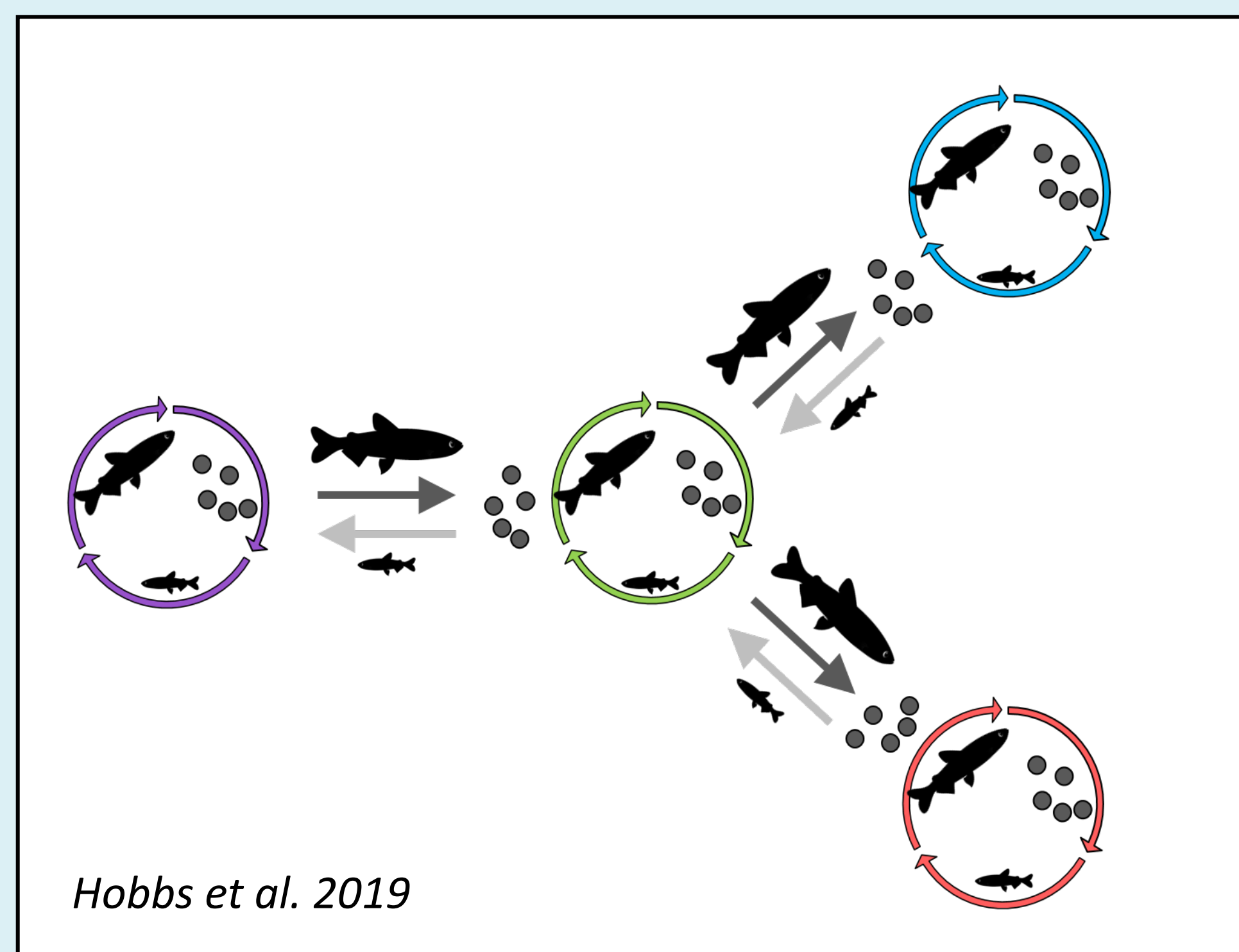
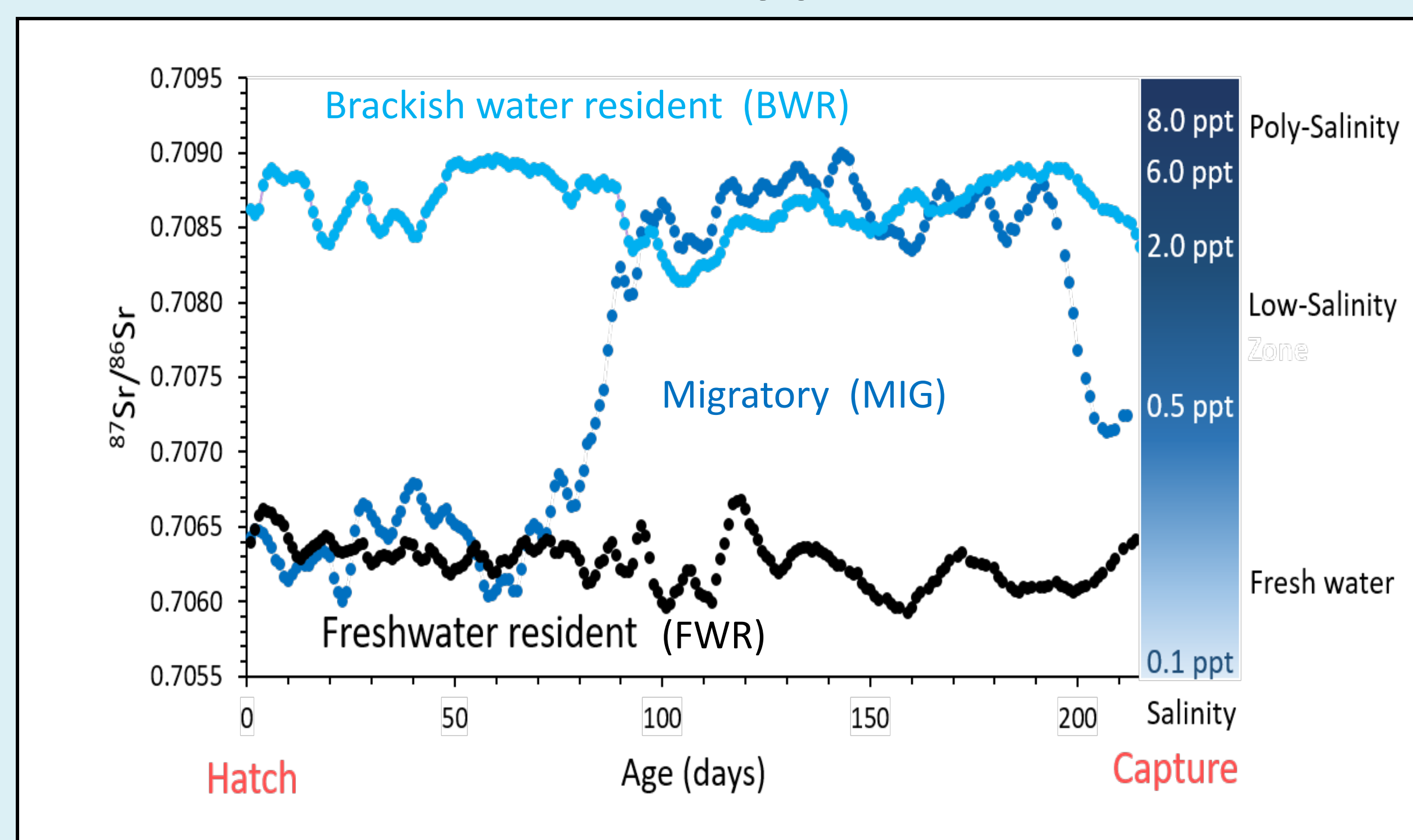


Mixed life history model: Both semi-anadromous and resident fish



- Previous life history models stated that Delta Smelt are semi-anadromous: born in freshwater, maturing in brackish waters, then returning to spawn in freshwater²
- Above: more representative model showing a mixture of migratory and resident life history types

Determining life history strategies with Sr isotope ratios and salinity profiles



- Geographic regions of the SFE have measurable differences in Strontium (Sr) isotope ratios and salinity that can be used to characterize fish movement patterns from birth to capture³
- Above: **Freshwater resident** (black), **Brackish water resident** (light blue), and semi-anadromous **Migratory** (blue) life histories from otolith analyses plotted with correlating salinity values

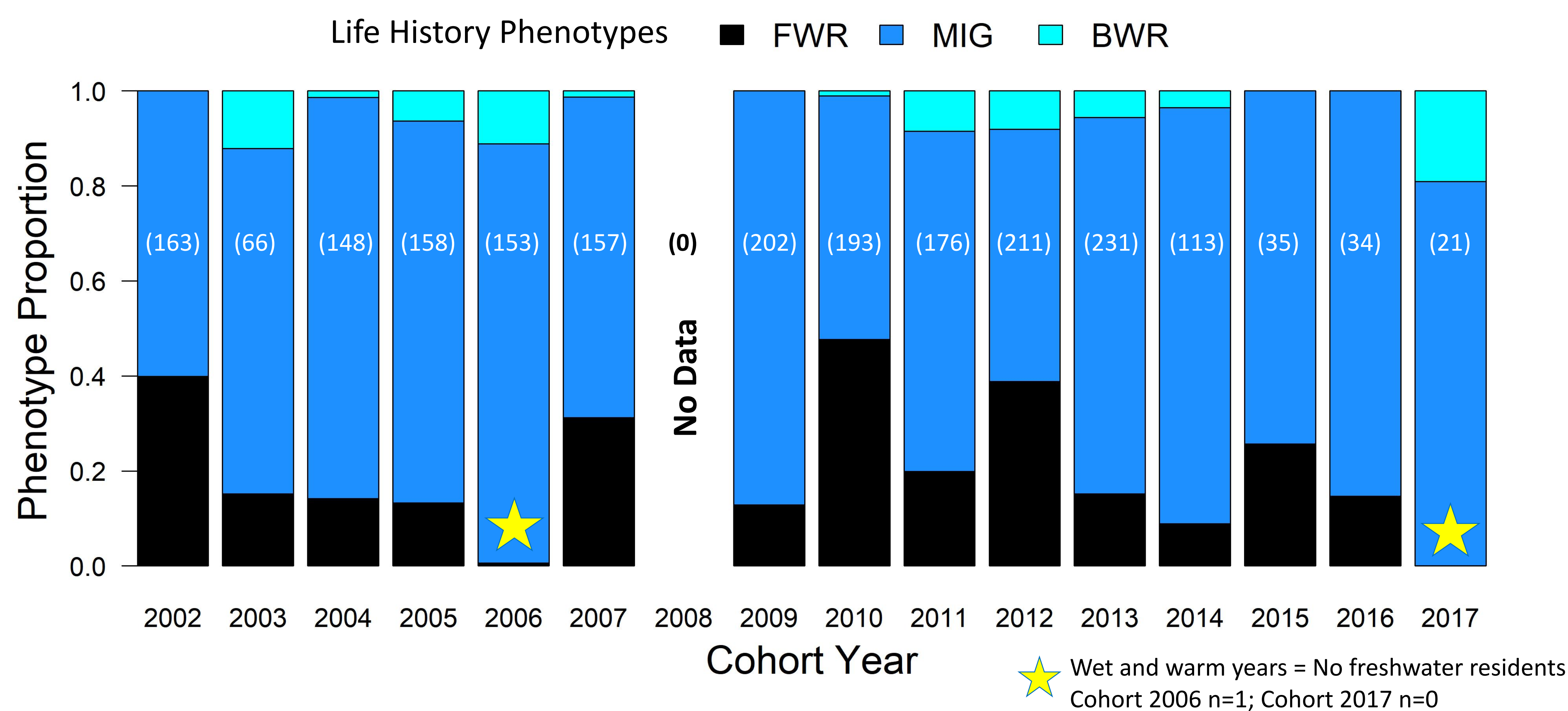


Photograph by Rene Reyes (USBR)

Not all Delta Smelt migrate; the proportion that does varies among years.



Presence of Life History Phenotypes Among Years in Spring Kodiak Trawl Surveys



From 2002-2017, Delta Smelt cohorts caught in the Spring Kodiak Trawl (SKT) survey showed interannual variation in the proportions of life history strategies. Each cohort year represents the year they hatched (the calendar year before capture). The number of samples per year (in parentheses) shows the recent, drastic decline in overall SKT catch.

Delta Smelt life history portfolios show interannual variation among years

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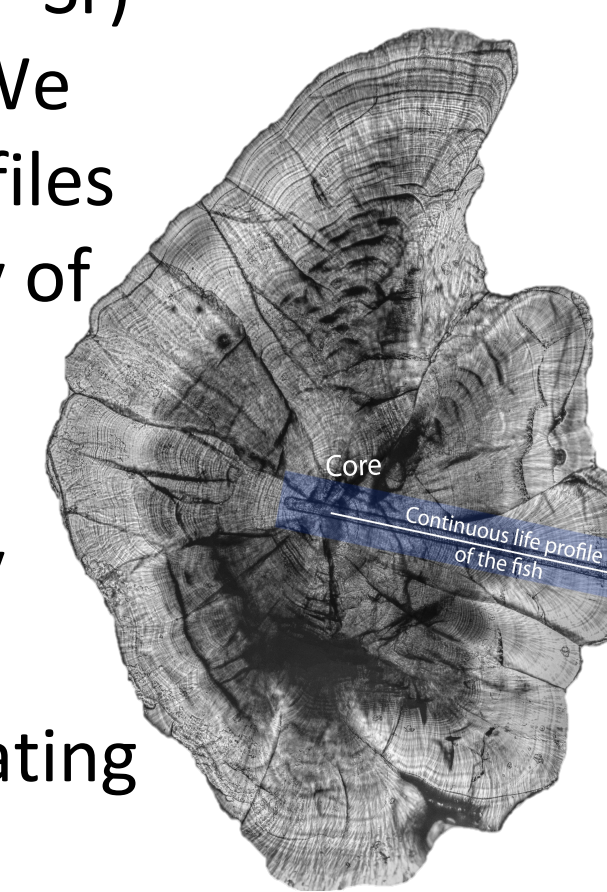
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Introduction

Delta Smelt (*Hypomesus transpacificus*) is an endangered, endemic fish species that functions as an indicator species of ecosystem health in the SFE. Over time, conservation efforts have been based on a semi-anadromous life history model. However, surprising otolith chemistry analyses suggested some individuals do not disperse into brackish water during early life¹. We asked, are resident life history strategies prevalent in the Delta Smelt population?

Methods

With ICP-MS laser-ablation of Delta Smelt otoliths, we obtained (⁸⁷Sr/⁸⁶Sr) Strontium isotope ratio profiles. We used age and daily increment profiles to examine the movement history of individuals across salinities.



We identified different life history phenotypes (portfolios) using hierarchical clustering⁴. By translating isotopic chronologies into salinity histories, we classified individual fish into these distinct clusters.

Discussion

The intraspecific life history diversity found in the Delta Smelt is not currently accounted for in ongoing conservation efforts. Incorporation of this information into policy decisions could help conserve and improve species resilience by spreading the risk of catastrophic mortality among specific habitats⁴.

Future Research

In collaboration with Genomic Variation Laboratory (GVL), we will further investigate how these life history strategies correlate with environmental factors, and if there are underlying genetic differences among phenotypes.

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References

1. Murphy, D.D. & Hamilton, S.A. Eastward migration or marshward dispersal: Exercising survey data to elicit an understanding of seasonal movement of delta smelt. *San Franc. Est. Wat. Sci.* 11 (2013).
2. Moyle, P.B. et al. Life-History and Status of Delta Smelt in the Sacramento-San-Joaquin Estuary, California. *T. Am. Fish. Soc.* 121, 67-77 (1992).
3. Hobbs, J.A. et al. Retrospective determination of natal habitats for an estuarine fish with otolith strontium isotope ratios. *Mar. Freshwater Res.* 56, 655-660 (2005).
4. Hobbs, J.A., Lewis, L.S., Willmes, M. et al. Complex life histories discovered in a critically endangered fish. *Sci. Rep.* 9, 16772 (2019).



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