

Chapter 6. Organisms in Sediments of Tanker Ballast Tanks

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6A. Purpose

At certain times and source ports, appreciable quantities of bottom sediment are taken up by tankers during ballasting. The entrained sediment potentially includes bottom dwelling organisms, which may be discharged and introduced into a receiving port (Smith et al. 1996). Few studies of such entrained sediment exist, but our samples of bulk carriers in Chesapeake Bay revealed that the bottoms of ballast tanks often hold a wide variety of large crabs, fish, shrimp, as well as many small organisms. To determine whether tankers arriving to Prince William Sound transported organisms associated with sediment in the bottoms of segregated ballast water tanks, we sampled a subset of ships traveling between Port Valdez and west coast ports, and between west coast ports and Asian ports.

6B. Methods

During 1998-99 we supplied 13 ships with “sediment sampling kits”, which we developed in cooperation with the shipping agents. The ships’ mates collected core samples and evident organisms in the sediment during routine cleaning operations, which usually occurred on voyages from Valdez to west coast ports, when ballast tanks were empty and open for maintenance, and in Asian ports, when ships were in dry-dock. The samples were preserved in 10% formaldehyde sea water, labeled and returned to Valdez. Samples were then sent to the SERC lab in Maryland for processing and identification. Subsamples of whole sediment were sent to Mary McGann in USGS, Menlo Park for identification of foramenifera. Remaining sediment was washed through a 0.5 mm mesh sieve and identified under a dissecting microscope.

6C. Results

Sediment samples of the 13 tankers contained a diverse array of taxa, including fish, polychaete worms, mollusks, adult crabs and other crustaceans, cnidarians, and other invertebrates (Fig. 6.1, Tables 6.1, 6.2). The ships averaged 2.8 taxa per ship, ranging from 0-6 taxa, with annelid worms occurring in about 90% of the ships. The number of individuals per sample varied widely from 1-147 individuals, with a mean of 47 individuals. Small crustaceans (particularly cumaceans) were the most abundant taxa, however polychaete worms were the most prevalent. The sediments also contained several species of Foraminifera, including *Trochammina hadai*, an NIS that has invaded many west coast ports and is very common in San Francisco Bay (McGann, pers. comm.), and which is reported from Prince William Sound in samples collected from deep sediments following the ExxonValdez oil spill. Organisms were abundant in sediments taken up in both San Francisco Bay (Benicia) and in Long Beach, where the ship intakes are near the port bottom. Ships sampled in dry dock in Asia tended to have few organisms, perhaps as a result of longer voyage time across the Pacific. However, the diversity of higher taxonomic groups present in sediments of ballast tanks did not show any obvious pattern by source port.

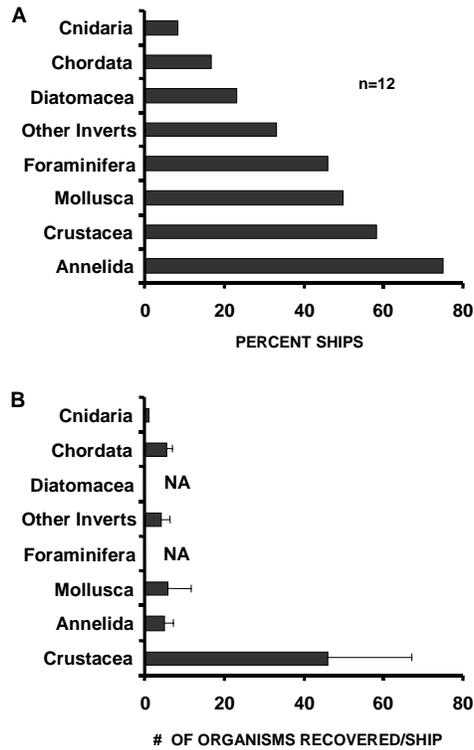
Table 6.1. Taxa Recovered From Ballast Tank Sediments of 12 Tankers.

Foraminifera	Annelida	Mollusca	Crustacea	Chordata	Other inverts.
<i>Ammonia hadai</i>	Capitellidae	Mytilidae	Alpheidae	Engraulidae	Bryozoa
<i>Bulimina sp.</i>	<i>Nereis sp.</i>	Nudibranchia	Amphipoda	Sciaenidae	Sipuncula
<i>Elphidium sp.</i>	Oligochaeta		<i>Balanus balanoides</i>		Turbellaria
<i>Globigerina sp.</i>	Spionidae		<i>Calanus</i>		
<i>Haglophragmoides sp.</i>	Syllidae		Canuellidae		
<i>Jadammina macrescens</i>			Caridea		
<i>Lagena sp.</i>			Cirripedia		
<i>Rosalina globularis</i>			Crangonidae		
<i>Trochammina hadai</i>			Cumacea		
<i>Trochammina inflata</i>			Grapsidae		
<i>Trochammina pacifica</i>			Harpacticoida		
			Hyperiidae		
			Majidae		
			Ostracoda		
			Tanaidacea		

Table 6.2. Presence/Absence of Taxa in Ballast Tank Sediment Samples Presented by Source Region(s).

Source(s)	Diatomacea	Foraminifera	Annelida	Mollusca	Crustacea	Chordata	Other Inverts	n
Korea	P	P	P	A	A	A	A	1
LB & Korea	P	P	P	P	P	P	P	2
PS	A	A	A	P	P	A	P	1
PS & SF	P	P	P	P	P	P	P	1
SF	A	P	P	P	P	P	P	6
SF&China	A	A	P	A	P	A	A	1

Figure 6.1. Prevalence (A) and numbers (B) of organisms recovered from sediments of tanker ballast tanks. Bars indicate means for 12 tankers.



6D. Conclusions

Sediment that accumulated in the bottom of ballast tanks often contained organisms from a diverse array of taxa. Many of these were adults in full reproductive condition. At least one NIS (the foraminiferan *Trochammina hadai*) found in these samples appears to be established in Prince William Sound, although the current status of this invasion is not known (McGann, pers. comm. 1999).

In future work, it would be valuable to sample sediment in ballast tanks that have undergone mid-ocean exchange. It is not clear if bottom-dwelling organisms will be affected by exchange in the same ways as planktonic organisms in the water column.

6E. References

McGann, M. 1999. Personal communication.

Smith, L.D., M.J. Wonham, L.D. McCann, D.M. Reid, G.M. Ruiz and J.T. Carlton. 1996. Biological invasions by nonindigenous species in United States waters: Quantifying the role of ballast water and sediments. Parts I and II. Final report to the U.S. Coast Guard and the U.S. Department of Transportation.