

# Invasive Species and Hull Fouling: Environmental Concerns in Texas



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# Definitions

- **Introduced Species (non-indigenous) are those moved outside their normal range due to human activities.**
- **Invasive species are those introduced species that cause measurable economic or ecological damage.**

*Federal Executive Order 13112 defines “invasive species” as 1) non-native to the ecosystem under consideration and, 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health.*

# Ecological Consequences of Biological Invasions

## Invasive species...

- **can consume, out compete, and drive native species to extinction**
- **can affect local diversity and ecosystem function**
- **are a significant risk factor for more than 40% of listed threatened and endangered species in the U.S.**
- **pose one of the most important threats to global biodiversity (second only to habitat loss)**

# **Economic Consequences of Biological Invasions**

- **Cost to world's economy: hundreds of billions per year (IUCN)**
- **Cost to U.S.: \$128 billion per year (Pimentel et al. 2000)**
- **Significant portion includes impacts on fisheries, boating, coastal recreation, etc.**

# Social Consequences of Biological Invasions

- Loss of jobs due to collapsed fisheries
- Loss of recreational use of affected areas
- Spread of human diseases such as cholera
- Damaged property and loss of property value
- Food and water shortages



Willey Durden, USDA Agricultural Research Service



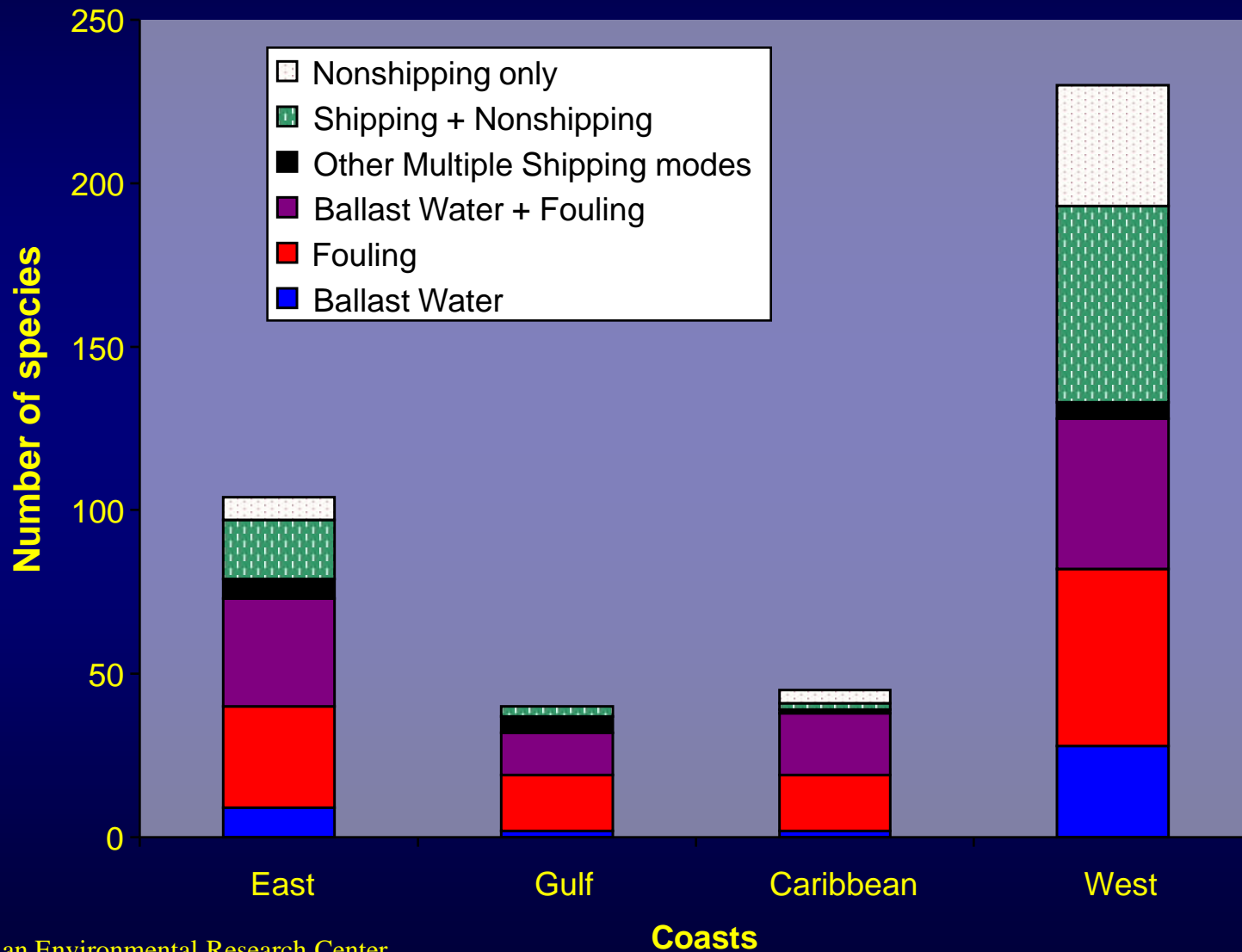
# Hull Fouling



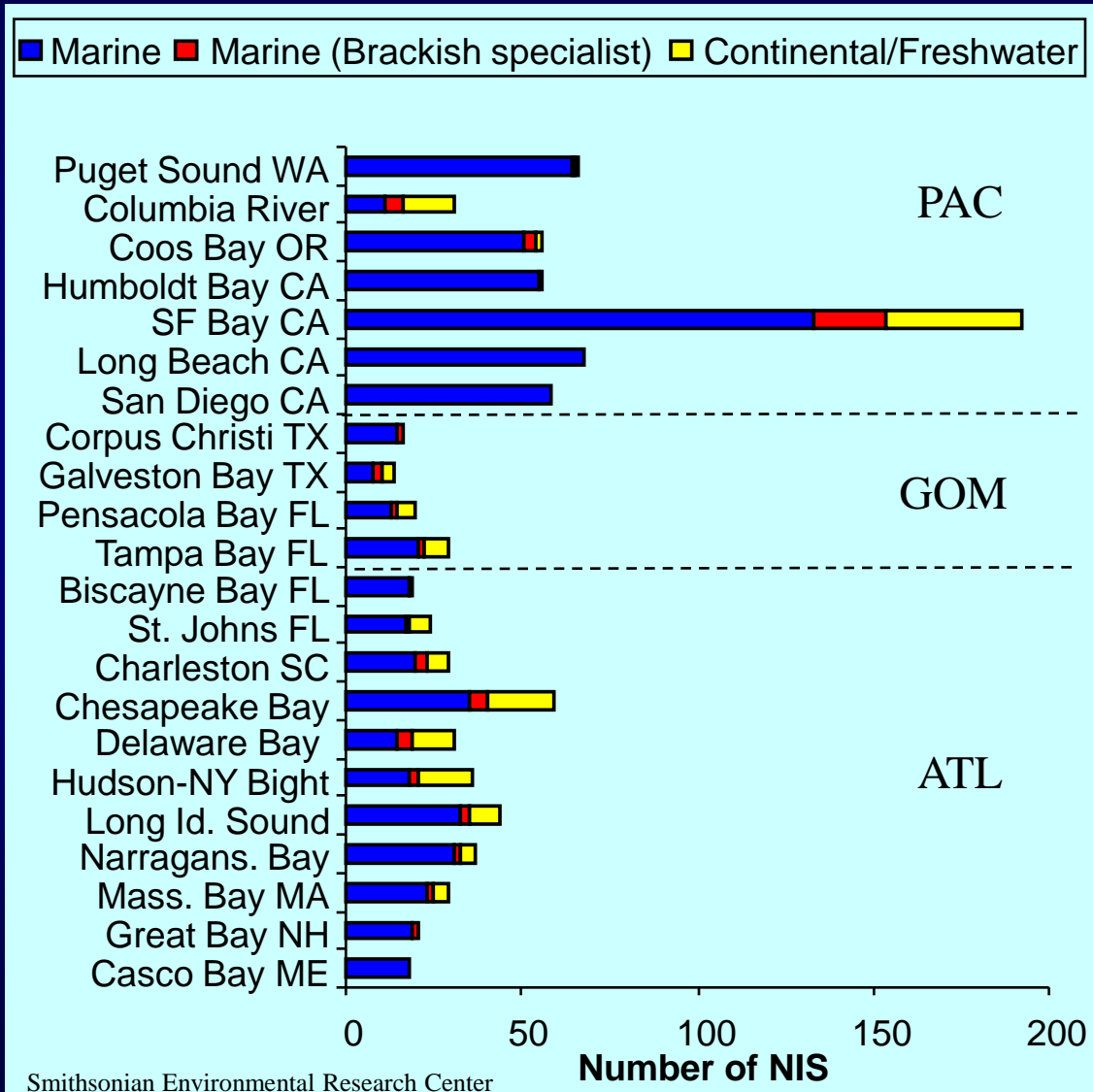
Dr. Ted Grosholz

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

# Vectors for marine NIS invertebrate-algae introductions To North American coasts



# Distribution of Introduced Non-Indigenous Species



# **Movement of Vessels from MARAD Reserve Fleets Without Scampering 2007**

*The San Francisco Bay/Delta Estuary is possibly the most invaded estuary in the entire world. More than 230 non-native species have become established in the system. (Cohen and Carlton 1998)*

# *Didemnum* sp.



- Colonial tunicate
- Intertidal to 65m (213ft)
- Overgrows other sessile organisms
- Georges Bank
  - 6 sq. miles in fall 2003
  - 40 sq. miles in 2004



USGS

# Chinese Mitten Crab

*Eriocheir sinensis*



- Juveniles in FW; reproduce in SW
- Direct competition with native shellfish (crabs, oysters, clam, mussels)
- Secondary intermediate host for the Oriental lung fluke



Clogged Fish Salvage Facilities at Tracy, CA  
(1996 - 30 crabs/d; 1997 - 25,000 crabs/d)

# Green Crab

*Carcinus maenas*



Western Australia Dept. of Fisheries

- 6-10 cm carapace width
- Capable of rapid range expansion (>750 km in less than 10 yrs. in CA)
- Significant impacts documented to commercial fisheries and natural ecosystems (clams, oysters, mussels)

- Thought to have been responsible for collapse of commercial fishery
- Consumes large quantities of phyto- and zooplankton
- >25,000/m<sup>2</sup> within one year

# Asian Clam

*Potamocorbula amurensis*



Janet Thompson, United States Geological Survey, California



# Factors Likely to Affect Biofouling Accumulation

- harbor residence time
- vessel speed
- voyage duration
- surface area & complexity
- voyage routes & geography
- environmental factors (salinity, temperature)
- season
- hull husbandry schedule
- antifouling regime

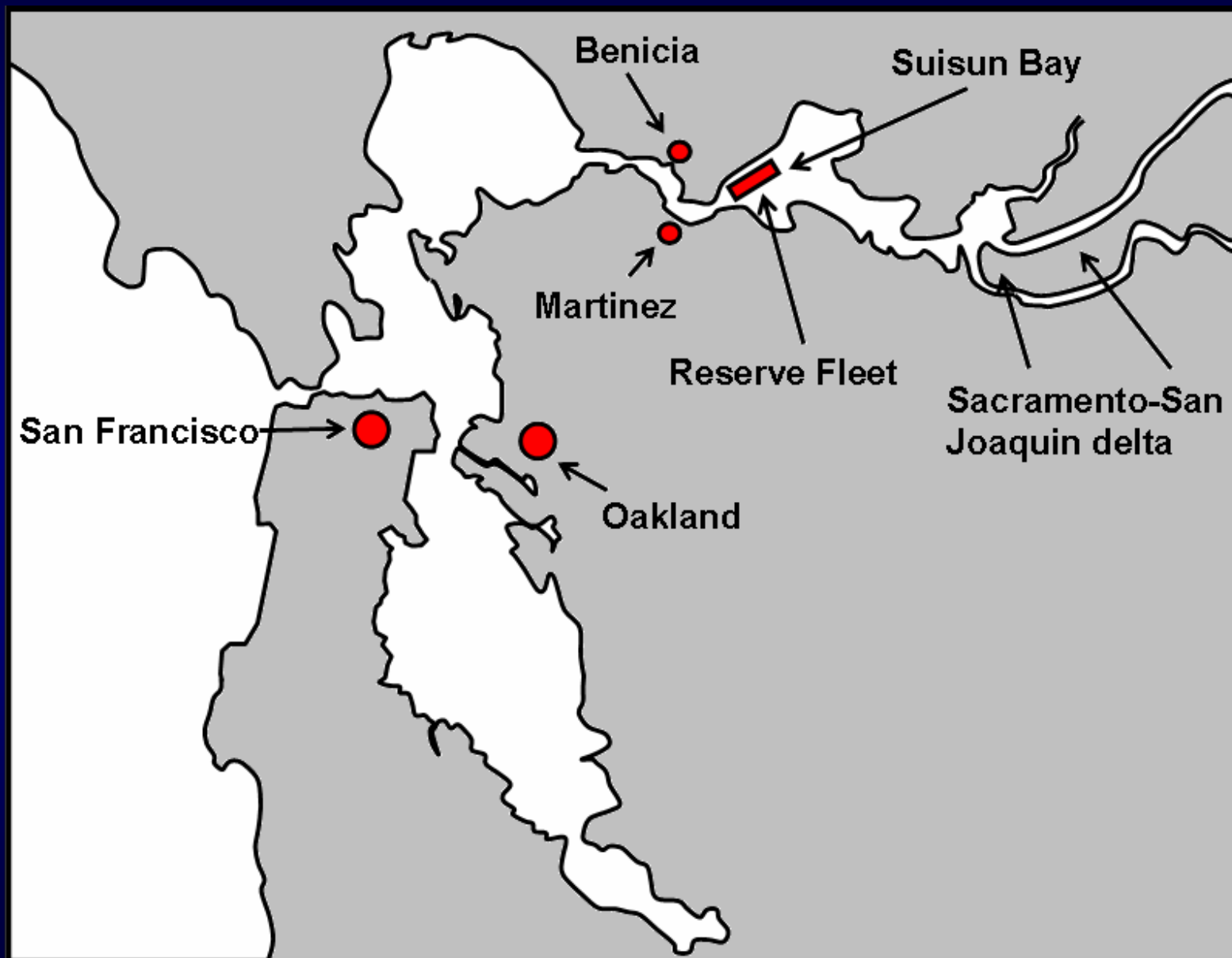
# Locations of MARAD Reserve Fleet and Ship Salvage Facilities



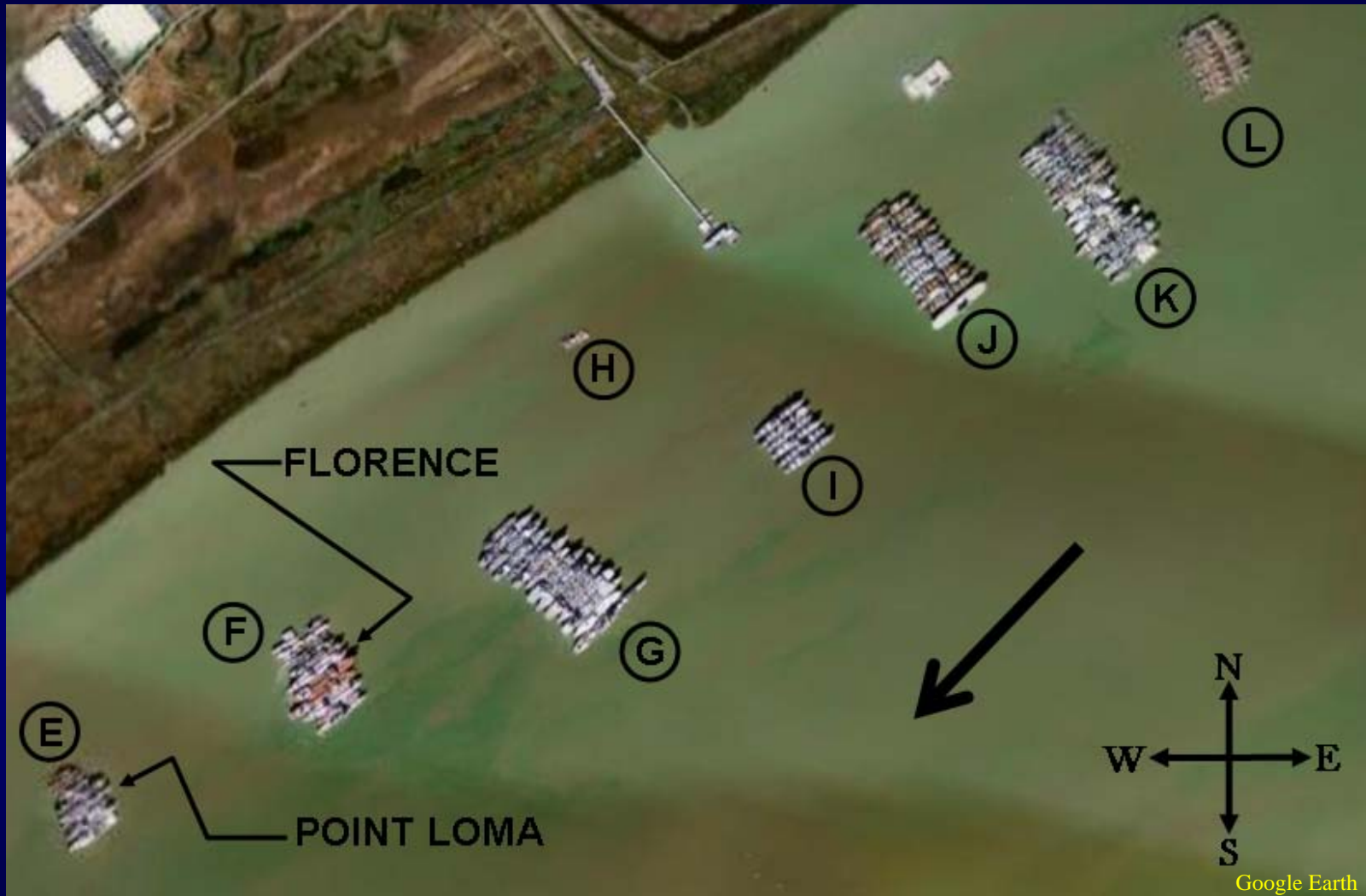
● Ship Salvage Facilities

★ Reserve Fleet Facilities

# MARAD Reserve Fleet in Suisun Bay, CA



# Suisan Bay, CA Reserve Fleet



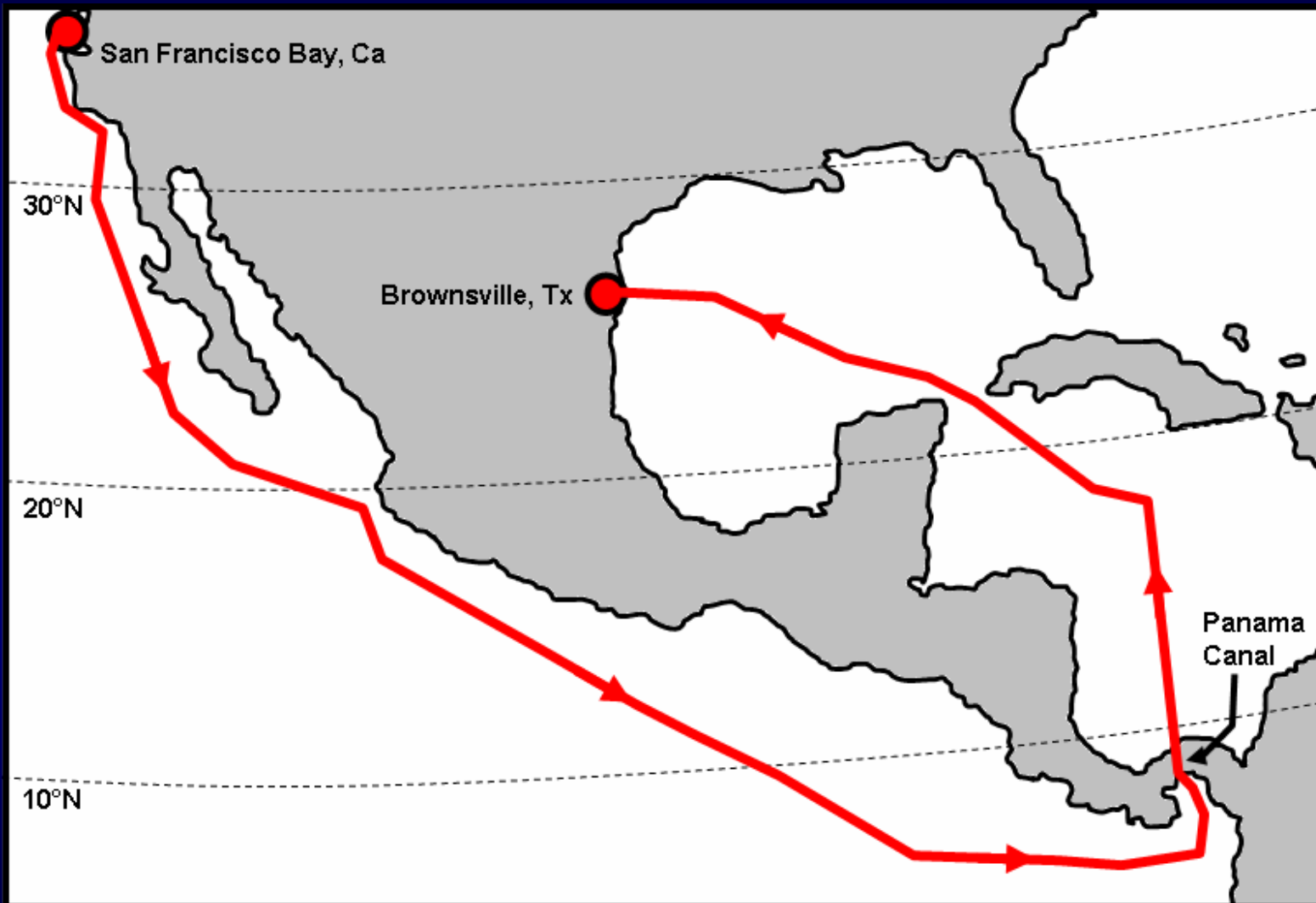
Google Earth

# Post-Voyage Analysis of Hull Biofouling on the Vessels Point Loma and Florence after Transit from CA to TX

## Sampling Protocol

- Macro-organisms collected from 6-inch square
- Sites sampled: propeller, rudder, propeller shafts, struts, transverse hull transects, and sea chests (n = 92 for each vessel)
- Photo-quadrat sampled within 1 m of biological sample (n = 99 for each vessel)
- Preliminary sorting was done dockside to determine live/dead
- Voucher specimens for live organisms were sent to SERC laboratories in MD and CA

## Route of the *Point Loma* and *Florence*



Davidson et al. 2006

# Results

- Departed Suisan Bay, CA.....February 14, 2006
- Arrived Brownsville, TX .....March 29, 2006 (43 days at sea)
- Water temperature.....9.8 C to 31.5 C
- Salinity.....0 to 37 psu
- Sea conditions.....Calm
- Tow speeds.....4.9 – 7.9 knots (avg. 6.4 knots  
over 24 daily reports)
- Max. latitudinal range.....32 degrees

# Results (cont.)

- 23 distinct species recorded during pre-transit survey (5 not encountered in post-transit survey)
- 51 distinct species recorded during post-transit survey (may increase pending additional identification)
- Live specimens observed for at least 25 of the 51 species
- 2 barnacles (*Balanus amphitrite* and *Lepas pacifica*) recorded from post-transit survey only
- Of species found in Texas but not Suisan Bay, many were rare (< 5% of samples); may not have been detected in pre-transit survey or attached during transit
- Pre- vs. post-transit photographic survey – most striking observation was reduction of bryozoan mat (2-5 cm during pre-transit survey)



# Conclusions

- Though no clear reduction in biomass between pre- and post-transit surveys many different taxa were detected in post-transit surveys and many were still alive.
- Of the species recorded on the hulls in Texas, at least 8 were non-native to the western Gulf of Mexico. Two of these are known to be already established, however introduction of different genotypes may cause shifts in ecological characteristics and community dynamics.
- The Asian clam (*Corbicula amurensis*) was not found live on the vessels in Texas.



# *Jason and Queens Victory - 2007*

- 1-2-07** TPWD contacted by MARAD requesting permission per USCG to bring *Jason* and *Queens Victory* into Texas waters for scamping and salvage
- 1-5-07** Upon review of *Point Loma* and *Florence* study permission to enter Texas waters denied
- 1-9-07** Received calls from Congressman Ortiz' office
- 1-22-07** Received call from USCG (Panama) re. request from MARAD to scamp in Panama
- 2-6-07** Received notification that vessels were en route to Texas
- 2-15-07** USCG informs TPWD that *Jason* is located 20 nm east of Brownsville and *Queens Victory* is through the Canal
- 2-16-07** MARAD notified by NMFS that they are required by Magnusson Act to conduct an Essential Fish Habitat consultation with NMFS before cleaning
- 2-23-07** Received notification that *Jason* had been cleaned outside 100 fathoms (50 nm)
- 4-12-07** MARAD notifies TPWD that program to move vessels to Brownsville has been temporarily suspended until issues raised by Texas and other states are worked out.
- 5-1-07** Suspension lifted for vessels originating from James River Reserve Fleet (VA only)
- 7-1-07** Suspension lifted for vessels originating from Beaumont Reserve Fleet.
- 8-1-07** Suspension lifted for vessels originating from Suisan Bay Reserve Fleet.



# Current Status - 2008

- Vessels from Beaumont fleet may be relocated to scrapping facilities in Brownsville without scamping. This decision is based on the best available information and the lower potential risk of invasive issues between these two Texas ports. This determination could change with new information or if concerns are raised by either Louisiana or Mexico because of their proximity to the Texas ports in question.
- Vessels from Suisan Bay, CA and James River, VA fleets may be brought into state waters provided they are scamped before coming into the Gulf of Mexico. It is also advised that any vessel originating from the Pacific should be scamped before entering the Caribbean via the Panama Canal.