Science Foundation Chapter 3
Appendix 3.1 – Case Study
Pacific Herring (*Clupea pallasii*)

Author: Wim Kimmer[1]

[1] *Romberg Tiburon Center, San Francisco State University, 3150 Paradise Drive, Tiburon, California, 94920.*

DESCRIPTION OF THE SPECIES

Pacific herring, *Clupea pallasii*, is the only fish that supports a commercial fishery in the Bay. Pacific herring occur in the coastal ocean for most of the life cycle but spawn, and larvae rear, in the Bay. They are captured for their roe, and eggs are harvested directly using kelp as a spawning substrate.

CRITERIA FOR SELECTION OF THE SPECIES

The spawning areas of Pacific herring are vulnerable to aspects of long-term change, especially sea level rise, changing salinity distribution, and possibly temperature. Schools of adult herring are likely affected by conditions in the coastal ocean.

OTHER INFORMATION ABOUT THE SPECIES

Pacific herring occur throughout the north Pacific Ocean in stocks associated with estuaries used for spawning. Schools of adult herring enter the Bay in winter and spawn by depositing sticky eggs on hard substrates and vegetation in the low intertidal and shallow subtidal areas of the Bay. Eggs are vulnerable to predation by fish, birds, and mammals, and can be harmed by excessive sediment loads. Early survival is related to salinity, with the highest survival at low to moderate salinity and low survival at oceanic salinity (Griffiths et al. 2004). Young herring rear within the Bay through the larval and early juvenile stages. Recruitment of young herring to the adult population is controlled mainly by survival from spawning through the larval stage (O'Farrell and Larsen 2005).

REVIEW OF LONG-TERM EFFECTS

Probably the most important long-term effects on Pacific herring will be due to changes in salinity. Since eggs and early larvae survive best at salinity well below oceanic levels, and spawning requires substrates that are most available in Central Bay, a trend toward a more landward position of the salinity field would result in lower recruitment. A possible exception to this would occur if eelgrass were to form large beds further up-estuary than where they now occur, providing lower-salinity spawning habitat. Increases in salinity during the winter spawning season are likely to arise through changes in the tidal prism, higher sea level, and changes in water project operations to capture more of the winter runoff than is now removed.

Changes in the coastal ocean would affect herring and in particular the proportion of the population that spawns in the Bay. These changes are not well constrained by climate forecasts, nor is the response of herring abundance to changes in the ocean well understood.

Sea level rise will alter the nearshore bathymetry, which would have either positive or negative effects on spawning habitat for herring. Higher temperature may reduce survival of eggs spawned in the intertidal zone.

A reduction in suspended sediment may improve survival of herring eggs. Winter suspended sediment concentrations depend more on flood-borne sediments than the decreasing pool of sediments in the Bay, but sediment loading through the Delta has decreased (Wright and Schoellhamer 2004).

OTHER STRESSORS

Eggs spawned on pier pilings containing creosote do not survive well (Vines et al. 2000). The eggs are vulnerable to damage by oil spills.

FACTORS THAT MAY AFFECT SPECIES RESILIENCE

Probably high. The herring fishery is closely monitored and well regulated.

LIKELY CLIMATE CHANGE IMPACTS AND RISKS

Changes in the salinity distribution during winter could have a large impact on early survival and subsequent recruitment.

MANAGEMENT ACTIONS TO BE CONSIDERED

If the anticipated landward shift in salinity were to occur, recruitment might suffer as a result of the poor overlap between suitable spawning substrate and suitable salinity. This may warrant action to provide more spawning habitat, perhaps in connection with construction to adapt to rising sea level and development of living shorelines.

LITERATURE CITED AND RESOURCES

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