Cruise Report
Regional Monitoring Program
Bivalve Deployment Cruise 1

February 18-26, 1993

1. Introduction

This report covers activities associated with collection and deployment of organisms for the measurement of bioaccumulation at 11 monitoring stations for the regional monitoring for toxic constituents in the San Francisco Estuary. Bivalves, the indicator organisms used for this study, were collected from areas with low levels of trace element and organic contamination, placed into nylon mesh bags, transported to the Estuary, and deployed at the sites. All deployment activities in the Estuary utilized the M/V Rincon Point, owned by the City of San Francisco. The bivalves will be retrieved approximately twelve weeks after initial deployment.

2. Objectives

The objectives of Cruise 1 were:

1. Obtain sufficient quantities of bivalves for use in this study;

2. Identify the 11 pre-selected sites in the Estuary suitable for deployment of bivalves and select alternative sites where deployment was unsuitable;

3. Install subsurface moorings at the sites;

4. Deploy bagged bivalves on each mooring.
3. Scientific Personnel

The personnel for this cruise and their duties were:

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dane Hardin</td>
<td>Marine Research</td>
<td>Chief Scientist, Diver</td>
</tr>
<tr>
<td>Matt Edwards</td>
<td>Marine Research</td>
<td>Diver</td>
</tr>
<tr>
<td>David Bell</td>
<td>Applied Marine Sciences</td>
<td>Dive Tender, Back-up, Diver</td>
</tr>
<tr>
<td>Andrew Gunther</td>
<td>Applied Marine Sciences</td>
<td>Coordination, car shuttle, and bivalve delivery to vessel</td>
</tr>
<tr>
<td>Patrick Conroy</td>
<td>City of San Francisco</td>
<td>Vessel Skipper</td>
</tr>
</tbody>
</table>

4. Collection of Bivalves

Bivalves were obtained from three locations depending on species. On February 18, 1993, approximately 1,500 mussels (*Mytilus californianus*) of 55-65 mm shell length were collected by hand from rocky substrate at Bodega Head, 30 miles west of Santa Rosa, California. On February 22, 1993, approximately 640 freshwater clams (*Corbicula fluminea*) of 20 - 35 mm shell length were dredged from the sediments of Lake Isabella, 35 miles east of Bakersfield, California. This collection site was chosen because of reports that the population of *Corbicula* in Lake San Antonio had “crashed”. On February 23, 685 oysters (*Crassostrea gigas*) of “medium size” were purchased from Tomales Bay Oyster Company in Marshall, California.

After collection, mussels were placed into nylon mesh bags in groups of 40 per bag. Bagged mussels were held in flow through sea water at the Bodega Marine Laboratory (BML) until 24-48 hr before deployment. Mussels were transferred to the cruise vessel in coolers packed with ice-filled plastic bags. Clams were placed into nylon mesh bags in groups of 40 per bag and stored on ice for 24-48 hours prior to deployment. Oysters were placed into nylon bags (25 per bag) and stored on ice for 24 hours prior to deployment.
5. Installation of Subsurface Moorings

Bivalve bags were suspended a minimum of four feet below the water surface using subsurface moorings. Each subsurface mooring consisted of a pair of 4-ft earth anchors screwed into the bottom and connected to a piling or channel marker with a 30-ft ground line. A pair of subsurface buoys (combined buoyancy of 43 lb) were attached to the anchors with a mooring line and bridle. The mooring line was adjusted according to water depth at each station so the buoys were never greater than 10 ft off the bottom. The nylon-mesh bags filled with bivalves were attached to the mooring line with nylon cable ties so they can be easily removed with wire snippers, allowing the moorings to remain in place for future deployments. A summary of bivalve deployment stations and site maps are presented at the end of this report in Table 1 and Figures 1-6, respectively.

Two divers were necessary to install the subsurface moorings. At each site, the mooring installation consisted of three tasks requiring two descents to the bottom. At all sites except Golden Gate, underwater visibility was “zero” and at several sites, strong currents made deployment of moorings in a given direction difficult. For safety, a tether line connected the divers. In the first task, the ground line was fastened around a piling or other object and deployed in a preferred direction. Both earth anchors were screwed into the substrate and the ground line was attached to them. After fastening the ground line to the anchors, the divers ascended to the surface to pick up the mooring line and bivalve bags. The divers then re-descended to the bottom and, following the ground line back to the anchors, attached the mooring line to the anchors. Bivalve bags were secured to the mooring and the divers then re-ascended to the surface. Under normal conditions, deployment of the moorings averaged 1.5 hours and diver time on the bottom averaged 45 minutes. In addition to dive responsibilities, the chief scientist also coordinated over-night lodging and transportation of the scientific personnel.

The dive tender was responsible for the overall, “on-deck” safety of each dive, assisting the divers and their equipment move in and out of the water, fastening bivalve bags to the mooring lines, and recording site information, underwater conditions, and deployment data in a log book. The vessel skipper was responsible for safe operation of the vessel and crew, setting anchor at each station, communications to land, and advance coordination for docking at the four marinas used in this cruise. The skipper also assisted the dive tender with preparation of bivalve moorings and recording site data.
6. Activities

2/18/93  1000 - 1900  A. Gunther, D. Bell, D. Hardin, and M. Edwards collect mussels at Bodega Head and place in tank at BML

2/21/93  1200 - 1900  D. Hardin and D. Bell transit to Bakersfield

2/22/93  0800 - 1700  D. Hardin and D. Bell collect clams at Lake Isabella

1700 - 2330  D. Hardin and D. Bell transit to Santa Cruz and load equipment into shuttle van

2/22/93  1700 - 2250  Cruise vessel Rincon Point transit from San Francisco South Beach Harbor to Antioch Marina

2/22/93  0900 - 1700  A. Gunther pick up oysters in Tomales Bay and mussels from BML

2/23/93  0730 - 0845  Group meeting with D. Hardin, M. Edwards, D. Bell, and P. Conroy to discuss cruise plan, dive plan, weather forecast, and safety issues

0900 - 1000  Mobilized Rincon Point

1000  Rincon Point departs Antioch Marina

1030 - 1300  Arrive San Joaquin River (Site 1), deploy 4 bags of clams

1300  Depart for Sacramento River

1330 - 1630  Arrive Sacramento River (Site 2), deploy 4 bags of clams. Transit to Grizzly Bay for a site reconnaissance

1630  Depart Grizzly Bay for Martinez Marina

1700  Arrive Martinez Marina

2000 - 2100  Vehicle transit to Antioch Marina to pick up shuttle car

2/24/93  0700 - 0900  Vehicle transit to Vallejo Marina to drop off shuttle, transit back to Martinez Marina

0900 - 1830  A. Gunther reconnaissance cruise to Golden Gate site in cruise plan. Bring mussels from BML to Vallejo Marina

0900  Rincon Point departs Martinez Marina, transit to Grizzly Bay

1000-1330  Arrive Grizzly Bay (Site 3), subsurface mooring too shallow for use. Used alternative mooring site and deployed 4 bags of clams and 6 bags of oysters

1330  Depart for Davis Point

1400-1630  Arrive Davis Point (Site 4), deploy 4 bags of mussels and 6 bags of oysters

1630  Depart for Vallejo Marina

1700  Arrive Vallejo Marina
2/24/93, continued

1730 - 1830 Refill SCUBA tanks

1900 - 2030 Vehicle transit to Martinez Marina to pick up shuttle car.

2/25/93

0830 Rincon Point departs Vallejo Marina, transit to Napa River

1000 - 1130 Arrive Napa River (Site 5), deploy 4 bags of mussels and 6 bags of oysters

1130 Depart for Pinole Point

1230 - 1330 Arrive Pinole Point (Site 6), deploy 4 bags of mussels and 6 bags of oysters

1330 Depart for Petaluma River

1400 - 1500 Arrive Petaluma River (Site 7), deploy 4 bags of mussels and 1 bag of oysters

1500 Depart for Golden Gate

1600 - 1700 Arrive Golden Gate (Site 8), deploy 4 bags of mussels

1800 Rincon Point arrives South Beach Harbor

1900 - 2130 Vehicle transit to Vallejo Marina to pick up shuttle car

2/26/93

0800 Rincon Point departs South Beach Harbor, transit to Dumbarton Bridge

0930 - 1130 Arrive Dumbarton Bridge (Site 9), deploy 4 bags of mussels

1130 Depart for Redwood Creek

1200 - 1245 Arrive Redwood Creek (Site 10), deploy 4 bags of mussels

1245 Depart for Yerba Buena Island

1415 - 1515 Arrive Yerba Buena Island (Site 11), deploy 4 bags of mussels

1600 - 1645 Arrive San Francisco Marina, demobilize Rincon Point

7. Discussion

Bivalve Collection 2/18 and 2/22/93

Collection of mussels and clams at Bodega Head and Lake Isabella, respectively, proceeded without difficulty, although collecting a sufficient quantity of freshwater clams required more time than estimated, due to their scarcity at the collection site. While the scarcity of clams also limited selectivity based on shell length, collected clams only varied by approximately 15 mm. The medium-size oysters bought from Tomales Bay Oyster Company were packed 25 per bag instead of the planned 40 per bag. Small oysters may be
used in the future. Bivalves stored in coolers before deployment were kept cool with ice sealed in plastic bags to prevent possible contamination from melting ice.

*Rincon Point* Transit to Antioch Marina 2/22/93

Unfavorable weather conditions and a late departure required the *Rincon Point* skipper to be accompanied by an additional crew member who acted as look-out during the trip from South Beach Harbor to Antioch. The look-out did not accompany the deployment phase of the cruise.

Bivalve Deployment 2/23/93

Techniques for deploying subsurface moorings were perfected and bivalves were deployed at two sites. A set of pilings 0.5 nmi E of Antioch Marina along the S shore was chosen for the San Joaquin River site. Channel marker “8” N of Sherman Island was chosen for the Sacramento River site. This location is 1.3 nmi E of Point Sacramento and was chosen to minimize influence of the San Joaquin River on this site. We suggest using this mooring on future deployments to improve conformity with water and sediment sampling locations.

Bivalve Deployment 2/24/93

No surface-identifiable structure was found at the coordinates for the Grizzly Bay site. A mooring that was installed on a dolphin 2.25 nmi N of Garnet Point proved to be too shallow the mooring was removed. Channel marker “9” 1.0 nmi NW of Garnet Point was selected. At Davis Point, permission was granted to use a private Unocal pier for the mooring. To reduce divers’ down time, the dive tender attached the bivalve bags to the mooring while aboard the cruise vessel, then handed the assembly to the divers to deploy. This procedure was followed for the remaining sites.

Bivalve Deployment 2/25/93

A set of surface pilings along the E shore of Mare Island Strait and 0.8 nmi NNW of channel marker “2” was used for the Napa River mooring. At Pinole Point, channel marker “P” 0.1 nmi NW of the pier was used for the mooring. This channel marker may be used by State Mussel Watch. The
ground line for the RMP mooring extends 30 ft NE of the piling and is marked by an un-trimmed cable tie near the piling. Channel marker "1", 3.5 nmi NW of Pinole Point was used for the Petaluma River mooring. One bag of oysters was deployed at this site for the purpose of a condition index reference. Because of depth and unfavorable sea conditions at the originally-designated Golden Gate site, this mooring was attached to a dolphin approximately 100 ft W of a pier in Horseshoe Bay.

Bivalve Deployment 2/26/93

The Dumbarton Bridge mooring was installed at channel marker "14", 0.8 nautical miles NW of the bridge. This channel marker is also used by State Mussel Watch and several relic lines were found attached to the piling near the bottom. One of these lines appeared to be connected to a mooring and the RMP mooring was located approximately 180° to the NE of the piling. The RMP ground line is marked with two un-trimmed cable ties approximately 18 in. apart near the piling. The Redwood Creek mooring was installed at channel marker "4", 0.8 nmi N of Redwood Point. This location avoids the diving hazard presented by the submerged obstructions noted on the nautical chart for channel markers "2" and "3". The Yerba Buena Island mooring was installed at a dolphin 0.1 nmi N of the Bay Bridge and 0.6 nmi ENE of Yerba Buena Island.

8. Comments

Overall, the bivalve deployment cruise was completed with few difficulties. The use of the cruise vessel Rincon Point from the City of San Francisco was a great benefit to meeting the objectives. Patrick Conroy provided valuable information for finding alternative deployment sites where necessary. The vessel itself was well equipped for handling the divers and their equipment, although the absence of Loran equipment required all site positions to be recorded from charts and physical descriptions. Because the vessel operated from four different ports (Antioch, Martinez, Vallejo, and South Beach Harbor), a shuttle was needed to bring the crew back to their vehicles. The shuttle required two people and two vehicles and was carried either at the beginning or end of each day, depending on location. It is anticipated that the logistic complexity of maintenance and retrieval cruises can be reduced by using two ports (Vallejo and South Beach Harbor). The time spent at each site will be reduced compared to this deployment cruise because installation of moorings will not be required. Consequently, more sites can be visited each day.
<table>
<thead>
<tr>
<th>Site Name</th>
<th>Date</th>
<th># Bags - Organism*</th>
<th>Latitude (N)</th>
<th>Longitude (W)</th>
<th>Depth (ft)</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Joaquin River</td>
<td>2/23/93</td>
<td>4 - C</td>
<td>38°01.07</td>
<td>121°48.69</td>
<td>39</td>
<td>Pilings 0.5 nmi E of Antioch Marina</td>
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<tr>
<td>Sacramento River</td>
<td>2/23</td>
<td>4 - C</td>
<td>38°03.58</td>
<td>121°48.50</td>
<td>36</td>
<td>Channel marker &quot;8&quot;</td>
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<tr>
<td>Grizzly Bay</td>
<td>2/24</td>
<td>4 - C; 6 - O</td>
<td>38°06.49</td>
<td>122°03.37</td>
<td>15</td>
<td>Channel marker &quot;9”, 1.0 nmi N of Garnet Point</td>
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<td>Davis Point</td>
<td>2/24</td>
<td>4 - M; 6 - O</td>
<td>38°03.26</td>
<td>122°15.63</td>
<td>30</td>
<td>Privately owned Unocal pier</td>
</tr>
<tr>
<td>Napa River</td>
<td>2/25</td>
<td>4 - M; 6 - O</td>
<td>38°04.94</td>
<td>122°14.84</td>
<td>18</td>
<td>Pilings 0.8 nmi NNW of channel marker &quot;2&quot;</td>
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<td>Pinole Point</td>
<td>2/25</td>
<td>4 - M</td>
<td>38°01.00</td>
<td>122°22.05</td>
<td>22</td>
<td>Channel marker &quot;P”, 0.1 nmi N of pier</td>
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<td>Petaluma River</td>
<td>2/25</td>
<td>4 - M, 1 - O</td>
<td>38°02.72</td>
<td>122°25.71</td>
<td>20</td>
<td>Channel marker &quot;1&quot;</td>
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<td>Golden Gate</td>
<td>2/25</td>
<td>4 - M</td>
<td>37°49.87</td>
<td>122°28.65</td>
<td>25</td>
<td>Dolphin 100 ft W of fishing pier</td>
</tr>
<tr>
<td>Dumbarton Bridge</td>
<td>2/26</td>
<td>4 - M</td>
<td>37°30.80</td>
<td>122°08.08</td>
<td>29</td>
<td>Channel marker &quot;14”, 0.8 nmi NW of Dumbarton Bridge</td>
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<td>Redwood Creek</td>
<td>2/26</td>
<td>4 - M</td>
<td>37°32.82</td>
<td>122°11.70</td>
<td>19</td>
<td>Channel marker &quot;4&quot;</td>
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<tr>
<td>Yerba Buena Island</td>
<td>2/26</td>
<td>4 - M</td>
<td>37°49.12</td>
<td>122°20.81</td>
<td>21</td>
<td>Dolphin 0.1 nmi N of Bay Bridge, 0.6 nmi ENE of Yerba Buena Island</td>
</tr>
</tbody>
</table>

*Note: C = Clams  
O = Oysters  
M = Mussels
Figure 1.

Sacramento River

Power line

Tower

Channel marker "8"

Bivalve Deployment

"10"

Piles

Sherman Island

Marsh

Site: Sacramento River

Not to Scale

Kimball Island

San Joaquin River

Channel marker "5"

Antioch Point

Marina

Bivalve Deployment

Piles

"Potato Barge" restaurant

RR Tracks

Tank

Antioch

Site: San Joaquin River

Not to Scale
Figure 3.

Site: Napa River

Not to Scale

Site: Pinole Point

Not to Scale
Figure 4.

San Pablo Bay

Site: Petaluma River

Site: Golden Gate

Not to Scale
Site: Yerba Buena Island