U.S. Fish & Wildlife Service

Recovery Outline for the San Francisco Bay-Delta Distinct Population Segment of the Longfin Smelt (*Spirinchus thaleichthys*)

Credit: Rene Reyes

Species Name: San Francisco Bay-Delta Distinct Population Segment of the Longfin Smelt (*Spirinchus thaleichthys*)
Scientific Name: *Spirinchus thaleichthys*
Species Range: CA
Recovery Priority Number: 6c
ESA Listing Status: Endangered, July 29, 2024; 89 FR 61029
Lead Regional Office: U.S. Fish and Wildlife Service, Region 8, Pacific Southwest
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Purpose and disclaimer statement: The recovery outline is a succinct document that presents a preliminary recovery strategy and actions to direct a newly listed species' recovery efforts until a recovery plan is completed. Recommendations in the recovery outline are non-binding and are intended to guide (not require) regulatory (e.g., section 7 consultations and section 10 permitting) and conservation actions to be implemented by the Service and our external partners. This document lays out a preliminary course of action for the survival and recovery of San Francisco Bay-Delta distinct population segment (DPS) of longfin smelt (*Spirinchus thaleichthys*). Formal public participation for recovery planning will be invited upon the release of the draft recovery plan for the listed species. However, we will consider any new information or comments that members of the public offer in response to this outline during the recovery planning process. For more information on Federal recovery efforts for Bay-Delta DPS of longfin smelt, or to provide additional comments, interested parties may contact the lead field office biologist for this species, Joseph Miller, at the above field office address, or email.

BACKGROUND

The following sections include a summary of the biology, life history, and ecology of the species. A complete discussion of the species' morphology, taxonomy, distribution, phenology, reproduction, life span, demographic trends, and habitat needs can be found in the Species Status Assessment (SSA) entitled, Species Status Assessment for the San Francisco Bay-Delta Distinct Population Segment of the Longfin Smelt (*Spirinchus thaleichthys*). An electronic copy of the assessment report is available on the ECOS species webpage for San Francisco Bay-Delta Distinct Population Segment of the Longfin Smelt (*Spirinchus thaleichthys*) (https://ecos.fws.gov/ServCat/DownloadFile/223002).

Important Information Gaps and Treatment of Uncertainties: The productivity of the San Francisco Bay-Delta distinct population segment of longfin smelt (hereafter "Bay-Delta longfin smelt," or species) has a strong positive relationship with freshwater flow, whereby juvenile recruitment is higher during wet years. While the overall pattern relating freshwater flows to abundance indices for the species is widely accepted, the mechanisms driving this correlation are not fully quantified or resolved. Ongoing and future research aimed at identifying the primary mechanisms behind this relationship will inform effective recovery actions.

Loss of intertidal wetlands in and around the San Francisco Estuary (encompasses both the Bay and the Delta proper) has likely had a negative effect on the Bay-Delta longfin smelt population. Recently, a significant effort towards creating or restoring impacted wetlands in intertidal habitats in the Estuary with a primary goal of boosting fish populations by creating more suitable habitats through planned restoration projects—some of which are already finished—has been undertaken. To what degree these "restored" wetlands benefit and sustain Bay-Delta longfin smelt populations, and which wetland designs provide the greater benefit for increasing Bay-Delta longfin smelt numbers, has not yet been fully evaluated. Research aimed at answering some of these questions will be important as wetland enhancement and restoration is increasingly used as a tool for native fish recovery, and specifically for recovery planning and implementation.

Several long-term surveys monitor the Bay-Delta longfin smelt within the larger estuary, however not all suitable or potentially suitable habitats are sampled in these surveys. Common sampling techniques such as trawl surveys can be challenging or ineffective in shallow Bay-Delta wetland and marsh habitats, limiting our understanding of species-specific habitat use. Similarly, no surveys sample the nearshore ocean for Bay-Delta longfin smelt which is widely used by migratory age-0 and older individuals. This has resulted in a limited understanding of how ocean and nearshore conditions may affect population dynamics of the species further upstream and under changing life history conditions.

Limiting Ecological Traits: Adequate freshwater flow into the estuary during winter and spring is a requirement of the species. The population typically experiences poor recruitment during drier water years, and higher recruitment during wet years. The amount of freshwater flow in the estuary each year is largely dictated by yearly precipitation and operation of water infrastructure diverting and exporting water away from the estuary. Over the last few decades in the State of California, drought conditions have become increasingly common, and favorable wet water years have become less frequent. It is predicted that average unimpaired runoff will slightly increase due to climate change, peak actual impaired runoff is expected to occur earlier, and drier water years are predicted to become more frequent (Knowles et al. 2018, pp. 7641–7646).

Bay-Delta longfin smelt is the species' southernmost population, and the San Francisco Estuary likely represents the upper thermal limit of where the species can inhabit. Longfin smelt is a cool-water species and requires cool water temperatures for successful reproduction and survival (Service 2024, p. 24). Currently, the upper estuary can exceed ideal larval rearing temperatures in the spring and can exceed the thermal maxima of juveniles and adults in the late spring and summer. Climate change is expected to exacerbate this problem, increasing the number of days the upper estuary is uninhabitable and shortening the spawning window of the Bay-Delta longfin smelt (Service 2024, p. 67). Such temperature-related consequences of a changing climate and the cascade of effects in water availability and flows may potentially hinder and complicate the trajectory and recovery of the species.

Bay-Delta longfin smelt require low salinity habitat to complete their life cycle. Adequate habitat ranging from 0.4-10 practical salinity units is needed for spawning and rearing during the winter and spring seasons. The geographic location of this low salinity habitat within the estuary may also have implications for larval retention within the low-salinity zone, and the temperatures experienced by larvae. Entrainment mortality from export facilities is not thought to have a substantial population level effect, however, when the low salinity zone is located further upstream, entrainment is likely to be higher (Kimmerer and Gross 2022, Table 1, p. 2736). Turbidity likely plays a role in survival of Bay-Delta longfin smelt in the estuary. Larval fish tend to benefit from turbid waters which can optimize feeding opportunity and predator avoidance (Utne-Palm 2002, p. 115). In laboratory tests, longfin smelt larvae grew larger at higher turbidities, and larvae did not successfully transition to feeding on larger prey items at lower turbidities (Yanagitsuru 2020, pers. comm.). Turbidity in the estuary has decreased over time (Bever et al. 2018, p. 1943), and this may have negatively affected the Bay-Delta longfin smelt population.

Bay-Delta longfin smelt require adequate food resources for survival. Two particular prey items appear to dominate the species diet: mysids and the copepod *Eurytemora affinis* (Barros et al. 2022, Fig. 6, p. 1775). *Eurytemora affinis* is the primary prey item for younger individuals until they reach approximately 25 millimeters in length and transition to primarily feeding on mysids. When these prey items are scarce, individuals can supplement their diet with amphipods and other copepods (Burdi 2022, pers. comm.; CDFW unpubl. Diet Study Data).

Threats: The threats facing the Bay-Delta longfin smelt include: habitat alteration (Factor A) and changes to hydrology associated with reduced and altered freshwater flows (Factor A); increased water temperatures (Factor A); reduced food resource availability (Factor E); predation (Factor C); entrainment from freshwater diversion facilities (Factor E); and contaminants (Factor E). We consider reduced and altered freshwater flows resulting from human activities and impacts associated with current climate change conditions (increased magnitude and duration of drought and associated increased temperatures) as the main threat facing the Bay-Delta longfin smelt due to the importance of freshwater flows in maintaining the life-history functions and adequate species ecological needs. However, because the Bay-Delta longfin smelt is an aquatic species and the needs of the species are closely tied to freshwater input into the estuary, the impact of many of the other threats identified above are influenced by the amount of freshwater inflow into the system (i.e., reduced freshwater inflows that reduce food availability, increase water temperatures and increase entrainment potential); for a detailed discussion of these stressors see Chapters 3 and 4 of the SSA conducted for the San Francisco Bay-Delta Distinct Population Segment of the longfin smelt (Service 2024, pp. 27–84).

Reduced and altered freshwater flows

The development of dams and water delivery infrastructure built throughout the Sacramento and San Joaquin River basins for flood protection and water supply for agriculture and human consumption has greatly impacted freshwater flows into the San Francisco Bay estuary (Service 2024, section 3.1.1). Operation of this system has resulted in a broader, flatter hydrograph with less seasonal variability, thus changing the timing, magnitude, and duration of freshwater flows into the San Francisco Bay-Delta (Kimmerer 2004, p. 15; Andrews et al. 2017, p. 72; Gross et al. 2018, p. 8). A reduction in freshwater flows into the estuary influences and impacts the location and function of the low-salinity zone (spawning and rearing habitat for longfin smelt). Freshwater inflow into the estuary and other co-linear indicators of wet versus dry conditions during the winter and spring have been statistically associated with recruitment of larvae to the juvenile life stage of Bay-Delta longfin smelt (Service 2024, pp. 27–34). Optimal growth and rearing conditions [food and water conditions (e.g., salinity, turbidity, circulation patterns)], especially for early life stage fish, are directly linked to freshwater inflow to the estuary. While the overall pattern relating freshwater flows to abundance indices for the Bay-Delta longfin smelt is widely accepted, the mechanisms driving this correlation are not fully quantified or resolved.

Climate change

Climate change is likely to have a substantial impact on the San Francisco Estuary, and thus on Bay-Delta longfin smelt. This impact is anticipated to accelerate into the future. As a cooler-water species, the species is already experiencing seasonal habitat conditions with water temperatures above its physiological tolerance, which may be exerting downward pressure on the species (Service 2024, p. 82). Water temperatures in the estuary are expected to continue increasing, rendering certain regions inhospitable for greater lengths of time, and likely contracting the spawning window of the species, resulting in reduced reproductive success.

Climate change is also expected to alter the San Francisco Estuary's hydrology, likely causing more extreme flows earlier in the year followed by a steep drop-off, inducing drier conditions

earlier than is currently normal. While higher flows may result in benefits to the species early in the year, these benefits may be offset by the succeeding protracted dry period. Additionally, the frequency of dry and critically dry water year types is projected to increase in the future. This would result in more years of poor reproductive success, further stressing a declining population. For a detailed discussion of the anticipated effects of climate change on the species see Chapter 4 of the SSA (Service 2024, pp. 56–84).

Current Biological Status: The Bay-Delta longfin smelt's abundance and density throughout the San Francisco Bay estuary have substantially declined. Currently, the species exists in very low abundance despite periods when appropriate habitat conditions, which typically would allow for population rebounds, are available. The best scientific and commercial information available, and our analysis of that information, revealed that several threats are causing or contributing to this decline and currently pose a meaningful risk to the viability of the species. These threats have put the Bay-Delta longfin smelt largely into a state of chronic population decline due to habitat loss (reduction in freshwater flows into the estuary), which is exacerbated by limited food resources and the impacts associated with climate change, thereby limiting its resiliency in combination with its relative inability to withstand catastrophic events (the DPS exhibits low redundancy). This decline in numbers of the Bay-Delta longfin smelt is also an indicator of the species' inability to adapt to the ecosystem changes.

As a result of the species' poor performance in withstanding the cumulative stressors acting upon it, we consider the Bay-Delta longfin smelt's adaptive capacity and therefore its current viability (as well as its current representation) to be low (Service 2024, p. 52). The Bay-Delta longfin smelt's continued reduced population size makes the species vulnerable to varying habitat conditions from year to year due to both anthropogenic and environmental conditions that are being influenced by the effects of climate change. Historically, with a larger population size, the species was more resilient to such stochastic and catastrophic events due to its ability to rebound in abundance when habitat conditions and resources would allow. Prolonged habitat changes, limitations to food resources, and resultant small population size now limit the species ability to maintain its current population levels.

Current and Ongoing Conservation Efforts

Numerous efforts have been initiated regarding conservation and regulation of the San Francisco Bay estuary and its resources, including managing water flows into and export from the estuary, improving water quality, conducting habitat restoration, and implementing measures or regulations to protect native fish. These efforts include establishment of multiagency collaborations such as the Interagency Ecological Program (IEP), which focuses on coordinating and prioritizing science needs and research to meet responsibilities under State and Federal regulatory requirements (IEP 2014, entire).

Under the California Endangered Species Act (CESA), in 2009, the State of California listed the entire distribution of longfin smelt in California as Threatened (CDFW 2009, entire; California Natural Diversity Database 2022, entire). In response to the State listing, the California Department of Fish and Wildlife has issued restrictions and requirements for the export of water for the State Water Project (SWP). Several other fish species (delta smelt, several salmonid

species) are listed under both the Federal Endangered Species Act and CESA, and the Service and National Marine Fisheries Service have also issued biological opinions regarding the effects to these species and their habitats for operations of the State and Federal water projects, which include delivery and export of water from the estuary. The California State Water Resources Control Board is responsible for issuing and enforcing water quality standards and monitoring contaminants within the estuary. However, despite efforts such as those identified above, the current condition of the estuary and continued threats facing the estuary and Bay-Delta longfin smelt, such as reduced freshwater inflow, severe declines in population size, and disruptions to the species food resources, have not been ameliorated.

PRELIMINARY RECOVERY PROGRAM

Recovery Priority Number: 6c

Rationale for assigned priority number: Bay-Delta longfin smelt are experiencing a high degree of threat. Continuing population declines and threats to its habitat will likely result in extinction in the near future. The recovery potential of the species is considered to be low due to the multitude of complex threats that are likely to be exacerbated by climate change. The species has a high potential for conflict with development due to its biological needs likely conflicting with an increasing human demand for freshwater in the region.

Preliminary recovery actions and objectives: The goal of this recovery effort is to address threats to Bay-Delta longfin smelt, such that protection of the species under the Endangered Species Act is no longer required, and delisting is warranted. Recovery includes describing the conditions that will allow the species to persist long-term in the San Francisco Estuary. Using recovery objectives and actions outlined below, we primarily focus on increasing the resiliency of Bay-Delta longfin smelt populations by maintaining and improving populations and habitat conditions. Achieving recovery of the species will rely on continued research, monitoring, and adaptive management of water operations and restoration sites in the estuary. Continued research will help identify the best strategies for improving habitat conditions and populations, and expanded monitoring will inform the efficacy of actions and guide adaptive management in the estuary. Continued expansion of the Bay-Delta longfin smelt culture program will enhance research opportunities and may eventually support population supplementation, if necessary, for recovery. Demographic monitoring is necessary to ensure that these objectives are fulfilled. Specific recovery goals, actions, and delisting criteria will be developed in the recovery plan.

Preliminary Recovery Actions

Objective 1: Continue to fill knowledge gaps on species and population needs, habitat use, and threats.

1.1 Continue support of ongoing development of a statistical model of the life cycle of Bay-Delta longfin smelt to identify spatial and temporal environmental stressors currently contributing to population decline. Findings of the life cycle model will help inform future recovery actions.

1.2 Continue and complete research studies necessary to understanding the drivers of abundance, growth, and survival.

1.3 Continue monitoring and investigating the effect of entrainment from SWP and CVP (Central Valley Project) facilities on Bay-Delta longfin smelt population dynamics.
1.4 Investigate the role of restored tidal wetlands in successful spawning and larval rearing as well as production of food resources. Determine the efficacy of tidal restoration in supplementing food supply and identify designs that optimize export of food resources into the estuary to help inform and prioritize recovery options.
1.5 Continue developing the longfin smelt genetic refugium/culture program. Availability of cultured longfin smelt will enhance laboratory research opportunities aimed at understanding longfin biology as well as studies examining longfin ecology in the estuary.
1.6 Test and implement new research and monitoring methods such as acoustic telemetry. Increase our real-time understanding of species movements and migration patterns in relation to environmental conditions.

Objective 2: Continue and expand population monitoring.

2.1 Continue long-term monitoring surveys that track Bay-Delta longfin smelt relative abundances. These surveys provide a historical context as well as a baseline of abundance in the estuary with which we can measure the success of future recovery actions. Long-term monitoring surveys should also be examined to determine if additional sites or longer sampling timeframes might provide greater insight into abundance, distribution, habitat use, and survival between life stages of the species.
2.2 Investigate spawning and rearing habitat. Knowledge of spawning locations and behavior in the estuary is limited. Identification of spawning habitat and behaviors will aid in potential restoration design. Expansion of existing monitoring programs or development of new programs targeting intertidal habitats will likely enhance our understanding of Bay-Delta longfin smelt reproductive requirements.
2.3 Monitoring of nearshore ocean. Currently, no monitoring of the species is conducted beyond the Golden Gate Bridge. Longfin smelt can spend a substantial portion of their life in the nearshore ocean (up to two years), however very little is known about the species and its ecology when residing in the nearshore ocean. Ocean conditions may affect growth and survival of the species. Monitoring of the population and environmental conditions in the nearshore ocean may reveal how and to what degree this marine phase may influence population dynamics.

Objective 3: Refine and implement adaptive management strategies so that Bay-Delta longfin smelt populations will persist for the foreseeable future.

3.1 To the extent possible, increase winter and spring freshwater flow in the estuary to provide favorable larval rearing conditions.
3.2 Refine existing tools and develop supported models that integrate multiple information sources to design flow actions to ensure and support high juvenile recruitment.
3.3 Adaptive management of restored and other intertidal wetlands to optimize food production and export of food items to the greater estuary. Adaptively manage restored tidal wetlands to provide suitable spawning and rearing habitat.

Stakeholder Involvement: Stakeholders will be involved throughout the development of the recovery plan. Stakeholders include, but are not limited to: Federal, State, and local governments, Tribes, water agencies, recreational interests, researchers, environmental groups, nongovernmental organizations, and other members of the public. At the local or regional level, stakeholders will be able to participate in Bay-Delta longfin smelt conservation efforts.

Approval:

TANYA SOMMER

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Assistant Regional Director, Fish and Aquatic Conservation Program
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Date

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