Ballast Water Risk and Management

Randall Marshall
WET Coordinator
WA State Dept. of Ecology
P.O. Box 47600
Olympia, Washington 98504-7600
360-407-6445 or rmar461@ecy.wa.gov
http://www.ecy.wa.gov/programs/wq/wet

Protecting State Waters

- The state legislature set July 1, 2007 as the deadline beyond which no discharge of unexchanged or untreated ballast water to state waters will be allowed. (The current Chapter 77.120 RCW has dropped the deadline without abandoning the goal.)
- Meeting the goal is dependent on providing the shipping industry with a list of tested and approved ballast water treatment technologies.

Protect State Waters?

What is the threat?

Ballast Water Release

Example - Griffen's isopod

- Griffen's isopod (*Orthione griffenis*) impairs mud shrimp reproduction by sucking blood.
- The parasite is a non-native species most likely introduced through ballast water.
- As many as 80% of adult mud shrimp in a bay can be infested causing reproduction to be almost completely halted.
- Mud shrimp are a key food for fish and birds, and humans use them as fishing bait.


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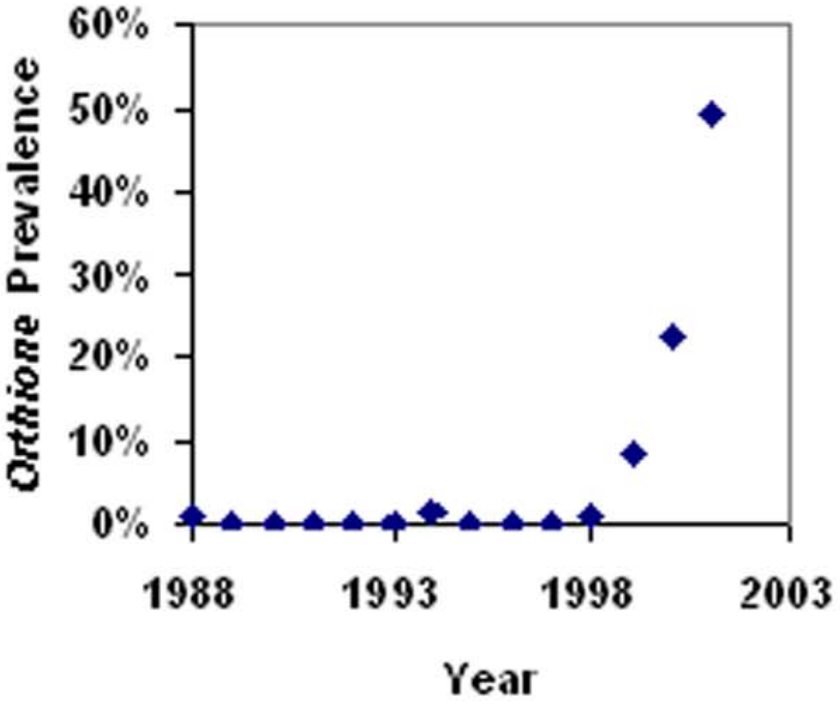
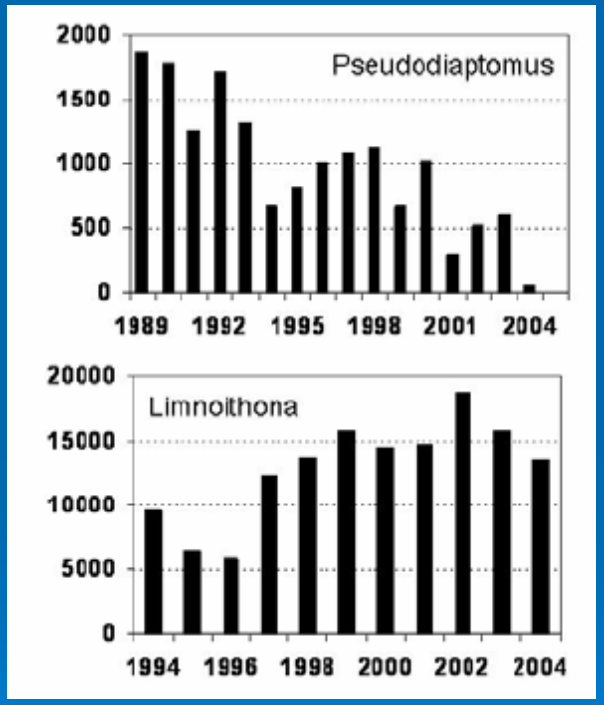

60%
50%
40%
30%
20%
10%
0%
Orthione Prevalence
1988
1993
1998
2003
Year


6
5
4
3
2
1
0
ln(Upogebia density)
1988
1993
1998
2003
Year

Example:
San Francisco Bay/Delta

Native Copepod



Introduced Copepod

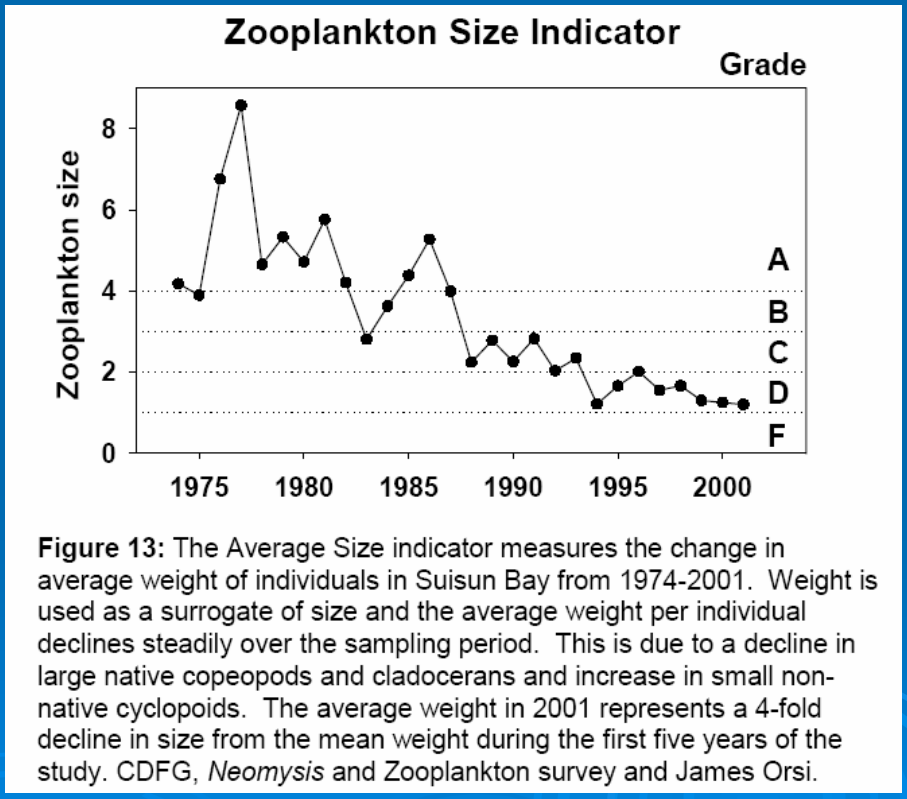


Figure 13: The Average Size indicator measures the change in average weight of individuals in Suisun Bay from 1974-2001. Weight is used as a surrogate of size and the average weight per individual declines steadily over the sampling period. This is due to a decline in large native copeopods and cladocerans and increase in small non-native cyclopoids. The average weight in 2001 represents a 4-fold decline in size from the mean weight during the first five years of the study. CDFG, *Neomysis* and Zooplankton survey and James Orsi.

Standards for Ballast Water

- State rules set standards for the effectiveness and safety of ballast water treatment.
- One standard is that treated ballast water must meet state water quality discharge laws.
- The Department of Ecology Water Quality Program is responsible for reviewing for compliance with this standard any ballast water treatment proposals involving biocides.

WAC 220-77-095(2)(d)(v)

"The discharge from a technology must be environmentally sound and in compliance with existing water quality discharge laws."

Establishing the Environmental Safety of Ballast Water Biocides

- Appendix H of Ecology Publication WQ-R-95-80 describes the procedure.
- Zero toxicity at discharge is preferred if treatment effectiveness is not impaired.
- Otherwise, the BW biocide concentration cannot be more than twice the LC_{50} (EC_{50}) of the most sensitive test.
- First BW biocide evaluation process in nation.

Maximum Allowed Chlorine Dioxide Discharge Concentration

- Toxic thresholds are sharp.
- EC_{50} results for the 3 most sensitive test endpoints were around 0.2 mg/L ClO_2.
- Effects disappear when concentrations reach 0.15 mg/L ClO_2 .
- 0.4 mg/L ClO_2 (twice the EC_{50}) would become nontoxic with the 1:2 to 1:3 dilution which occurs immediately upon discharge.

Safety Factors

- Test organisms receive greater exposure than wild organisms because test durations last longer than ballast water discharges do.
- Chlorine dioxide continues to degrade and volatilize in the environment.
- Natural organic matter and sunlight enhance ClO_2 decay.
- Ongoing toxicity testing is an approval condition.

Electrochlorination

- Uses electricity to generate chlorine and related oxidants (TRC) from chloride in seawater in order to destroy living organisms in ballast water.
- Dechlorination with sodium sulfite is used prior to discharge to neutralize toxicity ("chlorine goes back to chloride").
- The WQP required toxicity testing of seawater treated by a bench scale version of the system.

Peracetic Acid and H_2O_2

- Peracetic acid is very toxic and very reactive with a half-life of several hours.
- Hydrogen peroxide is also toxic but will react over time with organic matter or metals to become water and oxygen.
- Will oxidize and breakdown some organic pollutants in ballast water.
- Bench scale testing confirmed the breakdown and elimination of toxicity.

General Considerations

- Some toxicity tests are conducted for 7 days which is much longer than a BW discharge.
- Biocide toxicity at its worst would be confined to the vicinity of the vessel and last not much longer than the ballast water discharge.
- Zero risk does not exist.
- Proper risk management involves balancing sometimes competing priorities.

Current Status

- We still do not treat ballast water prior to discharge.
- The most that can be expected is mid-ocean exchange.
- The state ballast water standard is based upon percent removal and is unrealistic and not necessarily protective.
- National treatment standards are also lacking.

Proposed Standards

- IMO, Congress, and a few states have proposed standards.
- Some standards are so low as to be not measurable such as < 1 viable organism in 10 cubic meters (10 metric tons).
- Zero is excessive but no higher number is known to be adequately protective.
- WDFW and the state Ballast Water Work Group are drafting rules to try to solve all of these problems.

Fouling on Ship Hulls

Underwater view of a highly fouled ship hull showing attached fouling organisms

Hull Fouling

- Species attached to hulls, seachests, anchors, etc. are transported among harbors.
- Although fewer organisms than typical ballast water, fouling can include reproductive adults.
- 800 million square meters of wetted surface area on hulls enter into North American ports per day.
- Of 171 species introduced in the U.S. due to shipping, more are linked to hull fouling than ballast water.
- In Hawaii, New Zealand and Australia, hull fouling may be the most important vector for introductions.

Possible vector for coastal NIS introduced to North America by shipping (n=171)