San Francisco Bay Survey of Non-Indigenous Aquatic Species (NAS)

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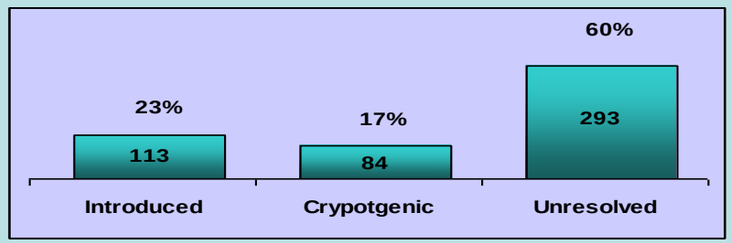
1 What is the Marine Invasive Species Program?

DFG conducts biological surveys to monitor coastal and estuarine waters of the state for new introductions to determine the effectiveness of ballast water control measures. We also maintain a comprehensive database, CANOD, of NAS occurrences.

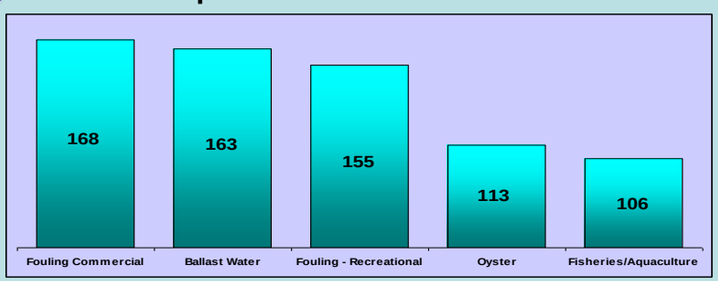
2 Organism Classification

Introduced	Cryptogenic	Unresolved
Not native to California	Neither demonstratively native or introduced	Not identified to species level

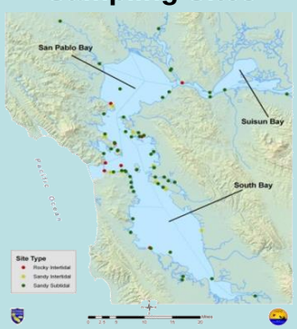
3 Number & Percentage of Organisms Per Classification



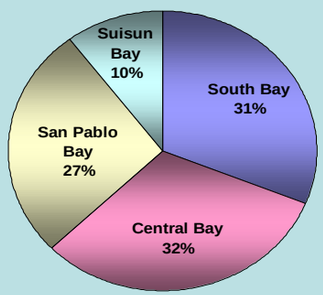
4 Top 5 Vectors of Introduction



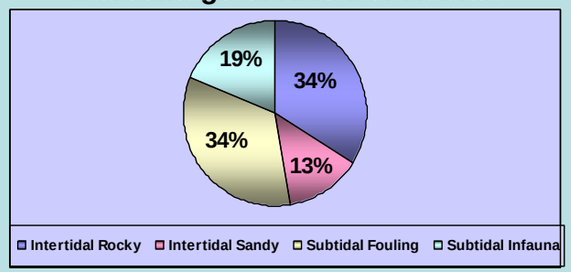
5 San Francisco Bay Sampling Sites



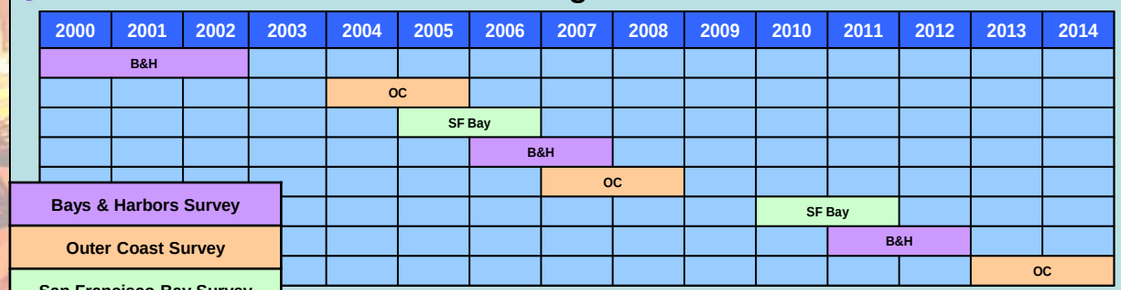
Percent of NAS Per Bay



6 Percentage of NAS Per Habitat



7 Monitoring Timeline



8 Additional Research

Study & Author	Research	Major Findings
Vector Study Ruiz, et al., Smithsonian Environmental Research Center (SERC)	Examine (a) the contribution of California and SF Bay as focal points for introductions to western North America and (b) the vectors attributed to initial introductions to California.	***Results indicate that California, especially San Francisco Bay, plays a pivotal rule in marine invasion dynamics for western North America, providing an entry point from which many species spread.*** Of 257 non-native species established in California: 61% were first recorded in SF Bay and 57% are known from multiple estuaries, also suggesting secondary spread.
Halichondria Sponge DNA Study Geller, J., Moss Landing Marine Labs, Genomes Lab (MLML)	A genetic study to determine the diversity and geographic origins of "Breadcrumb" sponges (genus Halichondria) found in CA.	Results revealed a new undescribed native species and two introduced species of Atlantic origin. The analysis found that none of the genetically identified species correspond to the names previously used to describe these species and that species identification can be made only by genetic analysis.
SF Bay Settling Plate & Molecular Genetic Analyses Study SERC & MLML	Establish baseline measures and the efficiency of DNA sequence analysis in the SF Bay using a "next generation" sequencing process, known as massively parallel pyrosequencing (MPPS).	A pilot NAS detection study combining genetic and morphological analyses of samples collected from artificial settling plates, quantitative surveys of existing hard substrate, and plankton tows. The MPPS process differs from conventional sequencing by exhaustively sequences a large volume (~1,000,000) of individual DNA template molecules simultaneously. If effective, this approach would be a rapid and cost-effective approach for widespread and frequent monitoring.
SF Bay Species Distribution Analysis MLML, Benthic Lab & CCR, Inc.	Examine the distribution of NAS in San Francisco Bay.	There was no relationship between sediment texture (grain size) and numbers of introduced species. Likewise, they type of hard substrate (e.g. wood, concrete, plastic) did not influence the distribution of introduced species. Hydrographic variations along the estuarine gradient apparently are more important in controlling community structure than changes in sediment and hard surface type.

Background imagine credit: http://wallpaper-s.org/63__San_Francisco's_Golden_Gate_Bridge,_California,_USA.htm