

A Review of Recently Completed Studies  
Undertaken to Develop an Inventory of  
Non-Indigenous Species Occurring in  
Marine and Estuarine Waters of California

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# Non-Indigenous Species

- Ballast Water Act of 1999 required the Department of Fish and Game to conduct studies to identify non-indigenous species
- DFG study directed at inshore marine and estuarine waters of the State and was designed to develop a non-indigenous species baseline data base
- The following presentation will focus primarily on a discussion of the program's sampling design and some preliminary results

# Non-Indigenous Species Sampling Design

- Focus of NIS sampling program was on State's major ports and estuaries where ballast water is and was most likely to have been discharged. Investigation addressed aquatic species only
  - Seven primary sampling locations established
    - Humboldt Bay
    - San Francisco Bay
    - Port of Stockton
    - Port of Sacramento
    - Port Hueneme
    - Los Angeles/Long Beach Harbor
    - San Diego Bay



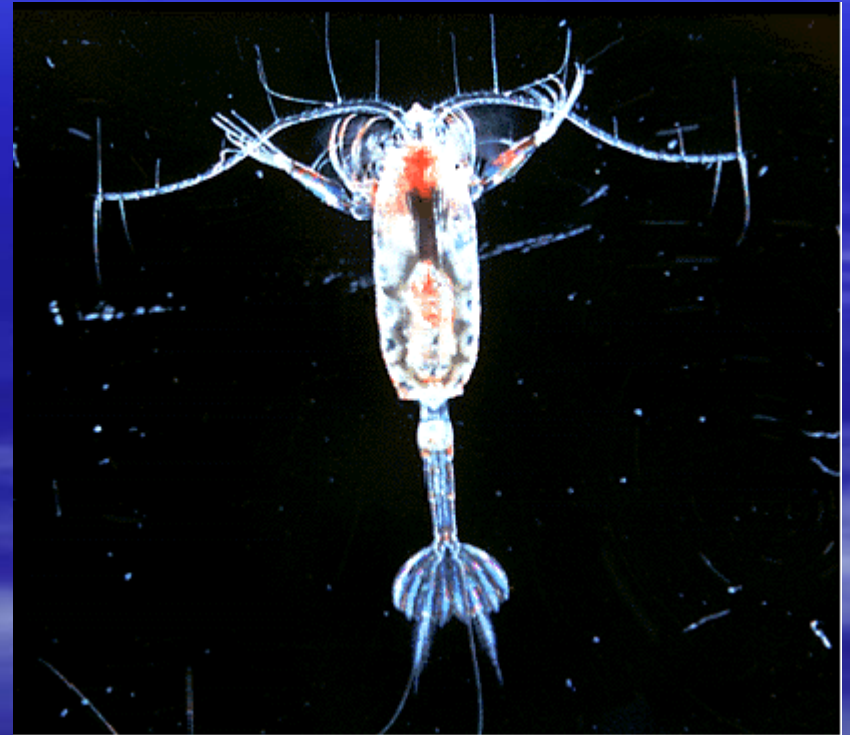
# Non-Indigenous Species Sampling Design

- At each primary site, four biological communities were examined:
  - Fouling
  - Soft bottom infaunal
  - Nekton
  - Plankton
- Investigation of each community conducted through field sampling, and/or literature review



# Non-Indigenous Species Sampling Design

- All but plankton sampling program was conducted once at each primary location
  - Non-plankton sampling conducted during mid to late summer
  - Plankton sampling conducted quarterly



# Non-Indigenous Species Sampling Design

- Secondary sampling sites were established to examine the distribution of members of the fouling community within the state
- Each secondary site sampled once during the program. Sampling period from mid to late summer
- Investigation supplemented with data collected by Dr. Andy Cohen during a 2000 Rapid Assessment Survey of selected southern California bays and harbors



# Non-Indigenous Species Sampling Design

- Fifteen secondary sampling sites located throughout the state:

Noyo Harbor

Bodega Bay Harbor

Tomales Bay

Elkhorn Slough

Monterey Bay Harbor

Moro Bay Harbor

Santa Barbara Harbor

Channel Islands Harbor

Ventura Harbor

Marina del Rey

Newport Harbor

Dana Point Harbor

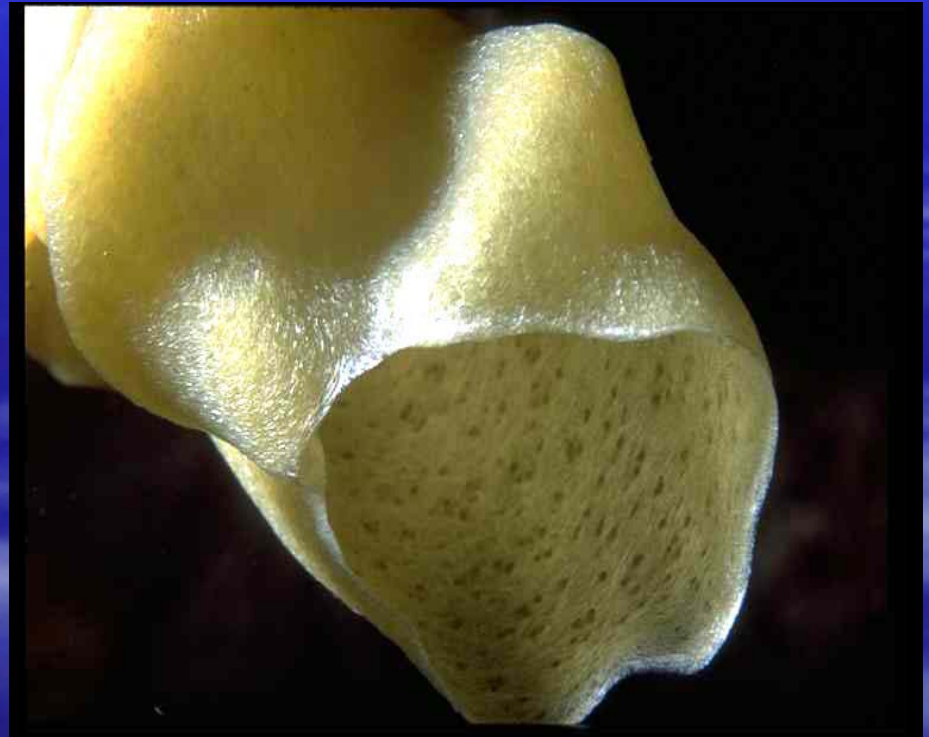
Oceanside Harbor

Mission Bay

Avalon Harbor

# Non-Indigenous Species Definitions

- What constitutes a non-indigenous species?  
Problems encountered:
  - Origin
  - Taxonomy
- Report separates species into four groups:
  - Non-indigenous
  - Cryptogenic
  - Unknown
  - Native X





# Primary Sites



# Non-Indigenous Species Humboldt Bay

- Bay not extensively studied in the past
- Initial literature review identified 55 NIS/cryptogenic sp. (excluding plants)
- DFG study conducted field investigation into fouling, benthic, algae, fish and plankton communities.
- Study identified 90 + sp. 60+ NIS and 30+ cryptogenic sp.





# Non-Indigenous Species San Francisco Bay

- DFG study relied on available literature
  - 1995 report by Cohen and Carlton
  - Calif. Dept of Fish and Game, Bay/Delta Studies
- SF Bay has one of the highest invasion rates in the world with over 230 known NIS and another 124 cryptogenic species





# Non-Indigenous Species

## Ports of Stockton and Sacramento

- No previous baseline studies conducted in ports
- USGS database identifies 48 NIS (3 copepods, 35 fish and 10 aquatic plants) from the adjacent delta watershed
- DFG study sampled fouling, benthic and fish communities in the two ports
- DFG study recorded 4 NIS and 15 cryptogenic species of invertebrates and 10 NIS species of fish
  - All but three invertebrate NIS/cryptogenic sp. collected were oligochaetes
  - Most of fish collected were intentionally introduced

# Non-Indigenous Species Port Hueneme

- No previous studies conducted in the port
- USGS database lists 19 NIS from general area
- DFG study sampled fouling, benthic, nekton, and plankton communities
- DFG study identified 34 NIS and 63 cryptogenic sp.





# Non-Indigenous Species

## Port of Los Angeles/Long Beach

- Previous studies identified 49 NIS/cryptogenic spp.
- Baseline investigations undertaken by Ports in 2000
  - DFG supplemented study with fouling community study in back harbor and plankton investigation
- Port's Investigation –  
42 NIS and 48 cryptogenic sp.
- DFG study added 4 NIS and 2 cryptogenic sp.





# Non-Indigenous Species San Diego Bay

- USGS list 16 NIS from the Port
- DFG study used Southern California Coastal Water Research Project 1998 study for information on benthic and nekton communities. Supplemented benthic information with data from 1992 State Water Board study
- DFG field investigation focused on fouling and plankton communities
- Results of all studies revealed 40 + NIS and 25 + cryptogenic species.

# Secondary Sites



# Non-Indigenous Species Preliminary Observations

- 760+ NIS/cryptogenic sp. identified from literature and field surveys
- Dominant groups include Annelids (240 + sp.) and Crustaceans (180 + sp.)
- Most common form of introduction – fouling and ballast water followed by aquaculture and intentional introductions





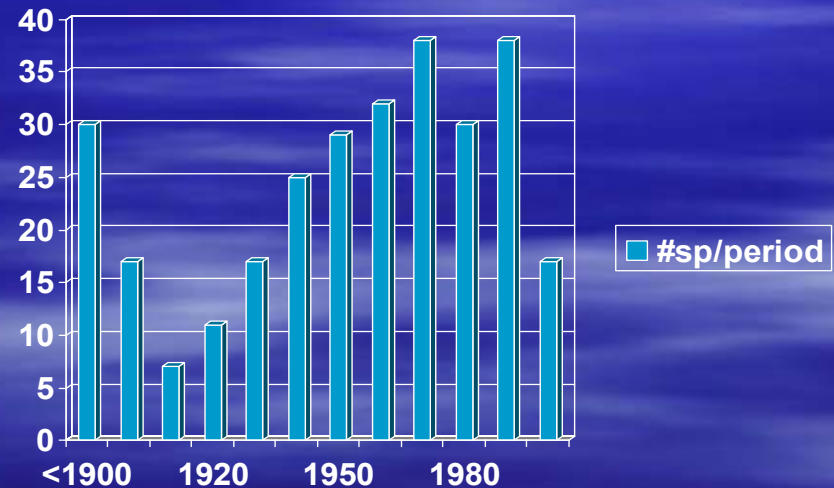
# Non-Indigenous Species

## General Observations

- Identified 170+ distinct unknown taxa from literature
  - Not identified to species level
  - Many from NIS or cryptogenic genera
  - Many well known but not identified
    - May be undescribed native species
    - May be undescribed or poorly known NIS

# Non-Indigenous Species Preliminary Observations

- The general state wide rate of NIS introductions increased during the 1920-1970 period with a secondary peak in 1990 (intro. Info. available for 50+% of NIS)
- Northwest Pacific major source of NIS in California
- At least eight new marine spp. (4 NIS, 4 crypto) found in present investigation



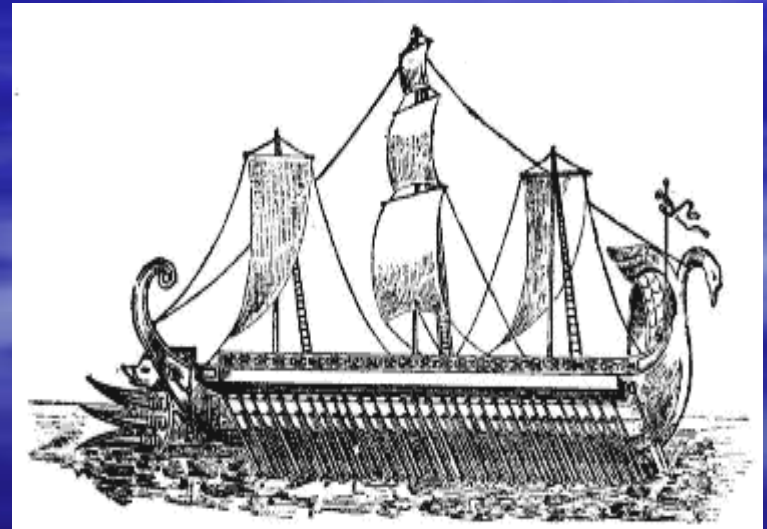
# Non-Indigenous Species Study Limitations

- Limited amount of time to conduct study
  - Except for plankton, no seasonal sampling
- Hard bottom benthic substrate not sampled except in LA/LB Harbor
- Crevices within riprap not adequately sampled
- Did not sample phytoplankton community



# Non-Indigenous Species Report

- Primary goal
  - Provide baseline data on NIS aquatic species in marine and estuarine waters of the state
- Secondary goal
  - Provide information on:
    - How the NIS were transported to state
    - Where the NIS came from
    - When the NIS arrived
    - Known impact of NIS on environment



# Non-Indigenous Species Report

- Report will be available January 2, 2003
  - Report will be available bound or on the DFG web site at [WWW.DFG.CA.GOV](http://WWW.DFG.CA.GOV)
  - Hard copies may be obtained from Marian Ashe  
[Mashe@OSPR.DFG.CA.GOV](mailto:Mashe@OSPR.DFG.CA.GOV)
  - Database may be obtained from Dr. Peter Ode  
[Pode@OSPR.DFG.CA.GOV](mailto:Pode@OSPR.DFG.CA.GOV)