

Cruise Report
2002 Regional Monitoring Program
Bivalve Deployment Cruise

May 16-17, 2002
May 27-31, 2002
June 5, 2002

A P P L I E D
marine
S C I E N C E S

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Introduction

This report describes activities associated with the 2002 bivalve deployment cruise of the Regional Monitoring Program for Trace Substances in the San Francisco Estuary (RMP). Bivalves were attached to moorings at 12 sites. Measurement of contaminant bioaccumulation in transplanted bivalves during dry-season deployment is designed to provide long-term data on concentrations of trace organic compounds in tissue throughout the estuary.

Contaminant bioaccumulation in bivalves is measured by collecting bivalves from sites that are known to have low contaminant concentrations and transplanting them to mooring locations in the Estuary. Three species of bivalves, *Mytilus californianus*, the Bay mussel (formerly referred to as *Mytilus edulis*), and *Crassostrea gigas* were deployed at different locations depending upon the expected salinity, historical deployments, and requirements for side-by-side investigations. *M. californianus* were collected from Bodega Head, Bay mussels were collected from Tomales Bay, and *C. gigas* were obtained from a commercial grower in Tomales Bay.

The 2002 deployment plan (available at <http://www.amarine.com/information/rmp/cruise/cruiseplans.html>) was developed in order to continue ongoing investigations into (1) the potential use of a single species of bivalves for future deployments, (2) impacts associated with switching to cage-type containment structures at all stations, and (3) impacts associated with discontinuing use of a maintenance cruise midway through deployments.

A minimum of 80 individuals of both Bay mussels and *M. californianus* were deployed at every RMP bivalve transplantation site. In addition, 72 *C. gigas* were deployed at the five stations where it is the current base species. These deployments will allow for a side-by-side comparison of bioaccumulation by Bay mussels and *M. californianus* at each station, and with *C. gigas* at appropriate stations. It will also allow for a full set of chemistry and growth data for a single species at all transplant sites to be analyzed if desired. Additionally, deployments were made to allow for side-by-side analyses of growth and survival at six sites, three mainstem sites and three margin sites, with both *M. californianus* and *M. edulis* deployed in bags and cages at each site. Finally, appropriate side-by-side deployments were made to continue testing of impacts on growth and survival of maintained vs. non-maintained deployments. A list of all bivalves deployed is given in **Table 3**.

Objectives

The objectives of this cruise were:

- 1) Collect *Mytilus californianus* from Bodega Head and deploy at twelve sites.
- 2) Collect Bay mussels from Tomales Bay and deploy at twelve sites.
- 3) Obtain *Crassostrea gigas* from Tomales Bay and deploy at five sites.
- 4) Install containment cages at six sites to continue analysis of growth and survival of bivalves of species in bagged vs. caged deployments.
- 5) Install containment cages at six sites to test growth and survival of bivalves at maintained vs. unmaintained stations.
- 6) Deploy multiple species at the same sites to develop data that could be used to move the RMP bivalve program toward use of a single bivalve species at all RMP stations.

Personnel

The personnel and work assignments for this cruise were as follows:

Name	Affiliation	Duties	Contact
Mey Akashah	AMS	Bivalve Collection, Tender, Diver	akashah@amarine.com
David Bell	AMS	Bivalve Collection, Tender, Diver	bell@amarine.com
Jordan Gold	AMS	Bivalve Collection, Cruise Manager, Diver, Vessel Skipper (5/31, 6/5), Tender	gold@amarine.com
Paul Salop	AMS	Bivalve Collection, Diver	salop@amarine.com
Adam Schumacker	N/A	Bivalve Collection (6/16)	N/A
David Morgan	RTC	Vessel Skipper, 6/27-30	dmorgan@sfsu.edu

Cruise Schedule

Cruise activities are shown in Table 1.

Table 1. Cruise Schedule for RMP 2002 Bivalve Deployment.

Date	Time	Activity
May 16	0800-1600	Gold, Akashah, and Schumacker collected Bay mussels from Tomales Bay and picked up <i>C. gigas</i> from Hog Island Oyster Company. All bivalves were then transported to Bodega Marine Lab (BML), where the bivalves were placed in free-flowing seawater tanks.
May 17	0900-1700	Akashah, Bell, Gold, and Salop collected <i>M. californianus</i> from Bodega Head, Sonoma County. <i>M. californianus</i> were then added to free-flowing seawater tanks at BML.
May 27	1400-2100	Gold picked up all bivalves from BML.

- May 28 0800-0830 Mobilized gear and loaded bivalves aboard *RV Questuary*, Emeryville Marina. Departed for Pinole Point site (BD30).
- 0934-1019 Replaced missing mooring buoy and deployed bivalves at Pinole Point. Departed for San Pablo Bay site (BD20).
- 1034-1125 Deployed bivalves at San Pablo Bay. Departed for Petaluma River site (BD15).
- 1205-1236 Deployed bivalves at Petaluma River. Departed for Emeryville Marina.
- 1410-1430 Arrived at Emeryville Marina. Demobilized vessel and replenished ice on bivalves.
- May 29 0730-0820 Mobilized gear aboard *RV Questuary*, Emeryville Marina. Departed for Red Rock site (BC61).
- 0925-0955 Deployed bivalves at Red Rock. Departed for Sausalito fuel dock.
- 1025-1055 Completed refueling. Departed for Horseshoe Bay site (BC21).
- 1105-1135 Deployed bivalves at Horseshoe Bay. Departed for Yerba Buena Island site (BC10).
- 1210-1235 Deployed bivalves at Yerba Buena Island. Departed for Emeryville Marina.
- 1255-1307 Arrived Emeryville Marina. Demobilized vessel and replenished ice on bivalves.
- May 30 0830-0917 Mobilized gear aboard *RV Questuary*, Emeryville Marina. Departed for Alameda site (BB71).
- 0950-1045 Deployed bivalves at Alameda (equipment problems delayed dive operations). Departed for Redwood Creek (BA40).
- 1138-1223 Deployed bivalves at Redwood Creek. Departed for Dumbarton Bridge site (BA30).
- 1240-1320 Attempted dive at Dumbarton Bridge site, but dive was aborted for safety reasons due to unfavorable currents. Departed for Coyote Creek site (BA10).
- 1340 Arrived at Coyote Creek site. Currents too high to dive safely. Departed for Emeryville Marina.
- 1545-1610 Arrived at Emeryville Marina. Demobilized vessel and replenished ice on bivalves.
- May 31 0900-0948 Mobilized gear and loaded remaining bivalves aboard *Karen M.*, San Leandro Marina. Departed for Coyote Creek site (BA10)
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- 1147-1210 Deployed bivalves at Coyote Creek. Departed for Dumbarton Bridge site (BA30).
- 1220-1232 Deployed bivalves at Dumbarton Bridge. Departed for San Leandro Marina.
- 1324-1330 Arrived at San Leandro Marina. Demobilized vessel and departed for Vallejo Public Boat Launch via surface streets.
- 1430-1442 Mobilized gear and loaded remaining bivalves aboard *Karen M.*, Vallejo Public Boat Launch. Departed for Davis Point site (BD40).
- 1510-1525 Deployed bivalves at Davis Point. Departed for Napa River site (BD50).
- 1537-1620 Arrived at Napa River site. Currents too strong to allow divers to safely visit mooring. Bivalves were attached to a line that was secured to a piling at the site and submerged into the water column (as discussed below). Redeployment was scheduled for a slack current on 6/5/02, at which time the bivalves would be fully secured to the mooring. Departed for Vallejo Public Boat Launch.
- 1630-1645 Arrived at Vallejo Public Boat Launch. Demobilized vessel and transported remaining bivalves to AMS for processing of T-0 bivalves.
- June 5 1000-1020 Mobilize gear aboard *Karen M.*, Vallejo Public Boat Launch. Departed for Napa River site (BD50).
- 1029-1100 Retrieved temporary deployment and deployed bivalves at Napa River site. Noticed significant mortality in *M. californianus*, not related to predation. Sampling team decided to inspect the Davis Point deployment to determine if mortality was also occurring there.
- 1105-1127 Inspected deployment at Davis Point site. 1-2' visibility at mooring allowed for inspection *in situ*. No mortality was observed in any of the bivalve species. Departed for Vallejo Public Boat Launch.
- 1136-1150 Arrived at Vallejo Public Boat Launch and demobilized vessel.
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Discussion

All cruise objectives were met. Deployment of bivalves in the Bay requires careful planning and execution, as visibility is often zero and during certain parts of the tidal cycle strong currents make diving unsafe. On this cruise, equipment problems encountered on 5/30/02 forced alteration of cruise plan by delaying dive operations and preventing deployment of bivalves at two of the scheduled sites, Dumbarton Bridge and Coyote Creek. These two sites were deployed on 5/31/02. This, however, greatly impacted dive operations at the Napa River and Davis Point sites by delaying the attempted dive operations at those sites outside of the acceptable current window.

The sampling team was able to deploy bivalves at the Davis Point site. However, the team was unable to make a regular deployment at the Napa River site the same day due to strong currents. Based on site conditions and personnel availability, the next available deployment date was determined to be 6/5/02.

The sampling team considered four alternatives for deploying the bivalves: (1) maintaining bivalves on ice for the intervening five-day period until deployment; (2) returning all remaining bivalves to the free-flowing tanks at BML and transporting back to the Napa River site at the appropriate time, (3) harvesting new bivalves to replace those on-hand, and (4) making a temporary deployment at the Napa River site from the surface. Alternative 1 was rejected because the bivalves were not expected to be viable for the five additional days out of the water. Alternative 2 was rejected because the shock associated with returning the bivalves to cold-water tanks, leaving for a short period, and returning to warmer water conditions could potentially impact interpretation of the program results. Alternative 3 was rejected due to the inherent uncertainty associated with sampling a population not part of the remaining deployments and T-0 bivalves. The sampling team elected to make a temporary deployment of Napa River bivalves by securing cages to a line attached to the Napa River fixed structure at the surface, and submerging the bivalves into the water column.

The sampling team retrieved the temporary deployment and redeployed the bivalves at their proper mooring on 6/5/02. Upon retrieving the bivalves, the crew observed nonpredation-related mortality in the *M. californianus*, but not in the Bay mussels or *C. gigas*. The sampling crew decided to inspect the Davis Point mooring to determine if mortality was also present at that site. The divers found no apparent mortality upon inspecting the species at Davis Point (visibility at the mooring allowed for inspection to be completed without removing the bivalves to the surface).

The cause of the mortality of *M. californianus* is unknown, but is potentially a combination of factors including elevated temperatures and depressed salinity. We have already seen a negative impact upon bivalve survival in *M. californianus* and it is possible the remaining bivalves may have been stressed sufficiently to alter their feeding behavior and therefore their usefulness as part of long-term trend investigations. This may require removal of those bivalves from the side-by-side comparisons that are part of this deployment.

As *C. gigas* is the base species at the Napa River station, this will most likely not negatively impact the base program results. Growth of *C. gigas* at this station will be compared with historical results and with other stations during the 2002 deployments as a method of testing this assumption.

Site Locations

The coordinates for all RMP bivalve stations are listed in **Table 2** below:

Table 2. 2002 RMP Bivalve Stations. San Joaquin and Sacramento River stations used for harvesting of resident bivalves only.

Site Name/Code	Latitude (N)	Longitude (W)	Comments
Coyote Creek BA10	37° 28.19'	122° 03.83'	Channel marker "18"
Dumbarton Bridge BA30	37° 30.80'	122° 08.08'	Channel marker "14"
Redwood Creek BA40	37° 32.82'	122° 11.70'	Channel marker "4"
Alameda BB71	37° 41.73'	122° 20.38'	Channel marker "1" 1.65 nmi. SE of Hunters Point
Yerba Buena Island BC10	37° 49.12'	122° 20.81'	Dolphin 0.2 nmi. SW of Bay Bridge (southernmost set of dolphins)
Horseshoe Bay BC21	37° 49.87'	122° 28.65'	Dolphin 100 ft W of fishing pier (southernmost of three remaining dolphins)
Red Rock BC60	37° 55.70'	122° 28.13'	Channel marker "2" for Larkspur ferry terminal
Point Pinole BD30	38° 01.00'	122° 22.05'	Channel marker "P"
San Pablo Bay BD20	38° 02.72'	122° 25.71'	Channel marker "1"
Petaluma River BD15	38° 06.77'	122° 30.05'	NE end of railroad bridge
Davis Point BD40	38° 03.26'	122° 15'.63	E side of Phillips Petroleum loading dock
Napa River BD50	38° 04.84'	122° 14.82'	Mare Island Strait adjacent to General Foods facility, 0.7 nmi. from channel marker "2"
Sacramento River BG20	38° 03'.58	121° 47.50'	Channel marker "8" N of Sherman Island
San Joaquin River BG30	38° 01.27'	121° 48.32'	Channel marker "8" 0.75 nmi. E of Antioch Marina

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Table 3. Bivalve Deployments for the 2002 Bioaccumulation Program

	Unmaint. Cages		Maintained, for side-by-sides				Add. Maintained Bags			Addl. Maintained Cages	
	MCAL	MEDU	Bags		Cages		MCAL	MEDU	CGIG	MCAL	MEDU
			MCAL	MEDU	MCAL	MEDU					
Yerba Buena Isl										1	1
Horseshoe Bay	1/2	1/2								1	1
Coyote Creek	1/2	1/2	2	2	1/2	1/2			2		
Redwood Creek	1/2	1/2	2	2	1/2	1/2					
Dumbarton Br.							2	2			
Alameda	1/2	1/2	2	2	1/2	1/2					
Red Rock							2	2			
Petaluma River							2	2	2		
San Pablo Bay	1/2	1/2	2	2	1/2	1/2			2		
Pinole Point			2	2	1/2	1/2					
Davis Point							2	2	2		
Napa River	1/2	1/2	2	2	1/2	1/2			2		
Total Bivalves	240	240	480	480	240	240	320	320	360	160	160

Notes:

- 1/2 cage deployments indicate 40 mussels (2 compartments of 20 each)
- Each full cage deployment indicates 80 mussels (4 compartments of 20 each)
- Bagged mussels indicate deployments of 40 mussels (4 compartments of 10 each)
- All oysters will be bagged, in quantities of 36 (3 compartments of 12 each)