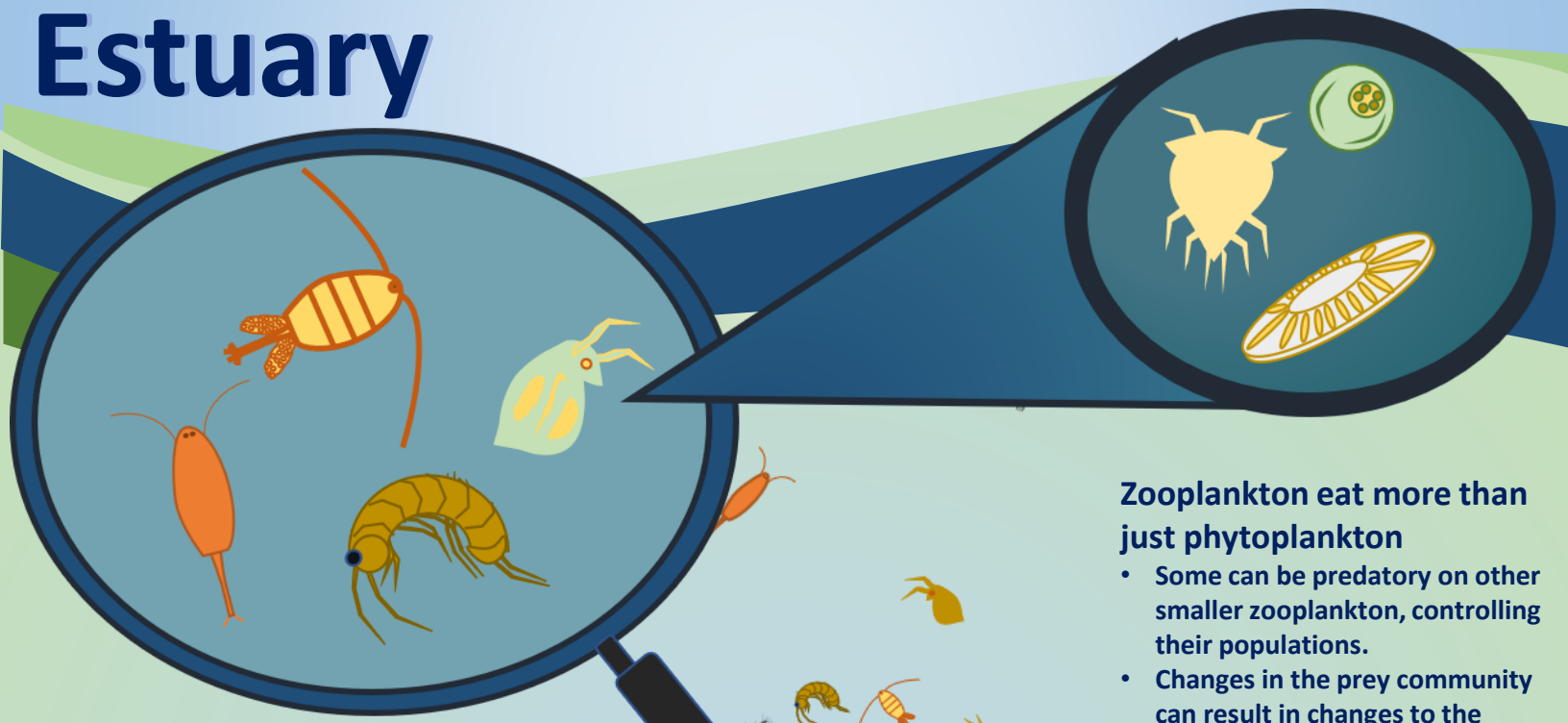
Zooplankton in the Estuary

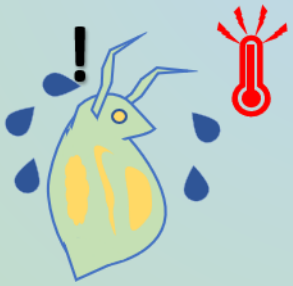


Zooplankton are diverse

- There are hundreds of zooplankton species in the San Francisco Estuary alone, but not all of them make good fish food.
- Some are pelagic, while others can be benthic or epibenthic.
- Studies should ensure they are using the right gear to target species relevant to their questions.

Climate change

- Communities may change to species with higher thermal tolerances.
- The timing of peak abundance may shift.



Zooplankton eat more than just phytoplankton

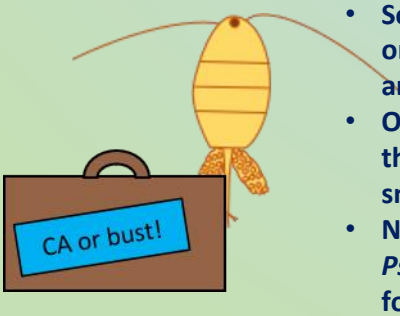
- Some can be predatory on other smaller zooplankton, controlling their populations.
- Changes in the prey community can result in changes to the zooplankton community, and cascade even further up the food chain.

Zooplankton can control their vertical position

- They move up to eat at night, down to avoid predation during the day, or up and down to maintain position in the estuary by "surfing" the tides.
- This movement can complicate efforts to "flush" zooplankton downstream with increased outflow.

- As zooplankton move from the surface to bottom, they can also help carbon sink by dropping "Zoop-Poop" on the way down!

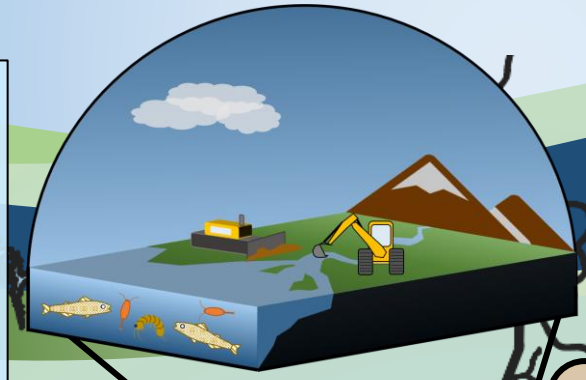
The San Francisco Estuary is one of the most invaded ecosystems on the planet

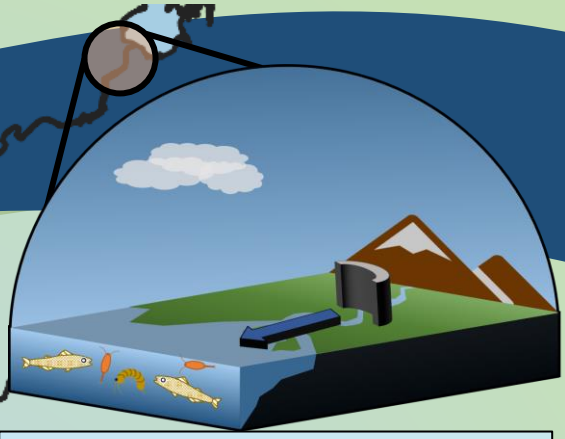


- Some invasive species can have sweeping impacts on zooplankton communities, leading to bottom-up and top-down effects on the ecosystem.
- One invasive, *Limnoithona tetraspina,* has become the most abundance copepod in the estuary, and is small and difficult for fish to catch.
- Not all non-natives are bad! Some, like *Pseudodiaptomus forbesi* have become important food sources for endangered smelt in the region.

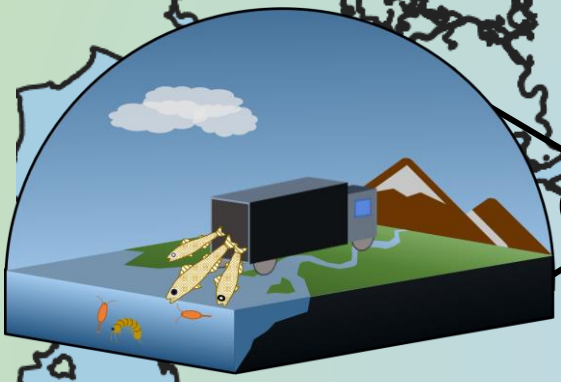
Using Zooplankton Data to Inform Management Actions

Wetland and floodplain managers can can use zooplankton data to assess the impact restoration efforts have on food production and supplies.

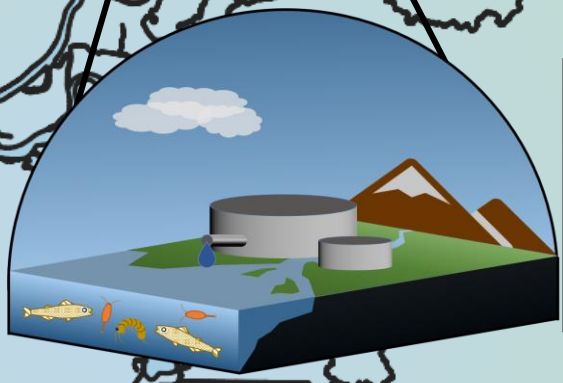




Determining how flow actions impact zooplankton community composition and peak biomass timings can be critical to managing food resources.



Timing and distribution of zooplankton populations can be integral for determining when and where to release hatchery fish.



Changes in water treatment processes may alter estuarine food webs, which can be detected with metrics of zooplankton community composition and population abundances.

Use Existing Datasets

Make sure to consider the decades of available zooplankton monitoring data in the estuary. Much of the data from different programs has been synthesized into one dataset available at the IEP github page.

(https://github.com/InteragencyEcologicalProgram/ZoopSynth)

And in a web shiny application.

(https://deltascience.shinyapps.io/ZoopSynth/)

General Recommendations

- Managers and scientists should work together to develop clear and concrete objectives for management actions.
- Stay focused on the objective, and study taxa relevant to your goals.
- Processing zooplankton samples consumes a lot of time and resources, consider investing in new sampling technology such as autonomous samplers or photo-recognition.
- Communicate openly to maximize the value of the zooplankton data.