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Population Expansion of the State-threatened Eastern Sand Darter, *Ammocrypta pellucida* (Agassiz, 1863), within the Vermilion River Basin (Wabash River Drainage), Illinois

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ABSTRACT

The Eastern Sand Darter, *Ammocrypta pellucida* (Agassiz, 1863), has undergone range-wide population declines as a result of anthropogenic disturbances. Within Illinois, the fish historically occurred throughout the Wabash River drainage and Ohio River, but its range was reduced to only the Embarras and Vermilion river basins, including the Middle Fork Vermilion River and North Fork Vermilion River sub-basins. We report the first occurrences of *A. pellucida* in the Salt Fork Vermilion River sub-basin, thus expanding the known range of this imperiled fish by nearly 50 river-kilometers. The distribution expansion might indicate improved physicochemical conditions in the Vermilion River basin.

POPULATION EXPANSION

The Eastern Sand Darter, *Ammocrypta pellucida* (Agassiz, 1863), is a small (<80 mm), sand-dwelling fish (Family Percidae) that has undergone range-wide population declines as a result of habitat loss (Smith 1979; Thompson et al. 2017). Jelks et al. (2008) listed *A. pellucida* as Vulnerable, which is a taxon that is "in imminent danger of becoming threatened throughout all or a significant portion of its range." Grandmaison et al. (2004) reported that *A. pellucida* is imperiled in eight of the nine states where it is located. Within Illinois, *A. pellucida* historically occurred in the upper Wabash River drainage and Ohio River (Smith 1965; Smith 1979); however, due to anthropogenic disturbances (e.g., siltation, impoundments, and water quality issues), the distribution of *A. pellucida* was reduced to the Vermilion and Embarras river basins (Smith 1971; Smith 1979; Henry et al. 2009). Because of population declines from these disturbances, *A. pellucida* was listed as state-endangered in Illinois in 1989 (Nÿboer et al. 2006; IESPB 2012). In 1999, the fish's status changed to state-threatened due to a slight increase in element occurrence records in the late-1990s and has been considered state-threatened since (IESPB 2012; Illinois Department of Natural Resources' [IDNR] Natural Heritage Program, Springfield).

Within the Vermilion River basin (Wabash River drainage), *A. pellucida* is common in the mainstem and Middle Fork Vermilion River sub-basin where clean sandy substrates are present but less abundant in the North Fork Vermilion River sub-basin (Smith 1979; Henry et al. 2009; IDNR Natural Heritage Program, Springfield; Illinois Natural History Survey Fish Collection, Champaign). To our knowledge, *A. pellucida* has never been reported in the Salt Fork Vermilion River sub-basin. We herein report what we believe are the first occurrences of *A. pellucida* in the Salt Fork, thus expanding the known range of this imperiled fish by almost 50 river-kilometers upstream from its previous known location (Figure 1).

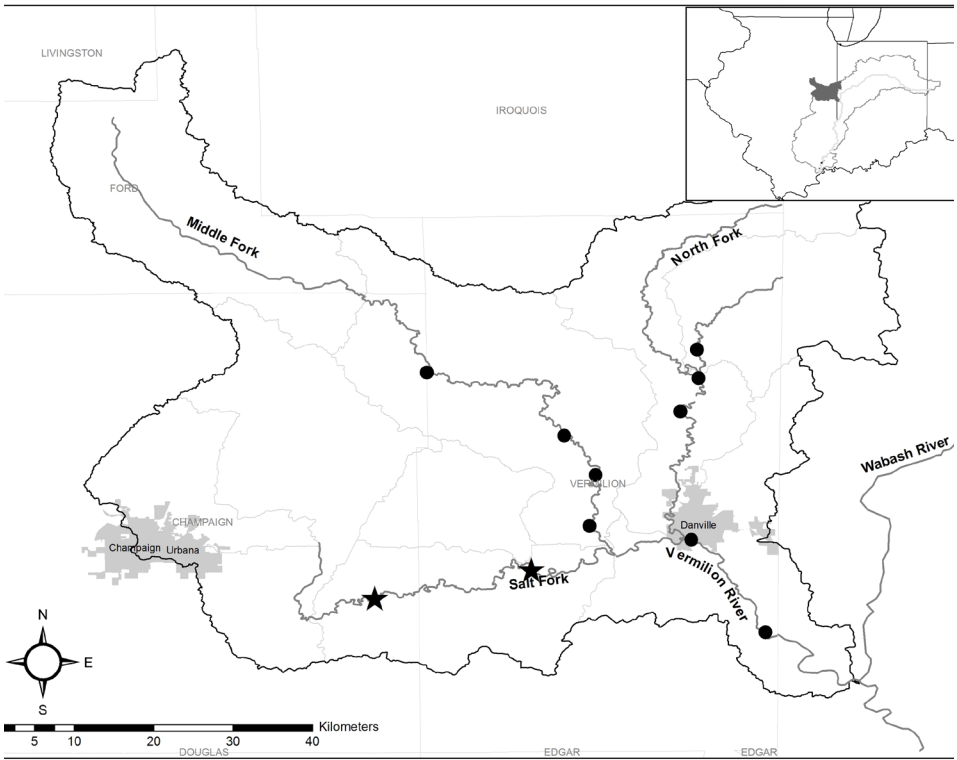

Figure 1. Distribution of the Eastern Sand Darter, *Ammocrypta pellucida*, within the Vermilion River basin (Wabash River drainage). Stars indicate where the fish was collected in the Salt Fork Vermilion River sub-basin in 2019.

Two adult *A. pellucida* were collected in the Salt Fork Vermilion River, approximately 1 km SE of Muncie, Vermilion County on 14 May 2019 via seining. This site is located nearly 20 river-kilometers from the nearest known location of *A. pellucida* in the Vermilion River basin, and is approximately 15 river-kilometers from the Salt Fork – Middle Fork confluence (Figure 1). Seven individuals, including 3 juveniles, were collected at the same site on 21 May 2019, and two individuals were collected here on 12 June 2019. One individual from 12 June 2019 was vouchered and deposited in the Illinois Natural History Survey (INHS) Fish Collection, Champaign (INHS 112666). This individual measured 51-mm total length. On 23 July 2019, two juveniles were captured via kick-seining in the Salt Fork Vermilion River, about 1 km NE of Homer, Champaign County, which is 29 river-kilometers upstream from the site near Muncie (Figure 1); one individual (22-mm total length) was accessioned in the INHS Fish Collection, Champaign (INHS 112667). At both locations, *A. pellucida* was collected over clean sandy substrates with moderate flow and the fish was encountered within three hauls / kick-sets using a 1-meter long, 0.65-mm mesh seine.

The Salt Fork Vermilion River is a highly sampled stream, with collections dating back more than a century (e.g., Forbes and Richardson 1909); therefore, the notion that *A. pellucida* went undetected seems unlikely. Several community samples and targeted surveys have occurred in the sub-basin. For example, Forbes and Richardson (1909), Thompson and Hunt (1930), Larimore and Smith (1963), Larimore and Bayley (1996), and Tiemann (2008) all failed to find *A. pellucida* in the Salt Fork Vermilion River during their surveys in Champaign County. Additionally, the Salt Fork Vermilion River is part of the IDNR's monitoring program and is sampled approximately every 5 years dating back to the 1980s (Trent Thomas, IDNR pers. comm.) and to date, IDNR has yet to collect *A. pellucida* in the Salt Fork (data IDNR Natural Heritage Program, Springfield).

Ammocrypta pellucida is a habitat specialist, often seeking out areas that are >90% sand (Daniels 1993; O'Brien and Facey 2008). This affinity for sandy substrates makes the fish susceptible to anthropogenic disturbances (Smith 1968; Thompson et al. 2017). The Vermilion River basin, especially the Salt Fork, experienced several anthropogenic disturbances during the past century, including domestic sewage, siltation, and dredging (Smith 1968). However, physicochemical conditions in the Salt Fork Vermilion River sub-basin have improved within the last few decades (Larimore and Bayley 1996) to the point where the Salt Fork Vermilion River was rated as a Highly Valued Aquatic Resource (Bertrand et al. 1996). Therefore, our recent discovery of *A. pellucida* in the Salt Fork Vermilion River is likely due to expanding populations from the Middle Fork Vermilion River and/or Vermilion River mainstem because of improved water quality and habitat within the Salt Fork. Similar population expansions of *A. pellucida* were observed in Ohio after physicochemical conditions improved in several rivers (Tessler et al. 2012; Hopkins and Zimmerman 2014). Given we collected multiple year-classes of *A. pellucida* at multiple locations suggests that the population is robust and might occur throughout much of the Salt Fork Vermilion River.

Data are lacking on dispersal rates for *A. pellucida*. Like other darters, *A. pellucida* is believed to be relatively sedentary and nonmigratory (Winn 1958; Schwalb et al. 2010; Finch et al. 2018). However, *A. pellucida* has been described as an opportunistic strategist, which is a small-bodied, short-lived fish with rapid larval growth, early maturation, and multiple spawning events (Winemiller and Rose 1992; Finch et al. 2018). These factors allow for rapid population growth and could explain how the fish was able to disperse quickly in the Salt Fork Vermilion River.

A comparable range expansion was recently reported for the state-endangered Bigeye Chub, *Hybopsis amblops* (Rafinesque, 1820) (Sherwood and Wylie 2015). Similar to *A. pellucida*, *H. amblops* is sensitive to anthropogenic disturbances and is often collected in clear water over sandy substrates (Smith 1968; Smith 1979; Tiemann et al. 2004; Thompson et al. 2017). *Hybopsis amblops* was nearly extirpated from Illinois (Smith 1979) but since the turn of the 21st century, *H. amblops* has expanded its range into the Salt Fork Vermilion River sub-basin from elsewhere in the Vermilion River basin (Sherwood and Wylie 2015). Several other native fishes have also recently expanded their ranges in the Vermilion River basin (Retzer 2005; Tiemann et al. 2015), suggesting the Salt Fork Vermilion River is recovering from prior physicochemical alterations.

Continued documentation that rare and sensitive taxa are expanding their ranges, especially in an area that is recovering from prior anthropogenic disturbances, can provide awareness into the quality of an ecosystem and help natural resource agencies in planning conservation projects. Nÿboer et al. (2006) stressed the importance of protecting the physicochemical conditions of the streams where *A. pellucida* is found. Several restoration activities have recently occurred or are occurring in the Vermilion River basin, including dam removal (Tiemann et al. 2016; Smith et al. 2017) and species reintroductions (Stodola et al. 2017). However, anthropogenic threats are on-going and further investigations are needed to examine their effects on *A. pellucida*, which should aid in the conservation of species. Studies addressing the dispersal rates of *A. pellucida* are needed to help natural resource managers develop models that address population viability, including both extinction probabilities and colonization scenarios. Other studies should inspect how feeding behavior and efficiency of *A. pellucida* varies among substrate types (Burbank et al. 2019), or how localized environmental factors affect biological traits, such as growth, survival, and fecundity (Finch et al. 2013). These studies will aid in the recovery of *A. pellucida* and offer insight into additional ways to improve the physicochemical

conditions of the Salt Fork Vermilion River.

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