Double Whammy in the San Francisco Estuary: Smaller mysids and less of them

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Introduction

- Mysids are an important trophic link between smaller zooplankton, such as copepods and cladocerans, and fish in the upper San Francisco Estuary. Mysids provide a valuable food resource for many fishes including striped bass, longfin smelt, juvenile sturgeon, and American shad.
- The California Department of Fish and Game's (DFG) Zooplankton Study monitors mysid abundance in the upper estuary, which has been declining since 1987.
- *Neomysis mercedis* was historically the most abundant mysid throughout the upper estuary until a severe population crash in the early 1990s.
- *Hyperacanthomysis longirostris* (formerly *Acanthomysis bowmani*) is an introduced mysid first detected in 1993, and has been the most abundant mysid in the upper estuary since summer 1995.
- The now numerically dominant mysid *H. longirostris* is smaller than *N. mercedis,* with much lower abundance than historical *N. mercedis* abundance.

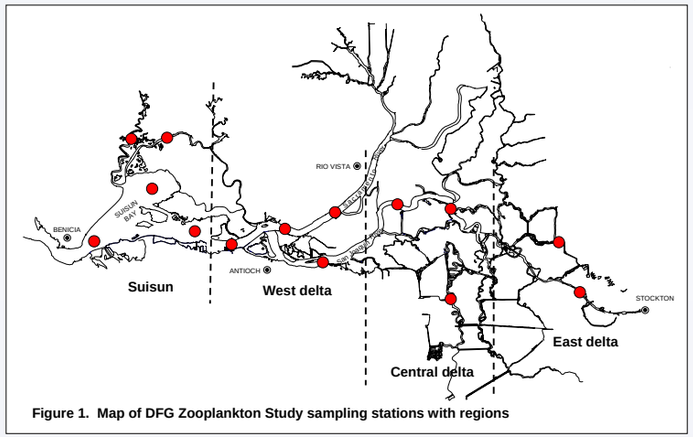

Figure 1. Map of DFG Zooplankton Study sampling stations with regions

Methods

- The DFG Zooplankton Study consistently sampled zooplankton monthly at 14 fixed stations in the upper San Francisco Estuary from 1974 through 2010 (Figure 1).
- A 505 micron mesh net was towed obliquely for 10 minutes to collect mysids. Catch-per-unit-effort (CPUE), as total catch per cubic meter of water, was calculated for comparison of mysid abundance between years and species.
- The first 100 mysids of each species in a sample were measured, and length and sex recorded. Total number of each species was determined through total counts or sub-sampling, if there were more than 400.
- Dry weight of the mysids was then estimated using length-weight equations developed by DFG. An average of dry weights obtained in 1971 and 1975 were used for *N. mercedis*, and dry weights obtained in 1999 were used for *H. longirostris*. The equation derived for *N. mercedis* was also used for all other species, which are found in much lower densities than *N. mercedis* and *H. longirostris.*
- Biomass was estimated by converting dry weights to carbon, assuming a carbon-to-dry-weight ratio of 40% (Uye 1982).
- Biomass-per-unit-effort (BPUE), in milligrams of carbon per cubic meter of water sampled, was calculated for comparison of mysid biomass between years and species.
- Average annual abundance and biomass were then compared by species and total mysids for March to November, the months consistently sampled all years. Average annual biomass by region was also examined.

Figure 2. Average size of adult native *N. mercedis* (top) and introduced *H. longirostris* (bottom)

Table 1. Mean length and biomass of *N. mercedis* and *H. longirostris*

	Juvenile		Adult	
Species	Mean length (mm)	Biomass (mg carbon)	Mean length (mm)	Biomass (mg carbon)
Neomysis mercedis	4.1	0.05	10.4	0.98
Hyperacanthomysis longirostris	3.3	0.06	7.8	0.43

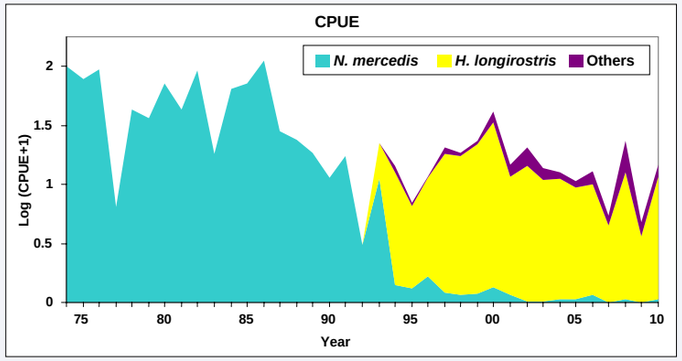

Figure 3. Annual abundance (log of CPUE+1) of mysids by species, 1974-2010

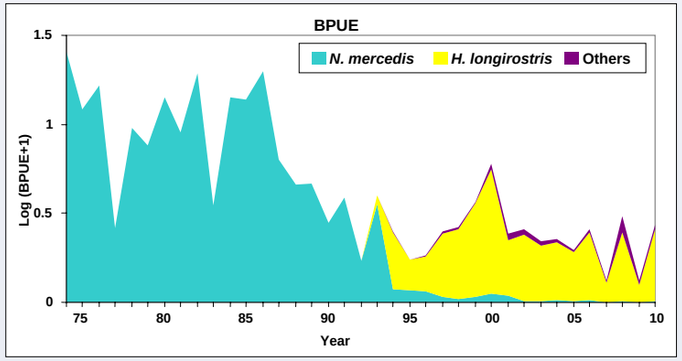

Figure 4. Annual biomass (log of BPUE+1) of mysids by species, 1974-2010

Results

- *H. longirostris* is smaller, on average, than *N. mercedis*. *H. longirostris* weighs more than *N. mercedis* at the same length, *H. longirostris* matures at a smaller size and does not get as large as *N. mercedis*. The average *N. mercedis* adult (Figure 2) is approximately 3mm longer than *H. longirostris,* and provides about twice as much carbon (Table 1).
- Species replacement of *N. mercedis* by the smaller *H. longirostris* has resulted in a sharper decline in biomass than abundance (Figures 3 and 4).
- Although mysid biomass has declined in all regions of the upper San Francisco Estuary, the east and central delta have declined more than the west delta and Suisun (Figure 5).

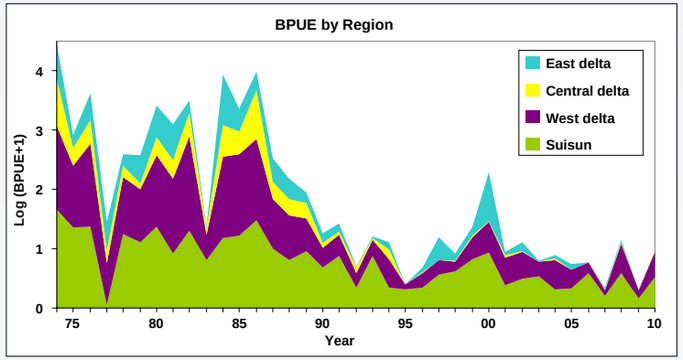

Figure 5. Annual mysid biomass (log of BPUE+1) by region, 1974-2010

Discussion

- Although the introduced mysid *H. longirostris* has replaced the native mysid *N. mercedis* as the most abundant mysid in the upper San Francisco Estuary, densities of *H. longirostris* are much lower than the historical *N. mercedis*.
- The introduced *H. longirostris* is also smaller than *N. mercedis,* thereby providing less biomass for fishes, such as longfin smelt, that depend on this important food source.
- Before the population crash in the 1990s, the native mysid *N. mercedis* was abundant throughout the upper San Francisco Estuary, whereas it's replacement *H. longirostris* has highest densities in Suisun and the western delta and very low densities in the central and eastern portions of the delta.
- Fish that depend on mysids in the upper San Francisco Estuary face a double whammy: not only are there fewer mysids available, but the ones available are also smaller. So fish are getting less bang for their buck!

Acknowledgements

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References

Uye, S.I. 1982. Length-weight relationships of important zooplankton from the Inland Sea of Japan. Journal of the Oceanographical Society of Japan 38: 149-158.