin chubs. While this reach of river is considered a single stream fragment, the entire length could be delineated into multiple reaches for either chub species that met or exceeded the minimum thresholds.

Redundancy describes the ability of a species to withstand catastrophic events and is often measured by the number of populations, their resiliency, and their distribution and connectivity across the landscape. For these species, we used these factors to describe redundancy of the populations of chubs defined in the range-wide genetic assessment.

Three populations of sturgeon chub were identified in the range-wide genetic assessment (Heist *et al*. 2022, pp. 3-5). Each population resides in a large geographic area and is separated from the other populations by mainstem dams on the Missouri River and associated reservoir habitat. It is unclear if sturgeon chubs move downstream through the reservoir habitats and dams to interact with downstream populations, but no upstream interaction among populations is expected due to the lack of upstream fish passage at any hydroelectric dams on the mainstem Missouri River.

The current number and distribution of sturgeon chub populations increases the redundancy of the species. First, the presence of three populations of sturgeon chubs increases the probability the species can persist in the face of a catastrophic event, relative to if there were fewer populations. Second, the three populations are distributed across a wide range and are physically separated from one another. This physical separation among the three populations reduces the probability of a catastrophic event affecting all three populations simultaneously.

Two populations of sicklefin chubs were identified in the range-wide genetic assessment (Heist *et al*. 2022, p. 6). Each population resides in a large geographic area and is separated from the other population by mainstem dams on the Missouri River and associated reservoir habitat. It is unclear if sicklefin chubs move downstream through the reservoir habitats and dams to interact with downstream populations, but no upstream interaction among populations is expected due to the lack of upstream fish passage at any hydroelectric dams on the mainstem Missouri River.

The current number and distribution of sicklefin chub populations increases the redundancy of the species. First, the presence of two populations of sicklefin chub increases the probability that the species can persist in the face of a catastrophic event, relative to if there were fewer populations. Second, the two populations are distributed across a wide range and are physically separated from one another. This physical separation among the two populations reduces the probability of a catastrophic event affecting both populations simultaneously.

Within populations, there is also redundancy among occupied stream segments. The distribution of occupied stream segments within populations also increases the margin of safety against a catastrophic event for both chub species. For example, a catastrophic event affecting chubs in the mainstem Missouri River above Fort Peck Reservoir would not be expected to also affect occupied reaches of the Yellowstone River because of the large distance between the two occupied stream reaches and their independence due to the dendritic pattern of the Missouri River watershed.

Representation describes the ability of a species to adapt to changing environmental conditions and is often measured by the breadth of genetic or environmental diversity within and among populations. We rely on both genetic and environmental diversity to describe representation of both chub species.

The effective population size is the number of individuals in an ideal (hypothetical) population that would result in the same loss of genetic diversity, inbreeding, and genetic drift, if they behaved in the manner of the real population (i.e., equal sex ratio, random mating, all adults producing offspring, and equal numbers of offspring per parent, and a constant number of breeding individuals across generations) (Frankham 1995, p. 96). The concept of effective population size relates to population viability because, as a general rule, closed populations with random mating that have effective population sizes below 50 are at higher risk of inbreeding depression, and below 500 are more likely to lose genetic variation important to maintaining long-term evolutionary potential (Frankham et al. 2014, entire). Fragmentation can further exacerbate inbreeding depression and genetic loss, while connectivity to larger source populations can alleviate the adverse effects of small effective population sizes (Frankham et al. 2014, p. 60).

Several lines of indirect evidence indicate that genetic variation observed in sturgeon chub and sicklefin chub is likely high. First, effective population sizes for all chub populations for both species were greater than 500; a level at which loss of adaptive variation is not expected. Populations where effective population sizes consistently remain over 500 are expected to have higher genetic variation relative to those below 500, due to the gradual loss of that variation through time when effective population sizes decrease below approximately 500. Second, relative measures of genetic diversity were high, compared to other, similar species. Given these multiple lines of evidence, it appears genetic variation in both chub species is high, along with the future adaptive potential that the genetic variation represents.

While declines in distribution from historical levels for both chub species are well documented, both species still occupy large portions of their historical representative range (53 percent for sturgeon chub and 75 percent for sicklefin chub) where suitable habitat remains. The current range of both species still spans many states and a diversity of ecological and climatic zones, which may indicate some ability to adapt to changing environmental conditions.

FUTURE CONDITION

Numerous potential stressors to sturgeon chubs and sicklefin chubs were discussed above and in the SSA report (Service 2023, pp. 45-54). Habitat fragmentation and associated habitat changes (e.g., reduced stream fragment length, decreased turbidity, altered flow regimes) from mainstem Missouri River dams were the primary stressors contributing to the current condition of both chub species, and the current reduced distribution relative to historical distribution. However, when looking to the future, we have no indication that the construction of additional dams, the demolition of existing dams, or major differences in dam operations are likely to occur. Similarly, we have no information to indicate that most of the other potential stressors identified are going to change in the future at levels meaningful to the viability of both chub species. However, the one stressor that we do have information on and reason to believe that it could act at a frequency and scale to potentially affect chub populations is climate change. Thus, we focus our future conditions analysis on the predicted effects of climate change to mean annual stream discharge and the resulting impacts to chub habitat and population resiliency, under multiple emissions scenarios, out to mid-century. This timeframe represents an appropriate biological timeframe during which responses of these species to potential changes in habitat and climate can be reliably assessed. Over this time, we would expect multiple generations of chubs and if any stressor were having a negative population effect on these species, we would expect to see responses from these species within this timeframe. We did not assess the future condition of these species beyond 2069 (for example, in 2100) due also to our high level of uncertainty related to the effect climate change would have on stream discharge and the response(s) of these species to changes in stream conditions, especially considering the wider range of plausible scenarios that exist that far into the future.

We investigated the potential effects of predicted changes in mean annual discharge in several ways. First, we used future discharge predictions from across the spectrum of climate change emissions scenarios to explore uncertainty among models and emissions scenarios. Temporally, we limited our use of future discharge predictions to those extending to approximately mid-century (i.e., 2040-2069) for reasons described above. Second, we looked at the predicted direction of change for stream discharge across the range of both chub species to explore where mean annual discharge was predicted to increase, decrease, or remain stable. Third, we investigated the magnitude of the predicted change in discharge to better understand how that may affect both chub species and their habitat. Fourth, we explored the timing and frequency aspects of predicted changes in mean annual discharge, namely patterns in annual discharge and frequency of extreme flows (both high and low). Finally, we summarized the potential effects of these predicted changes in mean annual discharge on the resiliency metrics (N_e, occupancy, and unfragmented stream length) that we describe above in the Current Condition section. See the SSA report for more information on the global climate models and emission scenarios considered (Service 2023, pp. 63-68)

Effects to resiliency of both chub species from predicted changes to mean annual discharge in the future are mixed. Increases to mean annual discharge may be favorable to chubs, given previous positive correlations between chub persistence and increasing stream discharge. However, decreased flows during the base flow period may have negative impacts to both chub species, particularly for those populations inhabiting tributaries. Past trends in chub distribution, particularly for sturgeon chub, indicate the largest range retractions have occurred in the secondary tributaries. These habitats are expected to be more vulnerable to the effects of climate change than mainstem habitats and will have the highest probability of habitat effects (e.g., low flows, potential dewatering) into the future. Therefore, Populations 1 and 2 of sturgeon chub may be more impacted by the effects of climate change than Population 3 or either sicklefin chub population, because they contain a higher proportion of secondary tributary habitat. In populations 1 and 2 of sturgeon chubs, effective population size and occupancy may be expected to decrease, due to the greater amount of total occupied habitat occurring within secondary tributaries (Service 2023, Table 16). However, if declines in these metrics are observed in the future, the magnitude of potential declines remains unknown. Regardless of impacts to secondary tributaries, Population 1 of sturgeon chubs is still expected to have multiple mainstem and larger tributary habitats (e.g., Yellowstone River) longer than 297 km (185 mi.). Population 2 of sturgeon chub is not expected to have mainstem Missouri river habitat (same as Current Condition) but is expected to maintain multiple reaches of tributary habitat longer than 297 km (185 mi.) because of the large size of the watershed and no empirical observations of dewatered reaches even under recent, intense, and lasting drought. Thus, populations 1 and 2 for sturgeon chub are predicted to have decreased resiliency under expected future changes to hydrology due to climate change (Figure 4). The future resiliency of both populations of sicklefin chubs is expected to remain the same as current condition because both populations occupy mainstem habitats that are expected to be more climate resilient than tributary habitats (Figure 4). Mainstem habitats are expected to have more consistent flow even in the future due to the moderating effects of mainstem reservoir storage and water releases. We note that both chub species have advantageous life history traits of having evolved in stochastic environments and the ability to batch spawn multiple times a season, which affords these species additional resiliency in the face of some potential changes.

Figure 42. Future conditions resiliency analysis.

		Genetic and Demographic Factors		**Habitat Factors**
Species	**Population**	***Effective Population Size***	***Occupancy, CPUA, CPUE trends***	***Unfragmented Stream Length (km)***
	1	**Decrease**	**Decrease**	**Stable**

Sturgeon Chub	2	**Decrease**	**Decrease**	**Stable**
	3	**Stable**	**Stable**	**Stable**
Sicklefin Chub	1	**Stable**	**Stable**	**Stable**
	2	**Stable**	**Stable**	**Stable**

Redundancy is not expected to appreciably change for either species under future predicted changes to mean annual discharge. While some changes to resiliency may be expected due to predicted disproportionate climate impacts on secondary tributaries relative to mainstem habitats, we do not expect any of the populations of either species to become extirpated such that redundancy of the species would be reduced.

Declines in effective population size in Populations 1 and 2 for sturgeon chub could result in declines in genetic variation, if effective population size were to decline and remain below 500 for multiple generations in the future. However, current effective population size estimates are robust and any potential decline in the future may not be detectable at the population level, unless the decline was of very large magnitude. We are not expecting declines in effective population size for either sicklefin chub population because the species mainly occupies mainstem habitats that are expected to have relatively consistent flow in the future, even under the most dire climate change scenarios. We do not expect such a large effect on the representation of either chub species because multiple tributary and mainstem habitat segments are expected to remain in the future. In addition, some of the effects of climate change on mainstem chub habitats are expected to be buffered by the Missouri River reservoir system, because the system was designed to increase the consistency of flows throughout the year, by storing water in reservoirs during wetter periods and releasing water from the reservoirs during drier periods. In short, both chub species are expected to remain in representative habitats across portions of their range in the future.

FINDING

Regulatory Framework

Section 4 of the Act (16 U.S.C. 1533) and its implementing regulations (50 CFR part 424) set forth the procedures for determining whether a species is an “endangered species” or a “threatened species.” The Act defines an endangered species as a species that is “in danger of extinction throughout all or a significant portion of its range,” and a threatened species as a species that is “likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.” The Act requires that we determine whether any species is an “endangered species” or a “threatened species” because of any one or a combination 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.

These factors represent broad categories of natural or human-caused actions or conditions that could have an effect on a species' continued existence. In evaluating these actions and conditions, we look for those that may have a negative effect on individuals of the species, as well as other actions or conditions that may ameliorate any negative effects or may have positive effects.

The Act does not define the term "foreseeable future, which appears in the statutory definition of "threatened species." Our implementing regulations at 50 CFR 424.11(d), as revised in 2019, set forth a framework for evaluating the foreseeable future on a case-by-case basis. The term "foreseeable future" extends only so far into the future as we can reasonably determine that both the future threats and the species' responses to those threats are likely. In other words, the foreseeable future is the period of time in which we can make reliable predictions. "Reliable" does not mean "certain"; it means sufficient to provide a reasonable degree of confidence in the prediction. Thus, a prediction is reliable if it is reasonable to depend on it when making decisions.

It is not always possible or necessary to define the foreseeable future as a particular number of years. Analysis of the foreseeable future uses the best scientific and commercial data available and should consider the timeframes applicable to the relevant threats and to the species' likely responses to those threats in view of its life-history characteristics. Data that are typically relevant to assessing the species' biological response include species-specific factors such as lifespan, reproductive rates or productivity, certain behaviors, and other demographic factors.

Status Assessment – Sturgeon Chub

Status Throughout All of Its Range

After evaluating threats to the species and assessing the cumulative effect of the threats under the section 4(a)(1) factors, we found that the sturgeon chub does not meet the definition of an endangered species throughout all its range. In our assessments of viability for the sturgeon chub, we considered the impact of Missouri River mainstem dams and reservoir operations (Factor A), tributary barriers and habitat fragmentation (Factor A), channel modifications (Factor A), water quality (Factor E), climate change (Factor A and E), pollutants (Factor E), impingement/entrainment (Factor E), predation (Factor C), and hybridization (Factor E). We also considered regulatory mechanisms (Factor D): we are not aware of any species-specific conservation measures or regulatory mechanisms developed for the sturgeon chub (Factor D) and it is uncertain if any regulatory mechanism considered for other species provide a benefit to sturgeon chubs. The past construction of mainstem Missouri River dams and associated reservoirs is the main stressor that has led to the largest reduction in habitat. While mainstem river dams and reservoirs have led to a large reduction in habitat, this species is still present above, in between, and below the six mainstem dams despite these features being on the landscape for decades. Going forward, climate change is the stressor most likely to have potential population level impacts in the future.

To assess the sturgeon chub's current condition, we characterized the resiliency of the three populations using effective population size, occupancy and abundance trends, and unfragmented stream length. All three populations have high effective population sizes and given the amount of habitat fragmentation that occurred historically, the presence of robust genetics and effective population estimates despite that level of fragmentation is indicative of highly resilient populations. Current occupancy and abundance information indicates that two populations are in high condition and one is in moderate condition for this factor. This indicates the species' needs are being met through the current habitat and conditions available. Furthermore, all populations currently occupy habitats with one or more stream fragments meeting or exceeding the minimum thresholds. The species currently exhibits high resiliency in three populations spread throughout a large portion of the species' historical range providing redundancy against potential catastrophic events. Genetic information suggests the species has a robust genetic profile and has retained high effective population sizes despite past and existing habitat fragmentation. There are no identified threats currently affecting the species' viability across its range at a population level. Thus, after assessing the best available information, we conclude that sturgeon chub is not in danger of extinction throughout all of its range.

Therefore, we proceed with determining whether the sturgeon chub is likely to become endangered within the foreseeable future throughout all of its range. When looking to the future, we have no indication that the construction of additional dams, the demolition of existing dams, or major differences in dam operations are likely to occur. Similarly, to the best available information does not indicate that most of the other potential stressors identified are going to change in the future at levels meaningful to the viability of sturgeon chub populations. The primary stressor to the sturgeon chub in the future is the potential for habitat loss and degradation from climate change. We examined a range of possible scenarios to project possible future changes in stream discharge and effects on sturgeon chub viability. For this analysis, we chose to forecast out to approximately mid-century (2040-2069) because that encompasses the best available information for future projections of the threats/stressors acting on the species and for drawing reliable predictions about the species' response to these factors. Beyond that timeframe, the level of uncertainty becomes high, and we are unable to make reliable predictions about the threats and the species' responses to those threats.

In the future, we project sturgeon chub population 3 to be relatively unchanged from its highly resilient current condition. This population largely occupies mainstem river habitat which is not likely to experience significant impacts from the effects of climate change on stream discharge. Here we predict effective population size, occupancy and abundance, and unfragmented stream length to remain stable. For populations 1 and 2, which include sections of secondary tributary habitat, we predict some decrease in effective population size, occupancy, and abundance due to changes in stream discharge related to climate change in those secondary tributary habitats. Although a decrease is predicted in overall resiliency of populations 1 and 2, we do not expect that reduction to significantly decrease population resiliency to the point at which they would be in danger of extinction. In addition, we expect future redundancy and representation to remain at levels similar to the current condition and continue to provide redundancy against potential catastrophic events and future adaptive capacity. After assessing the best available information, we conclude that the sturgeon chub is not likely to become endangered within the foreseeable future throughout all of its range.

Status Throughout a Significant Portion of Its Range
Under the Act and our implementing regulations, a species may warrant listing if it is in danger of extinction or likely to become so in the foreseeable future throughout all or a significant portion of its range. Having determined that the sturgeon chub is not in danger of extinction or likely to become so in the foreseeable future throughout all of its range, we now consider whether it may be in danger of extinction or likely to become so in the foreseeable future in a significant portion of its range—that is, whether there is any portion of the species' range for which it is true that both (1) the portion is significant; and (2) the species is in danger of extinction now or likely to become so in the foreseeable future in that portion. Depending on the case, it might be more efficient for us to address the "significance" question or the "status" question first. We can choose to address either question first. Regardless of which question we address first, if we reach a negative answer with respect to the first question that we address, we do not need to evaluate the other question for that portion of the species' range.

We evaluated the range of the sturgeon chub to determine if the species is in danger of extinction now or likely to become so in the foreseeable future in any portion of its range. Because the range of a species can theoretically be divided into portions in an infinite number of ways, we focus our analysis on portions of the species' range that contribute to the conservation of the species in a biologically meaningful way. For sturgeon chub, we considered whether the threats or their effects on the species are greater in any biologically meaningful portion of the species' range than in other portions such that the species is in danger of extinction now or likely to become so in the foreseeable future in that portion. We examined the following threats: Missouri River mainstem dams and reservoir operations, tributary barriers and habitat fragmentation, channel modifications, water quality, climate change, pollutants, impingement/entrainment, predation, and hybridization, including cumulative effects of the stressors. Except for climate change, these threats are ubiquitous across the range of the species and acting on the sturgeon chub more or less equally rangewide. Although the effect of climate change will impact the entire range of the species as well, the future impact of climate change on stream discharge may be more pronounced in the upper reaches of secondary tributary habitat in sturgeon chub populations 1 and 2. These stream reaches are much smaller and as a result less buffered from future changes in stream discharge resulting from climate change than the much larger and more stable mainstem river reaches that this species inhabits. These are the only portions we identified as potentially having a difference in status than the rangewide status, and therefore as worth considering further for the purposes of this analysis.

The secondary tributary habitats in sturgeon chub populations 1 and 2 that may be subject to higher impacts from climate change constitute approximately 348 stream km (216 mi) out of 5,455 km (3,390 mi) of currently occupied stream km, or approximately 6 percent of the occupied range. These areas are smaller in wetted area and overall stream discharge than the mainstem river sections occupied by this species and as a result may experience larger climate related swings in stream discharge which could negatively impact chubs living in those sections. These areas may be used opportunistically by the species when conditions allow, but these areas offer nothing ecologically unique and are not required by the sturgeon chub for any particular point of their life history. The mainstem river sections in these populations contain more sturgeon chub individuals and contain all of the same habitat features needed to meet the species' needs, including sufficient unfragmented stream length, for the sturgeon chub to complete their life cycle and maintain resilient populations into the future. Based on the small size of this portion relative to the rest of the range, and the lack of unique habitat features, we do not consider secondary tributary habitats to be significant for the purposes of this analysis.

These areas do not represent a significant portion of the range; therefore, we find that the species is not in danger of extinction now or likely to become so in the foreseeable future in any significant portion of its range. This finding does not conflict with the courts' holdings in *Desert Survivors v. Department of the Interior*, 321 F. Supp. 3d 1011, 1070-74 (N.D. Cal. 2018), and *Center for Biological Diversity v. Jewell*, 248 F. Supp. 3d 946, 959 (D. Ariz. 2017) because, in reaching this conclusion, we did not apply the aspects of the Final Policy on Interpretation of the Phrase "Significant Portion of Its Range" in the Endangered Species Act's Definitions of "Endangered Species" and "Threatened Species" (79 FR 37578; July 1, 2014), including the definition of "significant" that those court decisions held to be invalid.

Determination of Status

Our review of the best available scientific and commercial information indicates that the sturgeon chub does not meet the definition of an endangered species or a threatened species in accordance with sections 3(6) and 3(20) of the Act. Therefore, we find that listing the sturgeon chub is not warranted at this time.

<u>Status Assessment – Sicklefin Chub</u>

Status Throughout All of Its Range

After evaluating threats to the species and assessing the cumulative effect of the threats under the section 4(a)(1) factors, we found that the sicklefin chub does not meet the definition of an endangered species throughout all its range. In our assessments of viability for the sicklefin chub, we considered the impact of Missouri River mainstem dams and reservoir operations (Factor A), tributary barriers and habitat fragmentation (Factor A), channel modifications (Factor A), water quality (Factor E), climate change (Factor A and E), pollutants (Factor E), impingement/entrainment (Factor E), predation (Factor C), and hybridization (Factor E). We also considered regulatory mechanisms (Factor D): we are not aware of any species-specific conservation measures or regulatory mechanisms developed for the sicklefin chub (Factor D) and it is uncertain if any regulatory mechanism considered for other species provide a benefit to sicklefin chubs. The past construction of mainstem Missouri River dams and associated reservoirs is the main stressor that has lead to the largest reduction in habitat. While mainstem river dams and reservoirs have led to a large reduction in habitat, this species is still present above, in between, and below the six mainstem dams despite these features being on the landscape for decades. Going forward, climate change is the stressor most likely to have population level impacts in the future.

To assess the sicklefin chub's current condition, we characterized the resiliency of the two populations using effective population size, occupancy and abundance trends, and unfragmented stream length. Both populations have high effective population sizes and given the amount of habitat fragmentation that occurred historically, the presence of robust genetics and effective population estimates despite that level of fragmentation is indicative of highly resilient populations. Current occupancy and abundance information indicates that one population is in moderate condition, and one is in high condition for this factor. This indicates the species' needs are being met through the current habitat and conditions available. Furthermore, both populations currently occupy habitats with one or more stream fragments meeting or exceeding the minimum thresholds. The species currently exhibits high resiliency in two populations spread throughout a large portion of the species' historical range providing redundancy against potential catastrophic events. Genetic information suggests the species has a robust genetic profile and has retained high effective population sizes despite past and existing habitat fragmentation. There are no identified threats currently affecting the species' viability across its range at a population level. Thus, after assessing the best available information, we conclude that sicklefin chub is not in danger of extinction throughout all of its range.

Therefore, we proceed with determining whether the sicklefin chub is likely to become endangered within the foreseeable future throughout all of its range. When looking to the future, we have no indication that the construction of additional dams, the demolition of existing dams, or major differences in dam operations are likely to occur. Similarly, to the best available information does not indicate that most of the other potential stressors identified are going to change in the future at levels meaningful to the viability of sicklefin chub populations. The primary stressor to the sicklefin chub in the future is the potential for habitat loss and degradation from climate change. We examined a range of possible scenarios to project possible future changes in stream discharge and effects on sicklefin chub viability. For this analysis, we chose to forecast out to approximately mid-century (2040-2069) because that encompasses the best available information for future projections of the threats/stressors acting on the species and for drawing reliable predictions about the species' response to these factors. Beyond that timeframe, the level of uncertainty becomes high, and we are unable to make reliable predictions about the threats and the species' responses to those threats.

In the future, we project both sicklefin chub populations to be relatively unchanged from its highly resilient current condition. These populations largely occupy mainstem river habitat, which is not likely to experience significant impacts from the effects of climate change on stream discharge. Here we predict effective population size, occupancy and abundance, and unfragmented stream length to remain stable in light of potential changes to stream discharge. Although there could be some minor impact from climate change on mainstem river sicklefin chub habitat, we do not expect a reduction that would decrease population resiliency to the point at which they would be in danger of extinction. We expect future redundancy and representation to remain at levels similar to the current condition and continue to provide redundancy against potential catastrophic events and future adaptive capacity. After assessing the best available information, we conclude that the sicklefin chub is not likely to become endangered within the foreseeable future throughout all of its range.

Status Throughout a Significant Portion of Its Range

Under the Act and our implementing regulations, a species may warrant listing if it is in danger of extinction or likely to become so in the foreseeable future throughout all or a significant portion of its range. Having determined that the sicklefin chub is not in danger of extinction or likely to become so in the foreseeable future throughout all of its range, we now consider whether it may be in danger of extinction or likely to become so in the foreseeable future in a significant portion of its range—that is, whether there is any portion of the species' range for which it is true that both (1) the portion is significant; and (2) the species is in danger of extinction now or likely to become so in the foreseeable future in that portion. Depending on the case, it might be more efficient for us to address the "significance" question or the "status" question first. We can choose to address either question first. Regardless of which question we address first, if we reach a negative answer with respect to the first question that we address, we do not need to evaluate the other question for that portion of the species' range.

In undertaking this analysis for the sturgeon chub, we chose to address the status question first. We began by identifying portions of the range where the biological status of the species may be different from its biological status elsewhere in its range. For this purpose, we considered information pertaining to the geographic distribution of (a) individuals of the species, (b) the threats that the species faces, and (c) the resiliency condition of populations.

We evaluated the range of the sicklefin chub to determine if the species is in danger of extinction now or likely to become so in the foreseeable future in any portion of its range. The range of a species can theoretically be divided into portions in an infinite number of ways. We focused our analysis on portions of the species' range that may meet the definition of an endangered species or a threatened species. For sicklefin chub, we considered whether the threats or their effects on the species are greater in any biologically meaningful portion of the species' range than in other portions such that the species is in danger of extinction now or likely to become so in the foreseeable future in that portion. We examined the following threats: Missouri River mainstem dams and reservoir operations, tributary barriers and habitat fragmentation, channel modifications, water quality, climate change, pollutants, impingement/entrainment, predation, and hybridization, including cumulative effects. These threats are ubiquitous across the range of the species and acting on the sicklefin chub more or less equally rangewide. There are no areas with disproportionate impacts on sicklefin chub from these threats. Both sicklefin chub populations are currently high in resiliency and expected to continue to be so into the future despite the potential impact of the threats considered. Neither population 1 or 2 when considered as portions on their own meets the definition of an endangered or threatened species.

We found no biologically meaningful portion of the sicklefin chub's range where threats are impacting individuals differently from how they are affecting the species elsewhere in its range, or where the biological condition of the species differs from its condition elsewhere in its range such that the status of the species in that portion differs from its status in any other portion of the species' range.

Therefore, we find that the species is not in danger of extinction now or likely to become so in the foreseeable future in any significant portion of its range. This finding does not conflict with the courts' holdings in *Desert Survivors v. Department of the Interior*, 321 F. Supp. 3d 1011, 1070-74 (N.D. Cal. 2018), and *Center for Biological Diversity v. Jewell*, 248 F. Supp. 3d 946, 959 (D. Ariz. 2017) because, in reaching this conclusion, we did not apply the aspects of the Final Policy on Interpretation of the Phrase "Significant Portion of Its Range" in the Endangered Species Act's Definitions of "Endangered Species" and "Threatened Species" (79 FR 37578; July 1, 2014), including the definition of "significant" that those court decisions held to be invalid.

Determination of Status

Our review of the best available scientific and commercial information indicates that the sicklefin chub does not meet the definition of an endangered species or a threatened species in accordance with sections 3(6) and 3(20) of the Act. Therefore, we find that listing the sicklefin chub is not warranted at this time.

COORDINATION WITH STATES

We held three coordination meetings every month for approximately two years to engage our State conservation partners and provide opportunities for them to provide information, comments and ask questions about chub science or SSA process. In addition, we conducted five online stakeholder meetings to solicit information from our State partners about potential stressors to both chub species across the landscape. We also conducted another stakeholder meeting dedicated solely to the interactions of pallid sturgeon and both chub species.

All states within the range of sturgeon chub (Wyoming, Montana, North Dakota, South Dakota, Nebraska, Kansas, Iowa, Missouri, Illinois, Arkansas, Tennessee, Kentucky, Mississippi, Louisiana) provided information for the SSA either via the monthly calls or the stakeholder meetings. All states were provided the opportunity to review the draft SSA. We received reviews from Wyoming, Montana, South Dakota, Nebraska, Arkansas, Mississippi and Louisiana. We did not receive reviews from the remaining states.

All states within the range of sicklefin chub (same states as for sturgeon chub, minus Wyoming) provided information for the SSA either via the monthly calls or the stakeholder meetings. All states were provided the opportunity to review the draft SSA. We received reviews from Montana, South Dakota, Nebraska, Arkansas, Mississippi and Louisiana. We did not receive reviews from the remaining states.

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All SAFs supporting 12-month findings or candidate notices of review will be signed by the Director. SAFs should continue to be surnamed by Regional and Headquarters staff and leadership.

Date: 9/14/23

Martha Williams
Director
U.S. Fish and Wildlife Service