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First record of the Danube sturgeon *Acipenser gueldenstaedtii* Brandt & Ratzeburg, 1833 in Al-Furat Lake, Syria: likely aquaculture escapees

by

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Abstract

This study documents three separate occurrences of the Danube sturgeon (*Acipenser gueldenstaedtii*; Actinopterygii, Acipenseridae) in Al-Furat Lake, Syria, marking the first recorded presence of this species in Syrian freshwater systems. *A. gueldenstaedtii*, commonly known as the Russian sturgeon, is listed as critically endangered on the IUCN Red List of Threatened Species. This status is due to severe population declines caused by overfishing (primarily for caviar), habitat loss, and the damming of rivers that disrupt their spawning migrations. Conservation efforts, including fishing restrictions and aquaculture, are in place, but wild populations remain at high risk. The specimens were observed on 8 October 2020, in November 2020, and on 13 November 2022. These records are likely the result of aquaculture escapees from Turkish freshwater systems. The three juvenile specimens do not indicate an established reproductive population of *A. gueldenstaedtii* in the lake. The presence of *A. gueldenstaedtii* in Al-Furat Lake is ecologically significant because it could indicate: a new invasive species threat to the Euphrates system, a rare expansion of a critically endangered species, and human-induced changes in freshwater ecosystems facilitating unexpected species movements. Further studies are needed to assess long-term ecological consequences.

Key words: range distribution, new record, juvenile specimens, Euphrates River, ecology

1. Introduction

Sturgeons (family Acipenseridae) are ancient aquatic vertebrates characterized by their elongated bodies, cartilaginous skeletons, and rows of bony scutes (Kuhajda, 2014). Primarily inhabiting freshwater and brackish environments, some species migrate to marine waters for spawning (Lohe, 2021). As benthic predators and prey, sturgeons play a vital ecological role (Chen et al., 2022). However, overfishing, habitat loss, and pollution have severely threatened many sturgeon populations (IUCN, 2021), necessitating urgent conservation efforts for these evolutionarily significant fishes (White et al., 2023).

The Danube sturgeon *Acipenser gueldenstaedtii* Brandt & Ratzeburg, 1833 is a marine species that also inhabits freshwater and brackish environments, typically at depths of 2–100 m (Riede, 2004). An anadromous species, adults migrate from the sea to rivers for spawning, while juveniles return to marine habitats to mature (Demonte et al., 2017). Native to Eurasia, its range spans the Black Sea, the Sea of Azov, and the Caspian Sea basins. This species can reach lengths of up to 2360 mm (Kottelat & Freyhof, 2007) and live for 46 years (Chugunova, 1959).

The record of the Danube sturgeon (*A. gueldenstaedtii*) in Al-Furat Lake (a reservoir on the Euphrates River in Syria) is significant for several ecological and biogeographical reasons, e.g., *Potential Ecological Impact, Native versus Non-Native Status*: If the sturgeon was introduced (intentionally or accidentally), it could compete with native fish species for resources, disrupt food webs, or introduce new parasites/diseases; *Predation or Competition*: Sturgeons are bottom-feeders and may alter benthic ecosystems by preying on invertebrates or outcompeting native bottom-dwelling fish; *Threatened Species Implications*: Since *A. gueldenstaedtii* is critically endangered in its native range (Black/Caspian Sea basins), its presence in Al-Furat Lake could either represent a rare refuge (if naturally occurring) or an unnatural expansion (if introduced), new pathway for invasive species, biogeographical and hydrological significance, and conservation and management concerns.

The key reasons for the cultivation of *A. gueldenstaedtii* are (1) caviar production—this species is highly valued for its high-quality roe, which is processed into premium black caviar, a luxury food product with significant economic value; (2) conservation and biodiversity protection—due to overfishing, habitat loss, and illegal poaching, wild populations are critically endangered. Farming helps reduce pressure on wild stocks and supports species preservation; and (3) sustainable meat production—sturgeon meat is a nutritious and marketable product. Aquaculture provides a controlled environment for efficient growth, ensuring a steady supply without depleting natural populations (Memiş et al., 2011; Vecsei, 2001).

Saygı et al. (2018) conducted a comprehensive study on the future of aquaculture in the Middle East, covering the period from 1950 to 2023. Their findings emphasized the need for more detailed analyses of aquaculture practices in the examined countries. Additionally, they recommended that governments adopt stricter regulatory measures in fisheries policies to ensure sustainable growth.

In contrast, Memis et al. (2002) highlighted the remarkable expansion of freshwater aquaculture in Turkey. Between the early 1970s and 1999, licensed fish farms surged from just 2 to 1444. Cage farming also experienced significant growth, with 57 farms established by 1999, producing 4100 tons of fish. Overall, aquaculture production skyrocketed from 3075 tons in 1986 to 63 000 tons in 1999. Inland production, primarily trout (*Oncorhynchus mykiss*), dominated the sector, accounting for 60% of total output. Meanwhile, marine production saw a sharp rise from 8494 tons in 1995 to 25 230 tons in 1999, driven largely by sea bream (*Sparus aurata*) and sea bass (*Dicentrarchus labrax*).

The study projected that Turkey's aquaculture sector would continue expanding due to rising domestic demand, population growth, and increasing exports. Efforts are underway to diversify production by introducing new marine fish and shellfish species. However, bureaucratic hurdles in licensing—particularly for marine aquaculture—remain a major obstacle. The process is often cumbersome, plagued by technical knowledge gaps, and hindered by insufficient collaboration and knowledge-sharing on emerging industry developments.

Escapes of aquaculture fish into natural water bodies are common globally (Morris et al., 2008), including in Turkey (Innal & Erkakan, 2006). Such incidents often result from facility damage or predation. Sturgeon escapes have been documented previously, such as in the River Evros estuary (Koutrakis & Economidis, 2006). Here, we report an escape of *A. gueldenstaedtii* into the Euphrates River system, representing the first record of this species in Syrian waters.

2. Materials and methods

Three juvenile *A. gueldenstaedtii* specimens were recorded in Tabqa City, Al-Furat Lake, Syria,

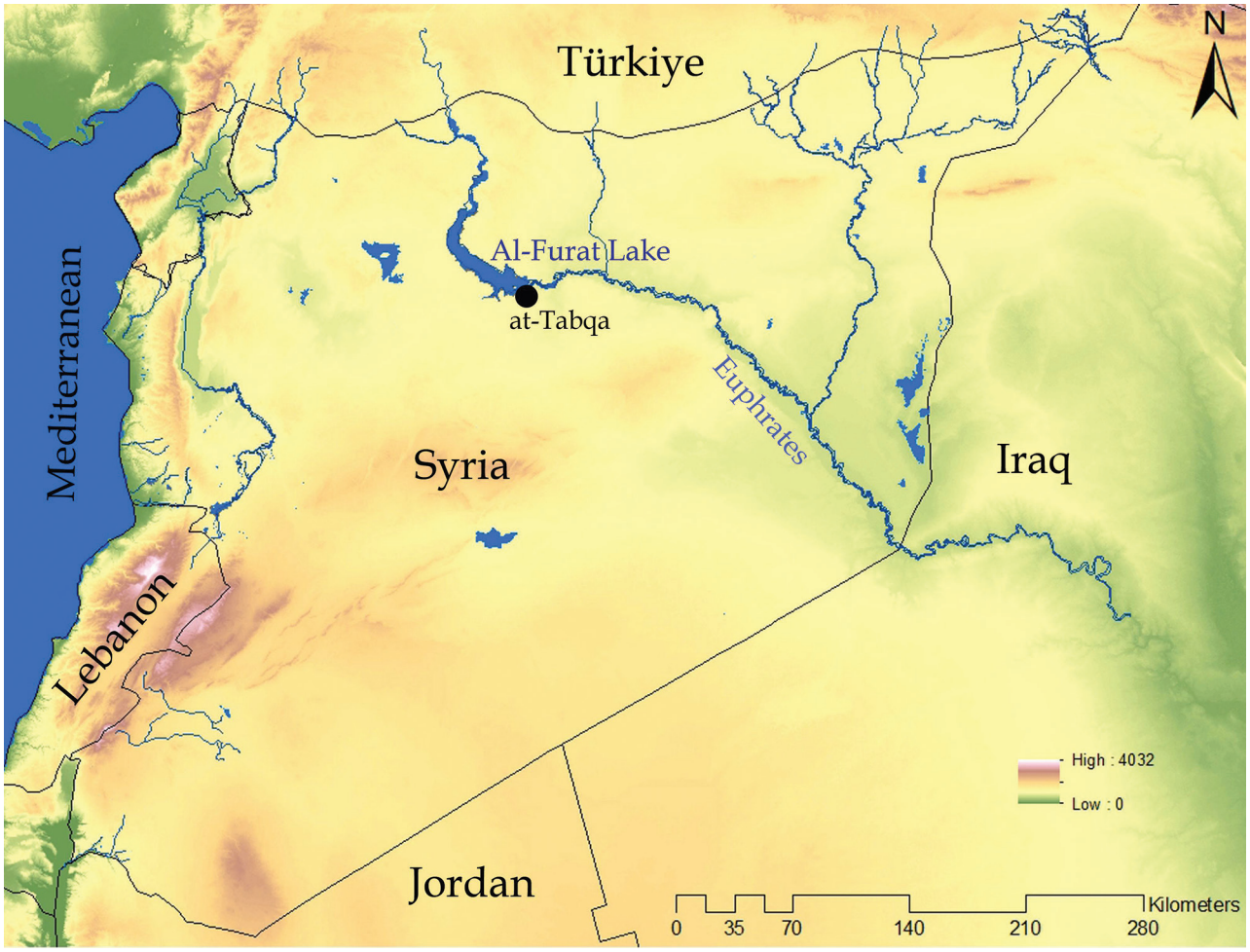

Figure 1

Map showing the sampling locations where three specimens of *A. gueldenstaedtii* were collected from Syria.

on 8 October 2020, in November 2020, and on 13 November 2022. Al-Furat Lake is an artificial reservoir formed by damming the Euphrates River, measuring 80 km long, 8 km wide, and up to 60 m deep (Fig. 1) (Ministry of Environment, 2000). The specimens were collected using gillnets by local fishermen near Tabqa City.

Since genetic analysis was not available to be performed, identification of the specimens was solely morphological and followed established taxonomic keys (Artûhin, 1979; Bănărescu, 1964; Peseridi, 1986).

3. Results

The collected specimens (three juveniles in 2020, one subadult in 2022) measured approximately 300 mm total length (TL) for the specimen from October 2020, 400 mm TL for the specimens from November 2020, 550 mm TL for the specimen recorded in 2022, and 1000 mm TL for the specimen caught in the waters around Elazığ City, Turkey and used for comparison (Fig. 2). Specimens when photographed were not alive. *A. gueldenstaedtii* can be identified by the following characteristics: the highest point of the body is not at the first dorsal scute (in contrast to *A. schrenckii* and *A. nudiventris*, where it is); postdorsal and/or post-anal plates are present (absent in *A. baerii*, *A. ruthenus*, *A. transmontanus*, and *A. stellatus*); plates are absent on the sides of the anal-fin base (whereas they are present in *A. sturio* and *A. oxyrinchus*); the first dorsal scute is separate from the head plates (in contrast to *A. medirostris*, *A. mikadoi*, *A. brevirostrum*, *A. naccarii*, and *A. fulvescens*, where it is connected); and the dorsal outlines of the head and body create an obtuse angle, with a short, blunt, and slightly rounded snout (unlike *A. persicus* and *A. colchicus*, which have uninterrupted dorsal outlines and an elongated, downward-curved snout). Additionally, the barbels are positioned closer to the tip of the snout.

Figure 2

(A) October 2020 (anonymous Fisherman; via Ahmad Aidek); **(B)** November 2020 (anonymous Fisherman; via Ahmad Aidek); **(C)** November 2022 (photo by Yosef Alabdo), **(A–C)** at-Tabqa, Syria; **(D)** July 2024 (photo by Aadel Hindawi), Elazığ, Türkiye.

The data given in this study were compared with those reported by other authors for wild populations (Artûhin, 1979; Bănărescu, 1964; Peseridi, 1986) and were found to fall within the range of these populations.

4. Discussion

The presence of *A. gueldenstaedtii* in the Euphrates River system is most plausibly explained by escapes from Turkish aquaculture facilities, assisted by the absence of physical dispersal barriers. Similar expansions have been noted in South America's Rio de la Plata Basin (Demonte et al., 2017). Hydrological modifications (e.g., dams and canals) in Turkey (Altinbilek, 2004; Yenigün et al., 2008) may further enable such dispersal.

Turkey hosts seven sturgeon species (*Huso huso*, *A. sturio*, *A. stellatus*, *A. gueldenstaedtii*, *A. nudiventris*, *A. ruthenus*, and *A. persicus*), many of which are threatened (Öztürk et al., 2020). While aquaculture has expanded (e.g., caviar production), conservation efforts remain critical (Wei et al., 2004).

Turkey is a primary source of non-native aquatic species in Syria and Iraq, whether through natural dispersal or accidental introduction (Tarkan et al., 2017). Analogous cases include non-native fish spreading from Ukraine to Belarus (Karatayev et al., 2008; Rizevsky et al., 2007). The recent record of *A. gueldenstaedtii* in Iraq (Jawad et al., 2021) supports this pattern.

The introduction of non-native *A. gueldenstaedtii* (Russian sturgeon) into Syrian freshwater ecosystems could have several ecological impacts, including: (1) competition with native species, Russian sturgeon may compete with native fish (e.g., *Barbus* spp., *Capoeta* spp.) for food (benthic invertebrates, small fish) and habitat, potentially reducing native biodiversity. If artificially stocked in high numbers, it could outcompete native sturgeon species (if any remain) or other bottom-dwelling fish; (2) predation pressure, as a large, omnivorous/carnivorous fish, it may prey on native fish eggs, juveniles, and invertebrates, disrupting food webs. This could negatively affect endemic or endangered species already under stress from habitat degradation; (3) habitat alteration, Sturgeons are benthic feeders; their foraging could disturb riverbed sediments, affecting water clarity and benthic communities. Dams and water extraction in Syria already stress aquatic ecosystems; adding a non-native sturgeon could exacerbate these pressures; (4) disease and parasite transmission, introduced sturgeon might bring novel pathogens or parasites that native species have no immunity against, potentially causing outbreaks; (5) hybridization risk, if native sturgeon (e.g., *A. nudiventris*, now rare in Syria) still exist, hybridization could further threaten their genetic integrity; and (6) socioeconomic and aquaculture conflicts, if escaped from aquaculture, Russian sturgeon could disrupt local fisheries by altering catch compositions or damaging gear. However, if properly managed, sturgeon farming could provide economic benefits (caviar production) without ecological harm.

The Syrian freshwater ecosystems (e.g., Euphrates River) are already degraded due to pollution, dams, and invasive species (e.g., *Carassius auratus*, *Cyprinus carpio*). There is no confirmed evidence of established wild populations of *A. gueldenstaedtii* in Syria, but accidental releases from aquaculture are possible. The potential impacts of non-native *A. gueldenstaedtii* (Russian sturgeon) in specific Syrian river systems, along with regulatory and ecological considerations.

4.1. Management recommendations and monitoring strategies

In this section, several issues need to be addressed, beginning with immediate actions. It is important to confirm the sighting by verifying the species' identity through genetic analysis using environmental DNA (eDNA) or tissue sampling to rule out misidentification. Additionally, rapid surveys should be conducted to assess the population status, including population size, age structure, and possible origin, such as natural migration versus human introduction.

In collaboration with Turkish authorities, long-term monitoring strategies can be divided into scientific monitoring, citizen science, and local engagement. Scientific monitoring includes telemetry tracking using acoustic or satellite tags to study movement patterns within the lake and potential migration routes. Regular seasonal surveys, such as gillnetting and hydroacoustics, should be conducted to monitor population trends, along with eDNA sampling to detect sturgeon presence. Citizen science and local engagement involve establishing a community reporting system where fishermen and locals are trained to report sturgeon sightings with photo verification, as well as awareness campaigns to educate stakeholders on sturgeon conservation to reduce bycatch and illegal fishing. Collaboration with Turkish authorities includes transboundary data sharing by coordinating with Turkish fisheries agencies to track potential upstream or downstream migration from the Euphrates-Tigris basin, as well as joint research initiatives with Turkish universities or

conservation groups for genetic studies and habitat assessments.

Habitat management involves protecting spawning grounds by identifying and safeguarding potential breeding sites in the lake or connected rivers. Mitigating bycatch is also essential by promoting sturgeon-safe fishing gear, such as modified nets, to reduce accidental catches. Water quality control should be implemented by monitoring pollution levels that may affect sturgeon health.

Policy and conservation measures include advocating for legal protection by pushing for national listing under Syrian wildlife protection laws, if the species is not already covered. If the population is viable, restoration programs, such as habitat restoration through flow management and substrate improvements, should be considered.

Research priorities include genetic studies to determine whether the population is native, introduced, or escaped from aquaculture, as well as food web analysis to assess the sturgeon's role in the lake ecosystem, including potential prey–predator dynamics.

In conclusion, the absence of adults or spawning evidence suggests these juveniles may represent accidental introductions rather than an established population, though further monitoring is critical to assess recruitment. Non-native sturgeon introductions can disrupt local ecosystems by altering benthic dynamics, increasing predation pressure, and risking genetic hybridization. Proactive management is essential to mitigate such impacts. Certain limitations in the present study should be acknowledged, including small sample size, reliance on morphology, and lack of genetic data.

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Author contributions

LJ: Conceptualization, formal analysis, investigation, methodology, project administration, supervision, validation, visualization, writing original draft, and writing review and editing. AA: Observation, obtaining information about the fish specimen, and reading the first draft of the manuscript.

Conflict of interest

The authors declare that they have no known conflict of interest that could have appeared to influence the work reported in this paper.

Availability of data and material

The data supporting the study findings are available from the corresponding author upon reasonable request.

Ethics statement

This work is based on personal fish catch. Therefore, ethical aspects are not applicable.

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