Agenda Report

For Agenda of: January 23, 2014

Title:

10a. Consideration of adopting the Mitigated Negative Declaration and associated Mitigation Monitoring and Reporting Program for the application by Pacific Gas and Electric Company for the Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project

10b. Consideration of adoption of Resolution 2014-02 which establishes findings relative to the application by Pacific Gas and Electric Company for the Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project

10c. Consideration of granting Permit 13-04 to Pacific Gas and Electric Company for the Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project

Place on Agenda: Unfinished Business – 10 a,b,c

Summary of the Issue: Pacific Gas and Electric Company **(Applicant)** has applied to the Harbor District **(District)** for a permit to remove contaminated sediments from the intake and discharge canals at the Humboldt Bay Power Plant in King Salmon. The project location and footprint is presented in Figures 1 and 2 of the Draft Initial Study (IS).

Issuance of a permit requires the **District** to complete an environmental review of the project and to make findings relative to CEQA as well as the District's enabling legislation.

The sediment is contaminated with low levels of radionuclides, and this cleanup is therefore required as part of the larger closure of the former nuclear component of the power plant by the federal Nuclear Regulatory Commission. The areas to be dredged will be dewatered first, and a variety of wetland and aquatic species impacts are associated with this effort. A detailed Biological Mitigation and Monitoring Plan is incorporated to minimize and mitigate for these impacts, and with the implementation of this Plan, the overall project impacts are mitigated to less than significant.

Specific Project Outline.

- Prepare pre-project plans and surveys
- Prepare the site
- Install water controls

  - Install water control structures in the intake canal
  - Plug outfall pipes at discharge canal
  - Isolate and sever the circulation water piping
  - Install dewatering systems and dewater the canals
  - Install a cofferdam in Humboldt Bay to isolate discharge canal levee and outfall pipes
- Remove sediment
  - Mechanically remove contaminated sediments from the intake canal
  - Mechanically remove contaminated sediments from the discharge canal
  - Manage and dewater removed sediments
  - Confirmation sampling to demonstrate removal of the contamination
- Demolish and dispose of the intake and discharge structures
  - Remove and dispose of the intake and discharge structures
  - Demolish the discharge outfall structure (portion within the HBPP levee)
- Contour the canals to stable slope conditions
- Restore the levee between the discharge canal and Humboldt Bay
- Remove remaining water control structures
- Temporarily use the remediated discharge canal for storage of clean, reusable sediments associated with the larger site closure effort.
- Implement ecosystem restoration plan and construct mitigation wetlands.

Consistency with Harbor District Policies and Priorities:

As a remediation project designed to remove contaminated materials from the Bay, this project is consistent with **District** policies and priorities. A detailed Biological Mitigation and Monitoring Program is incorporated into the project to address the impacts to wetlands and aquatic species associated with the project.

Comments Received and Responses:
The California Dept. of Fish and Wildlife indicated their support for the project as proposed.

Humboldt Baykeeper commented to request additional information about the nature and extent of the radionuclide contamination, including how the boundaries of the contamination were defined.

The Blue Lake Rancheria, in concert with the Bear River Band of the Rohnerville Rancheria and the Wiyot Tribe requested that language be included specifiying that the Tribal Historic Preservation Officers of each group be informed and consulted with in the event of an unanticipated discovery of Native American cultural resources during construction.

The City of Eureka requested additional information and possible additional analysis related to traffic impacts on the City.

These comments are included in Attachment B to the MND. Responses to the comments are included in Attachment C to the MND. *(NOTE – Some comment s were received as this staff report was in preparation, and a full response is not available in time for the agenda packet. Responses will be ready in time for the District meeting.*

Attached for your information are:

a) A final Mitigated Negative Declaration for your consideration of adoption, including:
    a. The Mitigation and Monitoring Reporting Program describing the final mitigation measures required of the applicant (Attachment A to the MND).
    b. The comment letters received on the project (Attachment B to the MND); and
    c. Responses to the comment letters received on the project (Attachment C to the MND) *(see note above –some responses still in preparation)*;
b) Draft Resolution 2014-02 making findings associated with issuing a permit; and
c) Draft Permit 13-04 for your consideration of approval

As part of considering the proposed MND, the Harbor District is required to consider the comments received during the public review process. Approval of the MND requires the finding that there is no substantial evidence the project, including mitigation measures, will have a significant effect on the environment.

Fiscal Impact: There are no fiscal impacts for permit issuance.

Staff Recommendation:

Staff recommends that the Board of Commissioners:

1. Adopt the Mitigated Negative Declaration for the application by Pacific Gas and Electric Company for the Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project;

2. Adopt Resolution 2014-02 which establishes findings relative to the application by Pacific Gas and Electric Company for the Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project; and

3. Grant Permit 13-04 to Pacific Gas and Electric Company for the Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project.

Staff makes these recommendations on the following basis:

- This project is consistent with the Humboldt Bay Management Plan and with the District's tidelands trust responsibility;
- The CEQA process has been completed, the possible environmental impacts of the project have been thoroughly evaluated, and there is no substantial evidence the project, including mitigation measures, will have a significant effect on the environment;
- The permit conditions include, among other things, completion of all other required permitting for the project

Mitigated Negative Declaration

for the

Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project

The Humboldt Bay Harbor, Recreation and Conservation District (District), as the lead agency pursuant to the California Environmental Quality Act (CEQA), prepared a Draft Mitigated Negative Declaration (Draft MND) for an application by Pacific Gas and Electric Company for the Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project in and adjacent to Humboldt Bay (State Clearinghouse Number 2013122032). The Draft MND was published for a 30-day public and agency review period pursuant to CEQA and the CEQA Guidelines (particularly Section 15073), which ended January 17, 2014. The Draft MND included an Initial Study for the proposed project, incorporated as a part of the Draft MND. The contents of the Draft MND and IS are incorporated into this Mitigated Negative Declaration by reference, as if fully set forth. The District received four (4) comments during the review period concerning the content of the Draft MND and IS. These comment letters are included in Attachment B to this Mitigated Negative Declaration. A response to comments received is included in Attachment C.

This final MND, and the included Mitigation Monitoring and Reporting Program (Attachment A) was developed based upon the content of the Initial Study and Draft MND, considered together with the comments received during the review process. The District finds that there is no substantial evidence that the proposed project will have a significant effect on the environment, when implemented together with the Mitigation Monitoring and Reporting Program, or measures as modified or substituted during further lead agency consideration.

Name of Project:	Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project
Lead Agency Name and Address:	Humboldt Bay Harbor, Recreation and Conservation District P.O. Box 1030 Eureka, CA 95502-1030
Contact Person and Phone Number:	Dan Berman, Director of Conservation (707) 443-0801
State Clearinghouse Number:	2013122032

Copies of the Initial Study documents, including attachments, the Draft MND, and other information pertinent to this environmental review may be obtained from the District; there may be document-production costs associated with the documents.

Signed:

Name: Jack Crider
Title: Chief Executive Officer, HBHRCD

Adopted on: January 23rd 2014

Attachment A

Mitigation Monitoring and Reporting Program
for the
Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project
Mitigated Negative Declaration

The Humboldt Bay Harbor, Conservation and Recreation District (District) has adopted a Mitigated Negative Declaration (MND) as an environmental assessment document pursuant to the California Environmental Quality Act (CEQA) for the Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project in and adjacent to Humboldt Bay by Pacific Gas and Electric Company (State Clearinghouse No. 2013122032.

As part of the MND, the District required mitigation measures that have the effect of reducing the proposed project's potential environmental effects to less-than-significant levels. These mitigation measures are summarized below and laid out in full in the Biological Mitigation and Monitoring Plan for the project, which is hereby incorporated in full by reference (Appendix E to the Initial Study and MND.)

The District requires that all of the following mitigation measures be incorporated into the proposed project. Each mitigation measure will be adopted as a condition of the District's approval of the permit for the proposed project.

The District assigns the responsibility to District staff to verify that each element of all mitigation measures are carried out by the applicant. This assignment of implementation monitoring shall serve as the mitigation monitoring or reporting program required by CEQA, as summarized in CEQA Guidelines section 15074(d). The following table briefly summarizes the mitigation measures for the project, but this MND requires the complete implementation of the Biological Mitigation and Monitoring Plan.

Mitigation Measures for the
Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project

The project will be mitigated by the full implementation of the Biological Mitigation and Monitoring Plan provided in Appendix E of the Initial Study/MND and incorporated herein by reference. The following table briefly summarizes the impacts and mitigation that are more fully described in that Plan.

Impact	CEQA Checklist Item Requiring Mitigation	Mitigation	Level of Significance after Mitigation
Biological Resources			
Excavation of sediment could result in injury or mortality to fish species present in the intake and discharge canals.	IV (a)	To minimize impacts on fish species in the canal, a rescue and relocation plan has been developed to move fish out of the affected area prior to excavation. The mitigation program described in Appendix E in combination with the fish rescue and relocation plan, will fully mitigate impacts on special-status and listed fish species including longfin smelt and coho salmon.	Less than significant
Excavation of sediment could result in water quality impacts that would affect fish species and their critical habitat.	IV (a)	To avoid and/or minimize water quality effects on fish species, the contractor would isolate the work areas through the construction of cofferdams and/or silt curtains to contain turbid water. In addition, implementation of the fish rescue and relocation plan will ensure that there are no fish in the excavation areas. Any turbid water behind cofferdams would be directed through the GWTS prior to discharge.	Less than significant
Excavation of sediment would result in the temporary or permanent loss of 283 square meters (3,049 square feet [0.07 acre]) of eelgrass habitat in the intake canal and a permanent loss of 76 square meters (815 square feet [0.019 acre]) of eelgrass habitat in the discharge canal.	IV (b)	Permanent and temporary impacts on eelgrass habitat affected by project activities would be mitigated for by restoring or creating additional eelgrass beds, at a ratio of 4:1 for impacts in the intake canal and 4:1 for eelgrass impacts in the discharge canal. Creation of this eelgrass habitat will fully mitigate impacts on special-status and listed fish species including longfin smelt and coho salmon.	Less than significant
Excavation of sediment in the intake canal has the potential to temporarily affect northern coastal salt marsh – considered a rare natural community.	IV (b)	Permanent and temporary impacts on northern coastal salt marsh affected by project activities would be mitigated for as part of the wetland mitigation for the project by restoring impacted salt marsh habitat and creation of new salt marsh habitat at a 6.9:1 ratio.	Less than significant
Project activities would result in temporary and permanent impacts on wetlands and waters under the jurisdiction of both the USACE and CCC.	IV (c)	Permanent and temporary impacts on wetlands and waters affected by project activities would be mitigated for creating wetlands in a ratio of 1:1 for federal and California Coastal Commission wetlands adjacent to the discharge canal, restoring and creating wetlands and waters in the intake canal area at a ratio of 1:1, creating wetlands and waters in the former Alpha Road parking area and intake canal (1:1 ratio of impacts on discharge canal waters) and enhancing existing saltmarsh in a ratio of 3.3:1 for temporary impacts and temporal loss for all wetlands and waters impacted by the project.	Less than significant

Attachment B
Comments Received
for the
Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project
Mitigated Negative Declaration and Draft Initial Study

Comment # 1:
From: Frey, Vicki@Wildlife [Vicki.Frey@wildlife.ca.gov]
Sent: Thursday, January 16, 2014 12:13 PM
To: Dan Berman (dberman@humboldtbay.org)
Cc: Smith, Mark G (HBPP) (MGS1@pge.com); Ota, Becky@Wildlife; Garwood, Rebecca@Wildlife
Subject: HBPP canal remediation draft MND comments

Importance: High

Hello Dan, thank you for the opportunity to review and comment on the draft MND for the Humboldt Bay Power Plant (HBPP) Canal Remediation Project. The proposed project is in support of the effort by Pacific Gas & Electric (PG&E) to fully decommission and terminate the license for its former nuclear power generation facility in King Salmon, Humboldt County, California. The objective of the proposed project is to remove contaminated sediments from the intake and discharge canals, and remove the intake and discharge structures to support the overall objective of restoring the land to conditions that allow for continued industrial use of the site. Sediments in both intake and discharge canals have low levels of radiological contamination which will be removed. The outfall pipes from the discharge canal to Humboldt Bay will be removed from the levee separating the bay from the plant site. A cofferdam will be constructed in Humboldt Bay to allow for the pipe removal and levee repair. The cofferdam and discharge canal will be dewatered and sediment removal and construction will begin. A Fish Rescue Plan will be implemented to prevent fish mortality and place fish back into the bay. The intake canal will be isolated with a water control structure, dewatered with fish rescue, and sediment removal and contruction to remove the intake structure will occur. Both intake and discharge canals have eelgrass present and the potential for sensitive listed fish species to be present. PG&E has agreed to mitigate for the impacts to eelgrass, potential take of longfin smelt and coho salmon, and wetland plants, and has developed a Biological Mitigation and Monitoring Plan. In addition, PG&E has agreed to obtain an Incidental Take Permit from the Department of Fish and Wildlife.

The Department has reviewed the draft MND and Appendices. The Department appreciates the level of detail in the document and finds that all issues raised by the Department during prior conversations and meetings have been addressed in the draft MND. The Department believes that the proposed mitigation measures will bring the impacts of the project to a less than significant level. The Department looks forward to continuing work with PG&E and their consultants on the Incidental Take Permit and the Mitigation and Monitoring Plan.

Thank you, Vicki

Vicki S. Frey
Senior Environmental Scientist Supervisor California Department of Fish and Wildlife, Marine Region
619 2nd Street Eureka, CA 95501
707-445-7830
707-484-6901 cell
Vicki.Frey@wildlife.ca.gov

From: Janet Eidsness [jpeidsness@yahoo.com]
Sent: Friday, January 17, 2014 3:33 PM
To: Dan Berman; dberman@humboldtbay.org
Cc: Stephanie Cimino; Erika Collins THPO; Tom; Janet Eidsness
Subject: Blue Lake Rancheria THPO comments on Humboldt Bay Power Plant Canal Remediation Project (draft)

Dear Mr. Berman:

Thank you for sending the Initial Study & Mitigated Negative Declaration (draft Dec. 2013) for the subject project, with comments due no later than 1/17/14.

I have reviewed the cultural resources sections and coordinated with the other Wiyot area THPOs (Bear River Band THPO Erika Collins & Wiyot THPO Tom Torma) in making these comments. I have also conferred with PG&E's archaeologist Stephanie Cimino about this aspect of the project, other related tasks, and prior cultural resources studies.

I concur with the findings of Section V. Cultural Resources (pp. 4-17 through 4-18), although note that the project occurs in an area sensitive for Wiyot cultural resources (Loud 1918) that have not been precisely located nor its significance and integrity evaluated. There remains a potential for associated buried archaeological deposits in the vicinity, including possible Wiyot village deposits and burials.

I recommend adding the following sentence at end of paragraph 5 on page 4-18 (under discussion a, b, c) to read:
" In the event that discernible Native American cultural resources are inadvertently discovered during ground-disturbing activities, the Tribal Historic Preservation Officers (THPOs) of the Wiyot Tribe, Bear River Band of Rohnverville Rancheria, and Blue Lake Rancheria, shall be immediately notified and consulted about the potential significance and treatment of the findings."

By this email, I have shared this recommendation to Ms. Cimino and copy the other two THPOs, for the record of NHPA Section 106 and CEQA consultations.

Regards,

JANET P. EIDSNESS, M.A.
Consultant in Heritage Resources Management
Member, Archaeological Resources Committee, State Historical Resources Commission
Tribal Historic Preservation Officer (THPO) for Blue Lake Rancheria

January 17, 2014

Mr. Dan Berman
Director of Conservation
Humboldt Bay Harbor, Recreation and Conservation District
601 Startare Drive, Eureka, CA 95502

Re: Humboldt Bay Power Plant Canal Remediation

Dear Mr. Berman,

On behalf of the board, staff and supporting members of Humboldt Baykeeper, these comments are submitted for your consideration on the Initial Study and Mitigated Negative Declaration for PG&E's Humboldt Bay Power Plant Canal Remediation.

Humboldt Baykeeper was launched in October 2004 to safeguard our coastal resources for the health, enjoyment, and economic strength of the Humboldt Bay community through education, scientific research, and enforcement of laws to fight pollution.

Humboldt Baykeeper's primary concern with the discharge canal remediation is regarding potential radionuclide contamination of bay sediments and the methodology used to delineate the area to be remediated. We are concerned that radionuclides may be present within bay sediments from effluent discharges over the years, and would like to know how PG&E and its consultants determined the extent of contamination. Are there sampling results that support the extent of remediation being proposed?

The attached document is one of several that we have come across in our research that suggests that radioactive contamination has traveled off-site. Note that mussels were collected with elevated levels of radionuclides from a sample site called Humboldt Bay Beach Jetty (p. 321 of the attached document).

Of particular concern are the levels of 238-Pu detected at the higher end of detections found in this study of sites across the Pacific and Atlantic Coasts of the U.S. With a half-life on the order of 6500 years, I would like to know how far from

the Humboldt Bay Power Plant the bay sediments have been sampled for 238-Pu as well as other radionuclides.

On p. 323, it states:

> ^{238}Pu concentrations (Tables 2 and 3) are generally low on all three coasts (median of all the values is ~3 x 10^{-6} Bq g^{-1}) and no statistically significant difference is detected among the means for these coasts. However, six locations (Jamaica Bay, NY, Savannah Estuary, GA; Biscayne Bay, FL; Cedar Key, FL; Humboldt Bay, CA; and Whidbey Island, WA) show relatively high concentrations (from ~8.6 up to ~59 x 10^{-6} Bq g^{-1}).

We look forward to learning more about this potentially significant impact and how PG&E plans to remediate the discharge canal to ensure the long-term health and safety of Humboldt Bay residents, particularly those who gather and eat mussels and other bivalves, as well as the wildlife that relies on mollusks and other invertebrates. Making public any sediment or mussel tissue sampling that has been done would be quite helpful in making a determination of whether such impacts have been mitigated to less than significant.

Thank you for the opportunity to comment on this matter.

Sincerely,

_____/s/_____
Jennifer Kalt, Policy Director
Humboldt Baykeeper
1385 Eighth Street, Suite 228
Arcata, CA 95521
(707) 499-3678
jkalt@humboldtbaykeeper.org

Attached:

Radionuclide Concentrations in Bivalves Collected Along the Coastal United States. NATHALIE J. VALETTE-SILVER and GUNNAR G. LAUENSTEIN. Marine Pollution Bulletin, Vol. 30, No. 5, pp. 320-331, 1995.

Pergamon

0025-326X(94)00780-4

Marine Pollution Bulletin, Vol. 30, No. 5, pp. 320–331, 1995
Elsevier Science Ltd
Printed in Great Britain

Radionuclide Concentrations in Bivalves Collected Along the Coastal United States

NATHALIE J. VALETTE-SILVER and GUNNAR G. LAUENSTEIN
National Status and Trends Program, N/ORCA 21, National Oceanic & Atmospheric Administration, 1305 East–West Highway, Silver Spring, MD 20910, USA

In 1990, the National Oceanic and Atmospheric Administation's National Status and Trends Program initiated a study of artificial radionuclides (^{241}Am, $^{239+240}$Pu, ^{238}Pu, ^{137}Cs, ^{110}Ag, ^{90}Sr, ^{65}Zn, ^{60}Co, and ^{58}Co) in oysters and mussels collected along the coastal US. The results of this study show that activation products ^{110}Ag, ^{65}Zn, ^{60}Co and ^{58}Co are sometimes present close to nuclear facilities. In addition, based on a nonparametric Kruskal–Wallis statistical test, it appears that ^{241}Am and ^{137}Cs concentrations as well as ^{241}Am/$^{239+240}$Pu and ^{137}Cs/^{40}K activity ratios are highest along the West Coast of the US. For ^{238}Pu, $^{239+240}$Pu, and ^{90}Sr activities and the other ratios, the differences observed in the distribution of the radionuclides between the various coasts are not statistically significant. There is also a statistical difference between the values of the $^{239+240}$Pu/^{90}Sr ratio in oysters vs mussels collected along the East Coast and of the ^{241}Am/$^{239+240}$Pu ratio between two species of mussels collected along the West Coast. Finally, when the NOAA results for ^{241}Am, $^{239+240}$Pu, and ^{137}Cs are compared with those of an earlier (1976–1978) Mussel Watch Program sponsored by the Environmental Protection Agency, the statistical Sign Test generally shows a significant decrease in the concentrations between the mid-1970s and the early 1990s.

The National Oceanic and Atmospheric Administration's (NOAA's) National Status and Trends Program (NS&T) was initiated in 1984 to monitor the environmental quality of US coastal and estuarine areas. The programme includes two main monitoring projects: the National Benthic Surveillance Project, initiated in 1984, which collects and analyses sediments and bottom fish from 149 sites; and the Mussel Watch Project (MWP), initiated in 1986, which collects and analyses bivalves (mussels and oysters) and sediments from over 250 sites. Until 1990, each site was sampled and collected material analysed on a yearly basis for 14 elements (major and trace elements) and 70 organic contaminants (polyaromatic hydrocarbons, polychlorinated biphenyl congeners, pesticides, and butyltins).

Because bivalves concentrate contaminants while filtering surrounding waters, these organisms are useful indicators of changes occurring in the chemistry of their environment. While their response to chemical changes in their surroundings may be detectable within a matter of days, depending on the species and on the contaminant, approximately 4–24 weeks are required for the bivalves to equilibrate with their environment (Roesijadi *et al.*, 1984; Sericano, 1993).

In 1990, bivalves were collected at 36 sites (Fig. 1) and analysed for the radionuclides: ^{241}Am, $^{239+240}$Pu, ^{238}Pu, ^{137}Cs, ^{110}Ag, ^{90}Sr, ^{65}Zn, ^{60}Co, ^{58}Co, ^{40}K, and ^{7}Be. Most of these 36 samples were obtained from MWP sites and the remaining samples were collected in the vicinity of nuclear facilities or known radioactive dumping sites. Three mollusc species were collected for this project: *Mytilus edulis* species complex along the North Atlantic and Pacific coasts; *Mytilus californianus*, generally found in high-energy environments on the Pacific Coast; and *Crassostrea virginica*, collected along the Atlantic shore from Delaware Bay to Florida and along the Gulf of Mexico coast (Table 1).

Between 1976 and 1978, the Environmental Protection Agency (EPA) conducted a Mussel Watch Program (MWP70s) that measured transuranic elements, polyaromatic hydrocarbons, polychlorinated biphenyls, chlorinated pesticides, and trace metals in bivalves collected around the country (Farrington, 1983; Farrington *et al.*, 1983; Goldberg *et al.*, 1978, 1983; Palmieri *et al.*, 1984). Thirty of the 36 sites sampled in 1990 are close to sites sampled in the 1970s. It is then possible to compare the results from the two sampling times for those sites. Comparisons were possible for the four radionuclides measured by both programmes (i.e. ^{241}Am, $^{239+240}$Pu, ^{238}Pu, and ^{137}Cs).

The first test of a nuclear weapon occurred in July 1945 at Alamogordo (NM, USA). Following the atomic bombings of Nagasaki and Hiroshima in August of 1945, several US nuclear devices were detonated on islands of the Pacific Ocean and at the Nevada Test Site

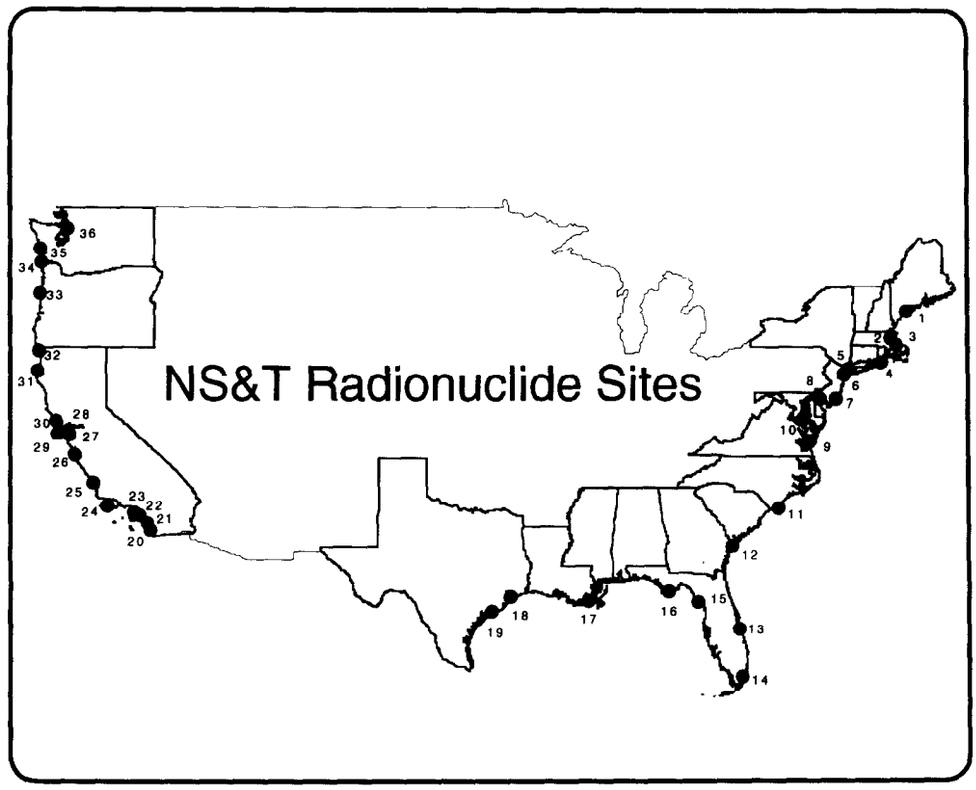

Fig. 1 Map showing the location of the NS&T sites where bivalves were collected for the NOAA NS&T Radionuclide Project.

TABLE 1

Location of the NS&T sites.

Site no.	Main location, specific location (acronym)	State	Species
East Coast			
1*	Merriconeag Sound, Stover Point (MSSP)	ME	*Mytilus edulis*
2*	Boston Harbor, Deer Island (BHDI)	MA	*Mytilus edulis*
3*	Duxbury Bay, Clarks Island (DBCI)	MA	*Mytilus edulis*
4*	Block Island Sound, Block Island (BIBI)	RI	*Mytilus edulis*
5*	Long Island Sound, Hempstead Harbor (LIHH)	NY	*Mytilus edulis*
6*	Hudson/Raritan Estuary, Jamaica Bay (HRJB)	NY	*Mytilus edulis*
7*	Absecon Inlet, Atlantic City (AIAC)	NJ	*Mytilus edulis*
9	Delaware Bay, Arnolds Point Shoal (DBAP)	DE	*Crassostrea virginica*
8*	Chesapeake Bay, Cape Charles (CBCC)	VA	*Crassostrea virginica*
10	Chesapeake Bay, Calvert Cliff (CBCL)	MD	*Crassostrea virginica*
11*	Cape Fear, Battery Island (CFBI)	NC	*Crassostrea virginica*
12*	Savannah River Estuary, Tybee Island (SRTI)	GA	*Crassostrea virginica*
13	Indian River, Sebastian River (IRSR)	FL	*Crassostrea virginica*
14	Biscayne Bay, Gould's Canal (BBGC)	FL	*Crassostrea virginica*
Gulf			
15*	Cedar Key, Black Point (CKBP)	FL	*Crassostrea virginica*
16*	Apalachicola Bay, Cat Point Bar (APCP)	FL	*Crassostrea virginica*
17*	Barataria Bay, Middle Bank (BBMB)	LA	*Crassostrea virginica*
18*	Galveston Bay, Hanna Reef (GBHR)	TX	*Crassostrea virginica*
19*	Matagorda Bay, East Matagorda (MBEM)	TX	*Crassostrea virginica*
West Coast			
20*	Oceanside, Municipal Beach Jetty (OSBJ)	CA	*Mytilus edulis*
21*	La Jolla, Point La Jolla (LJLJ)	CA	*Mytilus californianus*
22	Newport Beach, West Jetty (NBWJ)	CA	*Mytilus californianus*
23*	San Pedro Harbor, Fishing Pier (SPFP)	CA	*Mytilus edulis*
24	Santa Cruz Island, Fraser Point (SCFP)	CA	*Mytilus californianus*
25*	San Luis Obispo Bay, Point San Luis (SLSL)	CA	*Mytilus californianus*
26*	Pacific Grove, Lovers Point (PGLP)	CA	*Mytilus californianus*
27*	San Francisco Bay, San Mateo Bridge (SFSM)	CA	*Mytilus edulis*
28*	San Francisco Bay, Emeryville (SFEM)	CA	*Mytilus edulis*
29*	Farallon Islands, East Landing (FIEL)	CA	*Mytilus californianus*
30*	Bodega Bay, Bodega Bay Entrance (BBBE)	CA	*Mytilus californianus*
31*	Humboldt Bay, Beach Jetty (HMBJ)	CA	*Mytilus californianus*
32*	Crescent City, Point St. George (SGSG)	CA	*Mytilus californianus*
33*	Yaquina Bay, Yaquina Head (YHYH)	OR	*Mytilus californianus*
34*	Columbia River, South Jetty (CRSJ)	OR	*Mytilus edulis*
35*	Grays Harbor, Westport Jetty (GHWJ)	WA	*Mytilus californianus*
36*	Whidbey Island, Possession Point (WIPP)	WA	*Mytilus edulis*

*Common sites to NOAA NS&T and to EPA Mussel Watch Project (MWP70s).

(Carter & Moghissi, 1977). In the early 1950s, there was an active period of atmospheric weapons testing by the USA, UK, and the former USSR. A moratorium on nuclear testing was initiated in November 1958 and ended in September 1961. The pre-moratorium period was dominated by US weapons testing and the post-moratorium period was dominated by the former USSR weapons testing. From 1966 to 1974, most of the atmospheric tests were conducted by France in the Tuamotu Archipelago (Mururoa and Fantataufa Islands) and by the People's Republic of China (Koide *et al.*, 1979, 1985). In 1974, France joined the USA and USSR in conducting only underground tests and, in 1980, the People's Republic of China is believed to have followed suit. India detonated its first weapon underground in 1974. Presently, all known nuclear testing is underground, including the large events recorded in May 1992 and October 1993 from the People's Republic of China (Davis, pers. comm.).

The phase of intense atmospheric nuclear testing resulted in the injection into the upper atmosphere of a broad array of fission and fusion products as well as induced radionuclides and in a global fallout of radionuclides. The longer lived radionuclides ($T_{1/2} > 2$ years) from this source still persist in the environment.

In 1964, there was an additional input of ^{238}Pu to the atmosphere due to the burn-up of the plutonium-fueled SNAP-9A satellite (Mamuro & Matsunami, 1969; Koide *et al.*, 1977).

The occurrence of the fission product radionuclides ^{241}Pu ($T_{1/2}$=14.9 years), ^{241}Am ($T_{1/2}$=458 years), ^{239}Pu ($T_{1/2}$=24 400 years), ^{240}Pu ($T_{1/2}$=6580 years), ^{238}Pu ($T_{1/2}$=86 years), ^{137}Cs ($T_{1/2}$=30 years), and ^{90}Sr ($T_{1/2}$=28 years) in the environment is mostly derived from global fallout associated with this intense period of atmospheric testing, including redistribution from remobilized soil particles (Noshkin & Bowen, 1973; Olsen *et al.*, 1981a,b; Bopp *et al.*, 1982). Nuclear reactor accidents, such as Chelyabinsk (September 1957) and Chernobyl (April 1986) in the former USSR, have also released fission products such as ^{137}Cs into the atmosphere. However, because these inputs were released into the lower atmosphere, their distribution appears to be localized (i.e. a distance of hundreds of km, Mélière *et al.*, 1988; Pyatt & Beaumont, 1992).

Some shorter lived artificial radionuclides, such as ^{110}Ag ($T_{1/2}$=253 days), ^{65}Zn ($T_{1/2}$=243.6 days), ^{60}Co ($T_{1/2}$=5.3 years), and ^{58}Co ($T_{1/2}$=71.3 days), are formed by activation in nuclear reactors and can be released to the environment with nuclear power plant cooling waters.

^{40}K ($T_{1/2}=1.28\times10^{9}$ years) occurs naturally in the environment, and ^{7}Be ($T_{1/2}$=53.4 days) is formed in the upper atmosphere by cosmic ray bombardment of oxygen and nitrogen nuclei. The results obtained for both the ^{40}K and ^{7}Be analyses are mostly used here as reference.

The aim of this study is to determine the present status of radionuclide contamination in the coastal and estuarine environments of the US and to document the changes that have occurred in this contamination over the last 15 years.

Methods and Results

As for all the other contaminants analysed by the NS&T programme, each of the 36 samples used to analyse the radionuclides was a composite of molluscs collected at three stations within a site. Consequently, the results account for the site variability. The precision reported for each analysis is based on counting errors (Table 2).

In order to obtain about 300 g of dry soft tissue, approximately 180–200 mussels, or at least 125–150 oysters, were used for each site. Unfortunately, in a few cases, due to the small size of the molluscs and their high moisture content, < 100 g of dried sample was recovered, leading to high analytical uncertainties. After collection, the animals were packed in plastic containers and frozen on dry ice until shucked for analysis. The samples were shipped overnight to Texas A&M University, Geochemical and Environmental Research Group (GERG) where they were thawed and shucked and the soft tissues were freeze-dried and weighed. The dried samples were then shipped in sealed glass containers to Thermo Analytical Inc., California Laboratories (TMA/Norcal). At TMA/Norcal, the samples were redried, reweighed, charred, and ashed at 425°C. After appropriate radiochemical separation, the samples were analysed for the various isotopes using α, β, and γ counting techniques (see the Appendix for analytical details).

Table 2 displays the data obtained for the NOAA NS&T study. All the results are expressed in Bq g^{-1} (1 Ci = 3.7×10^{10} Bq) of material (dry weight). Along the US coasts fallout radioisotope concentrations range from 0.47×10^{-6} to $\sim 90\times10^{-6}$ Bq g^{-1} for ^{241}Am (Fig. 2), from 1.21×10^{-6} to 88.4×10^{-6} Bq g^{-1} for $^{239+240}Pu$, from 1.26×10^{-6} to 59.2×10^{-6} Bq g^{-1} for ^{238}Pu, from 17×10^{-6} to 400×10^{-6} Bq g^{-1} for ^{137}Cs, and from $\sim 16\times10^{-6}$ to 1994×10^{-6} Bq g^{-1} for ^{90}Sr.

The activation products are generally below detection limits (Table 2), with the following exceptions: $^{110}Ag = 1.2\times10^{-2}$ Bq g^{-1} (± 15%) at Chesapeake Bay–Calvert Cliff, $^{65}Zn = 3.7\times10^{-2}$ Bq g^{-1} (± 37%) at Delaware Bay–Arnolds Point Shoal and $^{65}Zn = 0.37\times10^{-2}$ Bq g^{-1} (± 75%) at La Jolla–Point La Jolla, $^{60}Co = 0.10\times10^{-2}$ Bq g^{-1} (± 90%) at Santa Cruz–Fraser Point, and $^{58}Co = 0.93\times10^{-2}$ Bq g^{-1} (± 12%) at Savannah River–Tybee Island.

Finally, concentrations of naturally occurring ^{40}K range from 0.4 to 46×10^{-2} Bq g^{-1}, and ^{7}Be was only detected at one site in the Pacific Northwest (site SGSG = 1.5×10^{-2} Bq g^{-1} ± 98%).

Interpretation

Geographical distribution of radioactivity in the coastal USA

For each radioisotope, geometric average and median activities were calculated for the whole set of data (Total) and by coast (East, Gulf, West). Results of geometric means were generally very close to the median values that are reported in Table 3.

TABLE 2

Isotope activities (Bq g^{-1}) and ratios.

	Isotope activities												Isotope ratios*						
NS&T	^{40}K $\times10^{-2}$	K ± %	^{90}Sr $\times10^{-6}$	Sr ± %	^{137}Cs¶ $\times10^{-6}$	Cs ± %	^{238}Pu $\times10^{-6}$	Pu ± %	$^{239+240}Pu$ $\times10^{-6}$	Pu ± %	^{241}Am $\times10^{-6}$	Am ± %	Cs/Sr	Cs/K $\times10^{-3}$	Sr/K $\times10^{-4}$	$^{238}Pu/Pu°$	Pu°/Cs	Pu°/Sr	Am/Pu°
MSSP	0.27	10	56.2	776	<†	–‡	4.88	200	47.0	42	6.25	229	–	–	2.05	0.10	–	0.84	0.13
BHDI	0.35	10	27.0	932	192	150	1.84	300	11.9	77	1.14	900	7.11	0.55	0.77	0.15	0.06	0.44	0.10
DBCI	0.28	8	27.0	810	195	128	1.58	200	27.4	32	7.92	61	7.23	0.71	0.98	0.06	0.14	1.02	0.29
BIBI	0.33	10	25.7	910	<	–	2.65	200	14.5	55	6.77	300	–	–	0.77	0.18	–	0.56	0.47
LIHH	0.23	8	31.5	140	103	158	1.26	267	1.25	267	1.27	200	3.27	0.44	1.36	1.01	0.01	0.04	1.01
HRJB	0.29	26	181	180	<	–	20.1	200	12.0	267	8.66	267	–	–	6.34	1.68	–	0.07	0.72
AIAC	0.32	50	503	150	<	–	<	–	46.3	267	8.33	600	–	–	15.96	–	–	0.09	0.18
DBAP	0.34	15	124	240	<	–	4.92	300	2.45	800	<	–	–	–	3.61	2.01	–	0.02	–
CBCC	0.40	10	16.5	1600	<	–	3.92	150	1.95	300	8.10	100	–	–	0.41	2.02	–	0.12	4.16
CBCL	0.28	9	209	45	74.0	320	5.22	89	7.55	77	0.47	600	0.35	0.26	7.44	0.69	0.10	0.04	0.06
CFBI	0.33	14	733	80	<	–	2.38	600	28.5	67	7.40	267	–	–	22.05	0.08	–	0.04	0.26
SRTI	0.40	12	117	246	<	–	13.2	200	4.37	600	NA§	–	–	–	2.9	3.02	–	0.04	–
IRSR	0.29	10	37.4	631	<	–	5.33	160	10.6	100	6.88	114	–	–	1.29	0.50	–	0.28	0.65
BBGC	0.04	10	692	174	<	–	16.3	150	4.07	600	5.03	400	–	–	155.8	4.01	–	0.01	1.24
CKBP	0.39	21	98.4	150	<	–	59.2	134	88.4	90	10.7	300	–	–	2.51	0.67	–	0.90	0.12
APCP	0.46	11	46.3	237	<	–	4.66	250	18.5	63	0.95	1000	–	–	1.01	0.25	–	0.40	0.05
BBMB	0.25	13	34.0	265	17.0	2100	4.96	115	4.22	1324	NA	–	0.50	0.07	1.34	1.18	0.25	0.12	–
GBHR	0.24	9	71.4	169	82.9	510	1.77	160	2.83	100	1.25	400	1.16	0.35	3.03	0.63	0.03	0.04	0.44
MBEM	0.32	10	377	76	91.8	390	1.40	300	7.70	91	31.6	51	0.24	0.29	11.78	0.18	0.08	0.02	4.11
OSBJ	0.29	9	27.0	161	400	130	2.74	200	8.21	90	11.8	172	14.79	1.37	0.93	0.33	0.02	0.30	1.44
LJLJ	0.27	11	30.5	380	360	100	1.86	200	4.66	81	69.9	29	11.81	1.31	1.11	0.40	0.01	0.15	15.00
NBWJ	0.24	11	61.4	120	295	146	2.74	150	2.05	267	6.51	175	4.80	1.25	2.6	1.33	0.01	0.03	3.17
SPFP	0.29	16	49.6	730	<	–	2.42	300	1.21	600	4.88	500	–	–	1.72	2.00	–	0.02	9.79
SCFP	0.27	9	68.8	304	189	200	1.56	300	27.2	35	86.6	20	2.75	0.71	2.59	0.06	0.14	0.40	3.18
SLSL	0.31	9	23.2	276	112	136	<	–	10.9	34	19.4	35	4.86	0.37	0.75	0.00	0.10	0.47	1.78
PGLP	0.29	13	50.7	270	<	–	<	–	6.44	300	67.7	31	–	–	1.73	0.00	–	0.13	10.52
SFSM	0.22	10	27.3	138	322	70	3.35	111	7.07	53	2.01	150	11.78	1.43	1.22	0.47	0.02	0.26	0.28
SFEM	0.29	17	45.1	462	<	–	1.34	1000	15.9	84	23.9	81	–	–	1.55	0.08	–	0.35	1.50
FIEL	0.31	9	50.7	81	118	200	2.31	160	18.4	36	64.8	23	2.32	0.38	1.63	0.13	0.16	0.36	3.52
BBBE	0.26	9	32.3	402	177	96	1.89	115	17.0	26	53.3	24	5.47	0.68	1.24	0.11	0.10	0.53	3.14
HMBJ	0.20	10	45.1	110	313	74	11.9	74	15.1	73	44.8	42	6.94	1.53	2.21	0.79	0.05	0.33	2.97
SGSG	0.38	9	1994	88	122	288	1.64	500	20.5	49	89.9	19	0.06	0.32	52.84	0.08	0.17	0.01	4.39
YHYH	0.25	10	172	54	<	–	NA	–	NA	–	49.6	27	–	–	6.94	–	–	–	–
CRSJ	0.32	9	144	139	268	216	2.86	300	24.2	60	12.7	63	1.86	0.83	4.44	0.12	0.09	0.17	0.53
GHWJ	0.31	11	27.5	632	280	144	2.29	200	9.18	100	7.29	172	10.16	0.90	0.88	0.25	0.03	0.33	0.79
WIPP	0.24	12	76.2	510	<	–	8.58	120	10.3	100	4.85	200	–	–	3.22	0.83	–	0.13	0.47

*Pu°; The sum of ^{239}Pu and ^{240}Pu unless otherwise noted.

† <; Data that are below the detection limit.

‡–; Precision could not be calculated because the result was below the detection limit.

§NA; Samples not analysed for these radionuclides.

¶All results reported here were obtained after chemical separation and β counting, a method that achieves lower detection limits than those obtained by direct α counting.

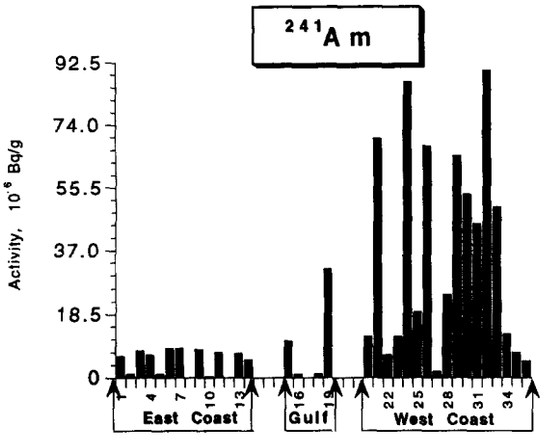

Fig. 2 Bar chart showing the activity of ^{241}Am in Bq $g^{-1} \times 10^{-6}$ (on the vertical axis) displayed as a function of site location (horizontal axis) given in a geographical order from the north of the East Coast through the Gulf of Mexico and ending in the Pacific Northwest. The correspondence between site numbers, site names and acronyms is given in Table 1.

As expected for a naturally occurring radionuclide, ^{40}K concentrations show small spatial variation.

For the activation products and ^{7}Be, averages and medians were not calculated because only a few of the data points were above the detection limits. In most cases, several months elapsed between collection time and analysis of the samples, explaining why ^{7}Be ($T_{1/2}$ = 53.4 days) and other relatively short-lived radionuclides were rarely measured in our samples. With the exception of Fraser Point, all the detectable spikes of short-lived activation products (Table 2) appear at sites located close to known nuclear facilities.

For ^{241}Am, the medians are comparable for samples collected on both East and Gulf Coasts (7×10^{-6} and 6×10^{-6} Bq g^{-1}, respectively), but different from the medians found in bivalves collected along the West Coast (24×10^{-6} Bq g^{-1}). Using the nonparametric Kruskal–Wallis test, it appears that the difference between activities of samples collected on the West Coast and on the other coasts of the US is significant ($p < 0.05$). Along the Pacific Coast, the activities of this radionuclide (Fig. 2) display a clear geographic pattern, with the maximal activity being measured in Northern California near Point Saint George (CA). In addition to this general pattern, isolated high values are present in other locations along the Californian Coast near Point La Jolla (~ 70×10^{-6} Bq g^{-1}), Santa Cruz Island (~ 87×10^{-6} Bq g^{-1}), Monterey Bay (~ 68×10^{-6} Bq g^{-1}), and the Farallon Islands (~ 65×10^{-6} Bq g^{-1}). Activities are fairly variable along the Gulf Coast where two sites, located near Cedar Key (FL) and Matagorda Bay (TX), show concentrations as high as ~ 11 and ~ 32×10^{-6} Bq g^{-1}, respectively. Along the East coast, values are almost uniformly low.

The median of the concentrations reported for $^{239+240}Pu$ (Tables 2 and 3) is lower for the Gulf (~ 8×10^{-6} Bq g^{-1}) than for the other coasts (~ 11×10^{-6} Bq g^{-1}). However the Kruskal–Wallis test shows that the difference is not statistically significant at the 5% level. Along the Gulf of Mexico, the oysters collected near Cedar Key (FL) display the highest activity (~ 88×10^{-6} Bq g^{-1}) measured in our data set, explaining why the average value is so high compared to the median value. Along the East Coast, several high values are also observed (Stover Point in Maine, 47×10^{-6} Bq g^{-1}; Duxbury Bay in Massachusetts, ~ 27×10^{-6} Bq g^{-1}; Absecon Inlet in New Jersey, ~ 46×10^{-6} Bq g^{-1}; and Cape Fear in North Carolina, ~ 29×10^{-6} Bq g^{-1}). Along the West Coast, $^{239+240}Pu$ activities are low, displaying a geographical distribution similar to what was observed for ^{241}Am with a maximum located in Northern California and high spikes at other locations of the Californian Coast. In particular, like for ^{241}Am, the bivalves collected near Santa Cruz Island–Fraser Point (CA) display the highest $^{239+240}Pu$ activity (~ 27×10^{-6} Bq g^{-1}) on the Pacific Coast.

^{238}Pu concentrations (Tables 2 and 3) are generally low on all three coasts (median of all the values is ~ 3×10^{-6} Bq g^{-1}) and no statistically significant difference is detected among the means for these coasts. However, six locations (Jamaica Bay, NY; Savannah Estuary, GA; Biscayne Bay, FL; Cedar Key, FL; Humboldt Bay, CA; and Whidbey Island, WA) show relatively high concentrations (from ~ 8.6 up to ~ 59×10^{-6} Bq g^{-1}).

Because analysis after radiochemical separation (see the Appendix) achieves a lower detection limit, only β counting results are displayed for ^{137}Cs (Tables 2 and 3). In this case, the values obtained for medians and averages calculated using the complete data set were very similar (~ 190 and ~ 200×10^{-6} Bq g^{-1}, respectively). On the West Coast, higher concentrations (up to 400×10^{-6} Bq g^{-1} at Oceanside, CA) are frequently observed resulting in higher median and average values. The use of the Kruskal–Wallis test reveals that the West Coast activities are significantly different from those of the other coasts ($p < 0.05$).

About 70% of the values reported for ^{90}Sr are below 100×10^{-6} Bq g^{-1} (Tables 2 and 3). Along the West

TABLE 3

Distribution of averages and medians of the radionuclide activities ($\times 10^{-6}$ Bq g^{-1}, except $\times 10^{-2}$ Bq g^{-1} for ^{40}K).

	^{238}Pu		$^{239+240}Pu$		^{241}Am		^{90}Sr		^{137}Cs		^{40}K	
	Average (SD)	Median	Average (SD)	Median	Average (SD)	Median	Average (SD)	Median	Average (SD)	Median	Average (SD)	Median
Total	6 (11)	3	15 (17)	11	22 (27)	8	180 (360)	51	200 (110)	190	29 (7)	29
East	6 (6)	5	16 (16)	11	6 (3)	7	200 (250)	87	140 (60)	150	30 (9)	30
Gulf	14 (25)	5	24 (36)	8	11 (14)	6	130 (140)	71	64 (40)	83	33 (9)	32
West	3 (3)	2	12 (8)	11	36 (31)	24	170 (470)	50	250 (100)	270	28 (4)	29

Coast, the geographic distribution of the activities exhibits a weaker but similar pattern to what has been observed for ^{241}Am. Only one very high value was obtained, near Crescent City–Point Saint George in California (1994×10^{-6} Bq g^{-1}). Along the East Coast, values above 100×10^{-6} Bq g^{-1} are frequent (86% of the data), reaching 733×10^{-6} Bq g^{-1} near Cape Fear (NC). Along the Gulf Coast, the site located in Matagorda Bay (TX) displays the highest activity measured in this area (377×10^{-6} Bq g^{-1}). For ^{90}Sr, no significant difference was observed among the coasts.

In summary, although the variability is very high, the data suggest that the geographical distribution of the radioisotopes varies from one coast to the other for a few radionuclides. In particular, relative to the other US coasts, the West Coast is characterized by higher activities of ^{241}Am and ^{137}Cs.

In the central part of the West Coast (Fig. 2), elevated activities of ^{241}Am were previously observed in the EPA MWP70s. At that time, it was hypothesized that the enrichment in fallout radionuclides was related to the California current and to the associated upwelling of intermediate waters (Goldberg *et al.*, 1978, 1983; Farrington *et al.*, 1983). In the ocean, americium and cadmium exhibit a surface depletion and an enrichment at intermediate depths (Volchok *et al.*, 1971; Livingston *et al.*, 1984). Upwelling of these intermediate waters to the surface would expose organisms to higher concentrations of certain radionuclides and cadmium than are normally found in areas with no upwelling. In the MWP70s study (Goldberg *et al.*, 1983), and in previous NS&T studies (O'Connor, 1990, 1992), high concentrations of cadmium found in the bivalves collected along the central part of the West Coast could support the upwelling hypothesis formulated for the radionuclides.

Isotopic ratios

Isotopic ratios are often used to trace the origin and fate of isotopes in the environment. In our study as well as in the EPA MSW70s study, due to the very low activities measured in the samples, large uncertainties were reported for some of the radionuclide measurements. Consequently, an even larger uncertainty will be associated with the ratio of these activities. It is, however, interesting to note that similar observations can be derived from the data generated in both the EPA and NOAA studies. For example, in the 1990 study, ^{241}Am to $^{239+240}$Pu ratios (Table 2, Figs 3 and 4) are approximately one order of magnitude lower in samples from the East and Gulf Coasts (medians = 0.38 and 0.28, respectively) than in those from the West Coast (median = 3; maximum = 15). Using the Kruskal–Wallis test, the differences between the West Coast median and each of the other coasts (East and the Gulf Coasts) medians are significant at the 0.05 confidence level. Previously, in the EPA MSW70s programme (Goldberg *et al.*, 1978, 1983; Farrington *et al.*, 1983), a similar difference between the West Coast (median = 1.70; maximum = 6.10 and the East and Gulf coasts (median = 0.45 and 0.40, respectively) was observed. These high Pacific ratios could result from a different fractionation of the two nuclides in the marine environment (Noshkin & Bowen, 1975). Livingston & Bowen (1976) have observed that ^{241}Am sinks faster in the ocean than $^{239+240}$Pu, and that the ^{241}Am/$^{239+240}$Pu ratio generally increases in deeper waters and sediments. In the 1970s, the high ratios observed along the Pacific Coast were explained by the upwelling of intermediate Pacific waters. Accumulation of ^{241}Am from the decay of its parent isotope ^{241}Pu ($T_{1/2}$ = 14.9 years), is also adding ^{241}Am to the environment. However, this process should not yield ^{241}Am/$^{239+240}$Pu ratios greater than 0.32 before the year 2000 (Livingston *et al.*, 1975, 1984; Livingston & Bowen, 1976). Very low ratios of ^{241}Am/$^{239+240}$Pu exist at a few sites along the East and Gulf coasts. For example (Table 2, Figs 3 and 4), in Massachusetts (near Stover Point and near Deer Island), the ratio is about 0.10 and in Chesapeake Bay (near Calvert Cliff) the ratio is only 0.06. As mentioned above, these differences could merely be due to the large variance in the measurement of the nuclides. However, it is interesting to note that in the EPA MWP70s study, low ratios were found in the same locations, Massachusetts and Chesapeake Bay. In particular, the low ratios observed in both the NOAA and the EPA studies in Massachusetts were associated with high concentrations in the plutonium isotopes. In the 1970s, it was hypothesized that, in this case, the bivalves could have been affected by a fresh input of long-lived plutonium coming from the effluents of a near-by nuclear reactor (Goldberg *et al.*, 1978).

Finally, differences in the isotopic ratios are observable when comparing the different bivalve species (Fig. 4). For example, along the East Coast, ^{241}Am/$^{239+240}$Pu, ^{238}Pu/$^{239+240}$Pu, $^{239+240}$Pu/^{137}Cs, ^{90}Sr/^{137}Cs, and ^{90}Sr/^{40}K ratios are generally lower in mussels (*M. edulis*) than in oysters (*C. virginica*). However, the only statistically significant difference is observed for the $^{239+240}$Pu/^{90}Sr ratio that are lower in oysters than in mussels. This difference may be explained by differences in habitat and/or by differences in bioaccumulation of the various isotopes by the two species. The fact that mussels generally live along the Northeast Coast, attached to hard siliceous substate, off the sea bottom sediments, whereas oysters live mostly along the Southeast Coast, directly on the bottom where they are exposed to a larger load of particles often rich in carbonates, may explain the differences observed between the two species. Differences are also observed between the two species of mussels living along the West Coast. For example, ^{241}Am/$^{239+240}$Pu, $^{239+240}$Pu/^{137}Cs, ^{90}Sr/^{137}Cs, and ^{90}Sr/^{40}K ratios are generally lower in *M. edulis* than in *M. californianus*, but this difference is significant only for the ^{241}Am/$^{239+240}$Pu ratios. Here too, the difference between the two species could be attributed to either a difference in bioaccumulation capability of the two species or to a difference in the marine habitat (high-energy environments located along open coast and in areas exposed to upwellings, for *M. californianus* vs more protected areas for *M. edulis*).

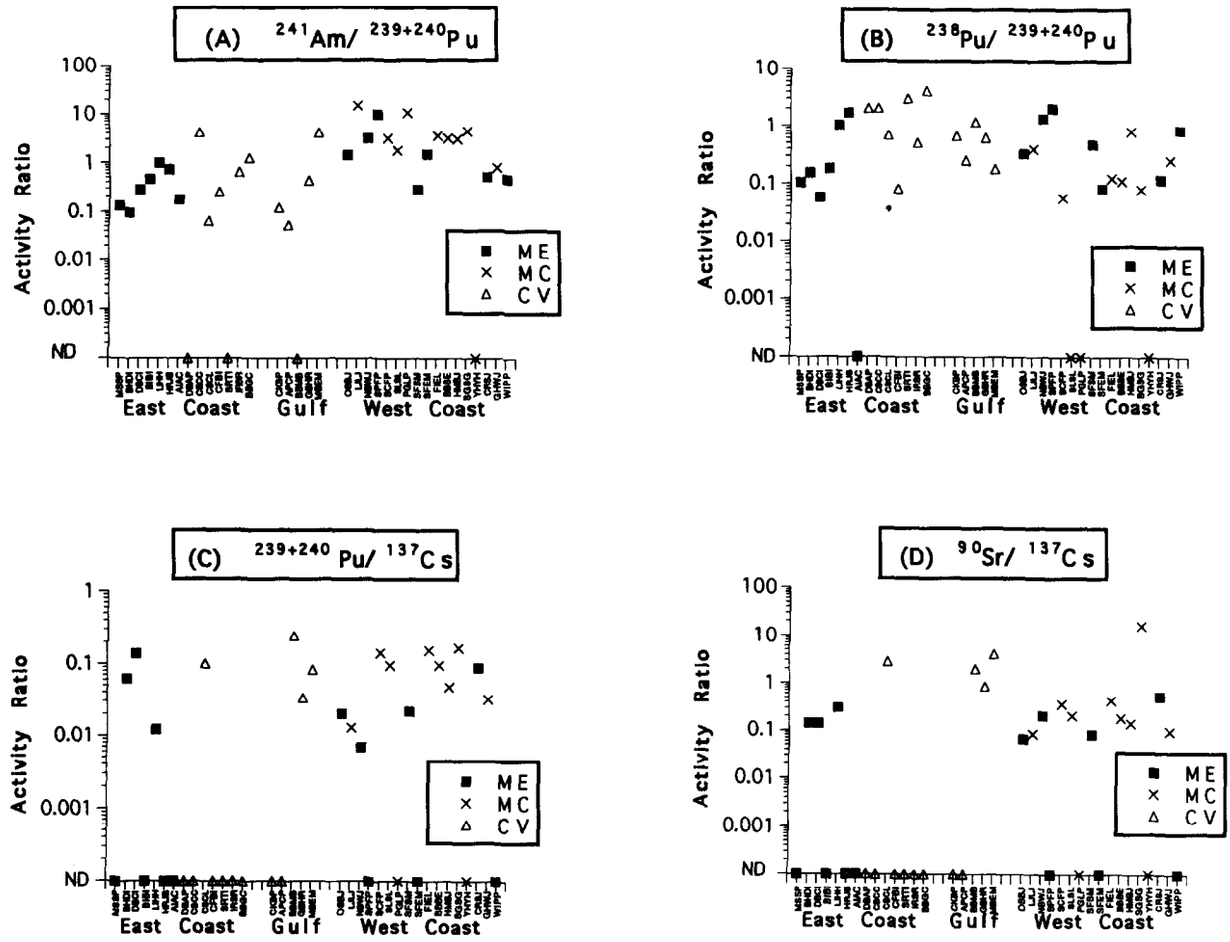

Fig. 3 Plots showing the isotope activity ratios (vertical axes, log scale) obtained for the NOAA NS&T Program displayed in a geographical order (horizontal axes) from the north of the East Coast through the Gulf of Mexico and ending in the Pacific Northwest. The correspondence between site names and acronyms is given in Table 1. The various symbols represent the different species of mollusc used in the study: ME = *Mytilus edulis*; MC = *Mytilus californianus*; CV = *Crassostrea virginica*. A, $^{241}Am/^{239+240}Pu$ ratio; B, $^{238}Pu/^{239+240}Pu$ ratio; C, $^{239+240}Pu/^{137}Cs$ ratio; D, $^{90}Sr/^{137}Cs$ ratio.

Temporal trends in the radioactivity of the coastal USA

The present study not only makes it possible to document the status of the radioactive contamination in the coastal waters of the US but, by comparing the results obtained in this study with the EPA MWP70s results, allows also for trend analysis over the last 15 years or so. In the absence of major new inputs, the concentrations of most of the isotopes would be expected to decrease over the years in the near coastal environment as a combined result of: (a) declining input from the stratosphere; (b) burial in shallow depositional sediments; (c) dispersion, dilution, and removal to other more remote environmental sinks such as deep ocean water or sediments; and (d) physical decay. The decrease in input of fallout radionuclides has been documented in undisturbed sediment cores, where the large peak in concentration of fallout radionuclides associated with the 1950s and early 1960s bomb tests declines rapidly in recently deposited surficial sediments (Noshkin & Bowen, 1973, 1975; Olsen *et al.*, 1981a,b; Bopp *et al.*, 1982). Consequently, when comparing NOAA and EPA data, lower activities are expected in the 1990 NOAA data.

When comparing two sets of data obtained by two different laboratories at two different times (about 15 years apart), technical differences that obscure the interpretation of the results can be expected. With this in mind, we have compared our results with those of the EPA MWP70s in order to see if there are differences in the concentrations of ^{241}Am, $^{239+240}Pu$, ^{238}Pu, and ^{137}Cs, the only radionuclides that were consistently analysed in both programmes. In general, the MWP70s study consisted of one analysis per year in each of the three consecutive years, 1976, 1977, and 1978 (Goldberg *et al.*, 1978, 1983; Farrington, 1983; Farrington *et al.*, 1983; Palmieri *et al.*, 1984) whereas our data represent one analysis for 1990. Consequently, the two sets of data are not absolutely equivalent. However, by comparing for each site the mean of the EPA MWP70s data with the 1990 NS&T data, we were able to test if the results obtained for the period 1976–1978 are different from those obtained in 1990 (Table 4, Fig. 5).

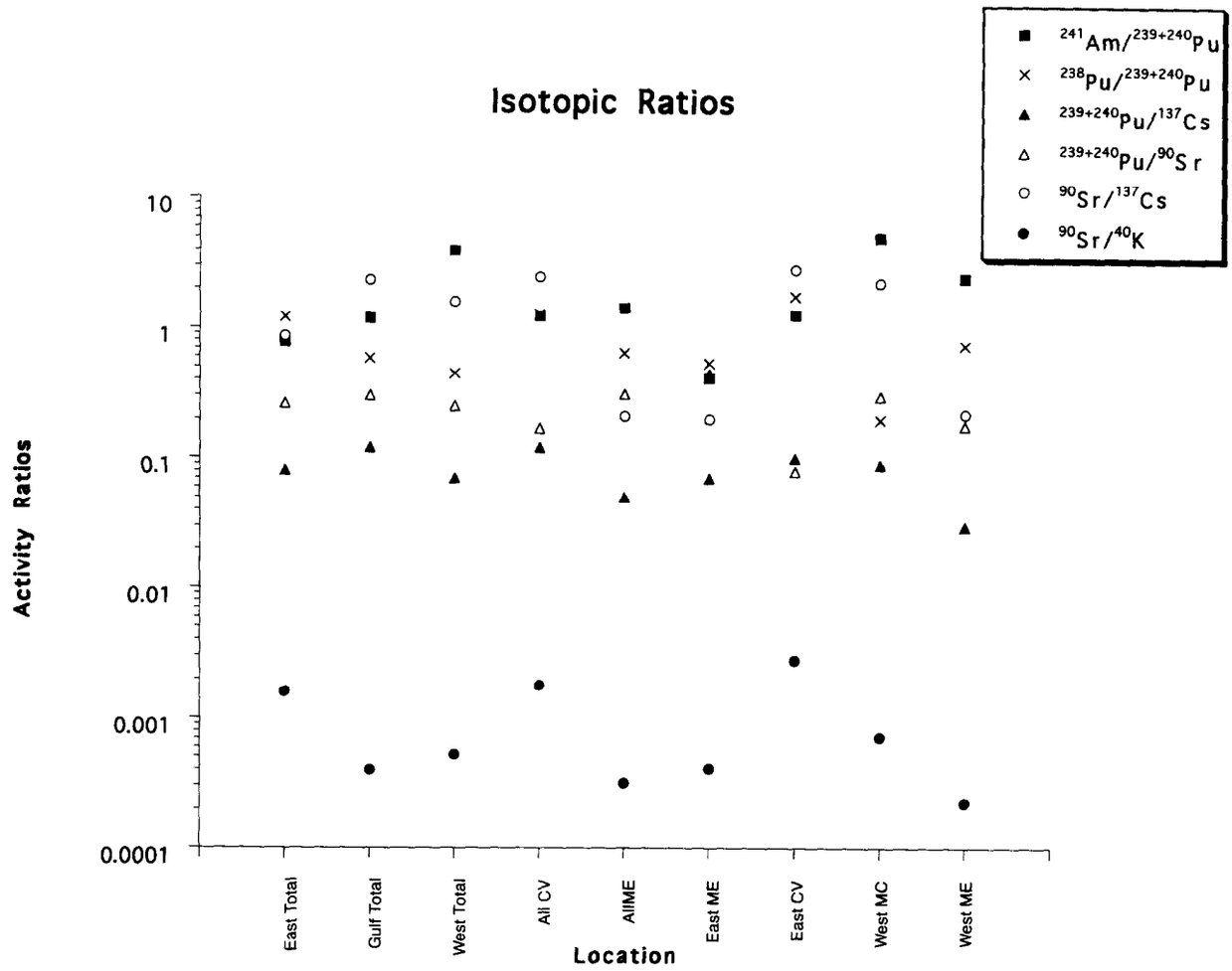

Fig. 4 Plot displaying a summary of the isotope activity ratios (vertical axis, log scale) for the NOAA study. Each point represents the average obtained for each category displayed along the horizontal axis. East Total, average of all the results obtained for the East Coast. Gulf Total, average of all the results obtained for the Gulf Coast. West Total, average of all the results obtained for the West Coast. All CV, average of all the results obtained for *Crassostrea virginica* around the country. All ME, average of all the results obtained for all *Mytilus edulis*. East ME, average of all the results obtained for *Mytilus edulis* along the East Coast. East CV, average of all the results obtained for *Crassostrea virginica* along the East Coast. West MC, average of all the results obtained for *Mytilus californianus* along the West Coast. West ME, average of all the results obtained for *Mytilus edulis* along the West Coast. Different symbols were used for different ratios.

TABLE 4

Comparison of the averages (SD) and medians calculated for NS&T and MWP70s data ($\times 10^{-6}$ Bq g^{-1}).

	^{238}Pu		^{241}Am		$^{239+240}$Pu		^{137}Cs	
	NS&T	EPA*	NS&T	EPA*	NS&T	EPA*	NS&T	EPA*
Average East	6 (6)	1.3 (0.7)	6 (3)	9 (6)	16 (16)	34 (18)	140 (60)	630 (340)
Median	5	1.2	7	7	11	33	150	630
Average Gulf	14 (25)	2.2 (2.2)	11 (14)	4 (2)	24 (36)	25 (22)	64 (40)	550 (900)
Median	5	1.3	6	7	8	32	83	630
Average West	3 (3)	1.3 (0.7)	36 (31)	63 (70)	12 (8)	33 (24)	250 (100)	400 (220)
Median	2	1.1	24	36	11	20	270	470
Average US	6 (11)	1.4 (1.1)	22 (27)	36 (60)	15 (17)	32 (22)	200 (110)	540 (270)
Median	3	1.2	8	13	11	27	190	530

*EPA MWP70s.

Between the mid 1970s and 1990, an increase in ^{238}Pu activity (Fig. 5A) can be observed. The Sign Test indicates that this difference between the two studies is statistically significant ($p < 0.001$). At several sites, the 1990 ^{238}Pu results are almost one order of magnitude greater than the results obtained in the 1970s, suggesting that this isotope may behave in a different manner than expected. Because concentrations reported by both EPA and NOAA are extremely low, very close to the detection limits, the precision of the data is low (the coefficient of variation reaches 300% in some cases for our results and up to 200% for the 1970s study). This ^{238}Pu increase is believed to be an artefact due to differences in the analytical techniques used in the two studies (the early data could be too low or our data could be too high). Although it is impossible to verify the results acquired more than 15 years ago, it will be possible to verify our data by repeating the survey as soon as possible and by using replicate analyses. In the meantime, great prudence must be exercised when interpreting these data and new analyses are necessary to sort out analytical uncertainties from real differences.

For $^{239+240}$Pu, when comparing the averages (Fig. 5C), a significant decrease has been observed ($p < 0.1$).

In 17 cases out of 28, ^{241}Am is lower in the 1990 study than in the mid 1970s study (Table 4, Fig. 5B). The Sign Test, however, shows that this difference is not statistically significant ($p < 0.5$).

In all the cases, radiocesium (^{137}Cs) activities are also significantly lower (Fig. 5D) in 1990 than in the mid-1970s ($p < 0.01$). Between the mid-1970s and 1990, ^{137}Cs activities have decreased by up to a factor of 8 (Table 4), reflecting the very rapid burial and the shorter half-life of ^{137}Cs compared to the other radioisotopes ($T_{1/2} = 30$ years for ^{137}Cs compared with 6580 years for ^{240}Pu, 24 400 years for ^{239}Pu, and 458 years for ^{241}Am).

In summary, except for the ^{238}Pu results, it appears that the radionuclide activities are often lower in 1990

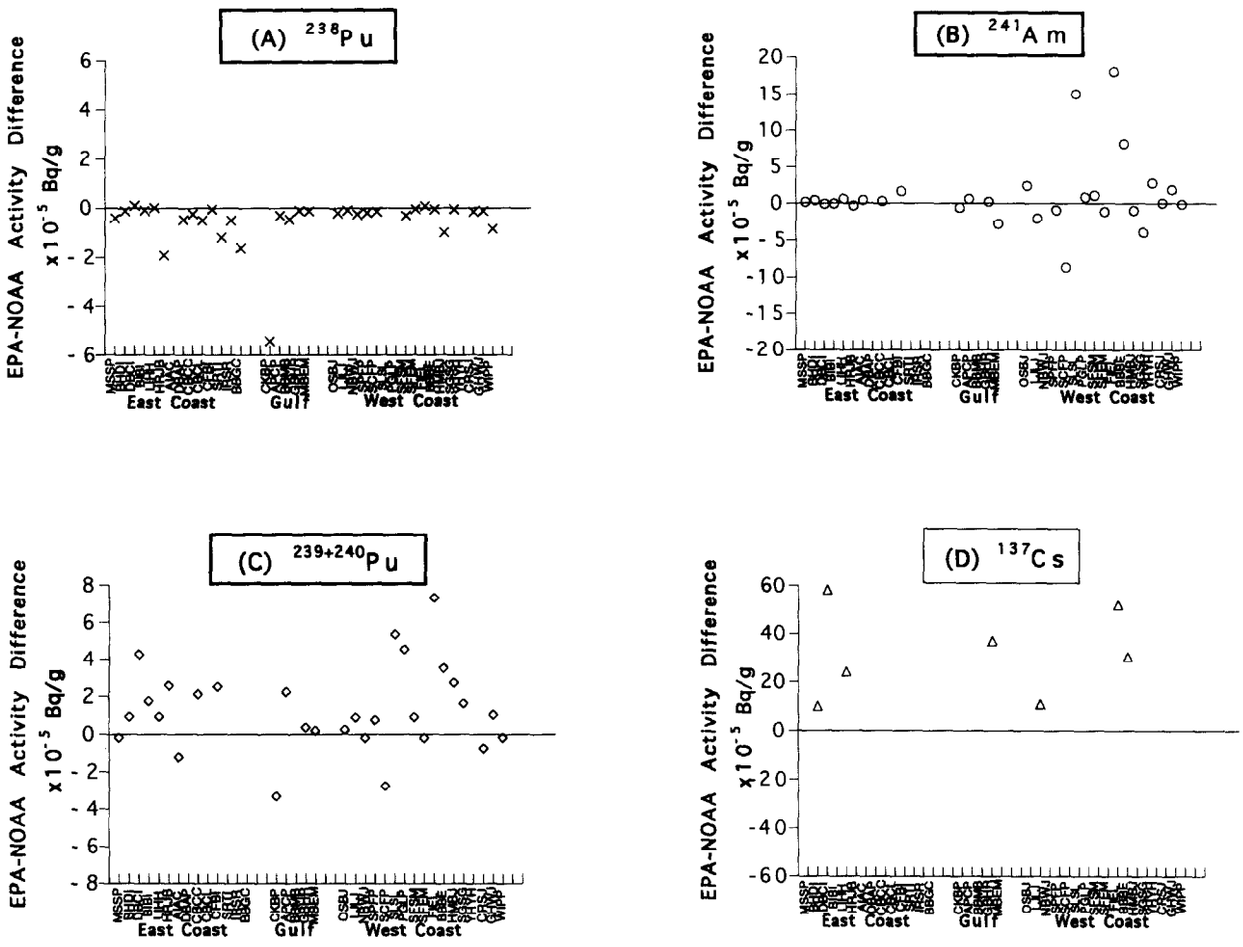

Fig. 5 Plot showing the geographical distribution (horizontal axes) of the difference in activity (vertical axes, Bq $g^{-1} \times 10^{-5}$) of the radioisotopes measured in the MWP70s and in the NOAA NS&T studies. At each site, the results are expressed as the difference between the mean of EPA's activities (1976, 1977, 1978) minus NOAA's activities. The horizontal zero line represents no difference between the two studies. The points lying above the zero line represent sites for which 1970s activity was higher than 1990s activity. Conversely, the points lying under the zero line represent sites for which 1970s activity was lower than 1990s activity. A, comparison for ^{238}Pu; B, comparison for ^{241}Am; C, comparison for $^{239+240}$Pu; D, comparison for ^{137}Cs.

than in the mid-1970s, clearly exhibiting the same decreasing trend observed in most coastal sediments.

Conclusion

The results obtained in this study show that over the last 15 years, $^{239+240}$Pu, and ^{137}Cs concentrations in bivalves have decreased significantly and that in many cases the ^{241}Am activities are also lower in 1990 than in the mid-1970s. These decreases reflect the ban on atmospheric nuclear testing and the decrease of fallout radionuclides in the environment. The new data, like the results obtained for the period 1976–1978, show that ^{241}Am activities are higher in samples collected along the West Coast than in bivalves sampled at other locations. Previous studies have related this observation to the upwelling of intermediate Pacific waters associated with the California Current. In this study, a few spikes of activation products were detected in the vicinity of nuclear power plants. In general, the radionuclide activities measured at the 36 sites studied along the coasts of the US are low.

Differences in the radionuclide activity of bivalves collected in the coastal US can be explained by differences in fractionation among radionuclides in the marine environment, by ingrowth of ^{241}Am from ^{241}Pu decay, by local input of radioisotopes associated with nuclear power plants, and by exposure/bioaccumulation differences observed not only between oysters and mussels, but also between various species of mussels.

The authors are grateful to the NOAA Oxford Laboratory, the Maryland Department of Natural Resources, Battelle, and Texas A&M University for their assistance in collecting and preparing the bivalves used in this study. Many thanks to Douglas Wolfe (NOAA) for providing invaluable information on the environmental behaviour of radionuclides and for criticizing this manuscript in a very constructive way. The authors gratutide is expressed to Andrew Robertson (NOAA) for the numerous reviews of this manuscript and for his helpful comments. Finally, the authors want also to thank Thomas O'Connor (NOAA) for reviewing this manuscript and Jeffrey Fritsen (Versar) for providing reference documentation.

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Appendix: Analytical Method (after TMA/NORCAL 1991-1992)

Once mollusc soft tissues were received by the analytical laboratory, the samples were redried, reweighed, classed, and ashed at 425°C. After the ashing step was completed, the entire sample was placed into either a 100 ml jar or a 15 ml petri dish for γ counting. The geometries were double-checked to verify accurate and current calibrations. Counting was performed with high-resolution, low-background γ spectrometers. High-purity germanium (HPGe) detectors were used to analyse for ^{7}Be, ^{40}K, ^{58}Co, ^{60}Co, ^{65}Zn, ^{110}Ag, and ^{137}Cs. The typical background for ^{60}Co was about 0.08 count per minute (cpm) and for ^{137}Cs, the typical background was about 0.07 cpm. A standard nuclear data peak search routine (ND6620) was used to identify γ emissions, and calculations were done using a TMA/Norcal program, which was double-checked by the staff. This included: verifying data inputs (e.g. aliquot, reference time, geometry, etc.), reviewing the automated peak search routine, verifying peak subtraction, and double-checking the peak library to verify that all the isotopes present in the sample were accounted for.

After γ counting, the ashed material was dissolved and ^{241}Am, $^{239+240}Pu$, ^{238}Pu, ^{137}Cs, and ^{90}Sr were chemically separated. Techniques used to quantify the radionuclides of interest are discussed in Wessman *et al.* (1971, 1977, 1978). Because of the high sensitivity needed for the analysis, sequential determination was performed. A brief discussion of the methods used for chemical separations and counting follows (after TMA/Norcal, 1991, 1992).

After an initial leaching with nitric acid (HNO_3) and hydrogen peroxide, the samples were filtered and the filters were ashed and dissolved using a mixture of concentrated hydrofluoric acid (HF)+HNO_3+hydrochloric acid (HCl). All dissolution fractions were combined, dried, and dissolved in 8 M HNO_3.

Aliquots (80% of the total solution) were taken, ^{242}Pu and ^{243}Am tracers and a yttrium carrier were added, and the solutions were equilibrated and the volume of the 8 M HNO_3 solution reduced.

Plutonium was initially extracted from the sample in a nitric acid solution on a large-scale AG 1×8 anion resin column and eluted with HNO_3+HF. The eluant was then further purified on a second small scale nitrate column of AG 1×8 anion resin. The purified fraction was electro-deposited onto a 1 in. stainless-steel disc and submitted for α spectrometry. Each α spectrum was obtained from one of the 26 solid-state 450 mm^2 surface barrier diodes used by TMA/Norcal. Each detector utilizes 256 channels in a Nuclear Data ND66 computer controlled multichannel analyser system. The sample was counted for at least 1000 min with the spectra collected in 256 channels over the 3.6–7.00 MeV energy region. Energy calibration sources were counted before and after the sample to set peak integration limits. A background measurement and evaluation programme was maintained for each detector, with backgrounds ranging usually from 0.0005 to 0.004 cpm within the regions integrated for the spectrometric analysis. The efficiencies varied from 24 to 33%.

Strontium-90 was analysed by isolating the ^{90}Y daughter product ($T_{1/2}$=64 h) and β counting up to five times over a period of 2 weeks. A least squares regression was used to calculate ^{90}Y at separation and equilibrium was assumed in the calculation of ^{90}Sr activity. Chemical purification was performed using DDCP (*n,n*-diethyl dicarbamoyl phosphonate) extraction out of the column load fraction from the initial Pu column. The yttrium was back-extracted into dilute HNO_3. Hydroxide, fluoride and oxalate precipitations were performed for further purification. A mixed nitric acid+alcohol anion column was run to separate the Am species which had been carried with the yttrium to this point. Further precipitations were performed and the purified yttrium fraction was mounted on a planchet as an yttrium oxide (Y_2O_3), weighed for chemical recovery, and β counted on a gas flow proportional detection system. The yttrium planchets mounted for ^{90}Sr analysis had default counting instructions for a 200 min first count. In actuality, the great majority had a 400 min first count. This first count was used in determining the detection limit. Counts of 100–200 min were repeated until the count rate dropped below 0.2 counts per minute (cpm) or the count rate became indistinguishable from the background. The interval of counting varied from 1 to 3 days. Most samples received only two or three total β counts since their activities were low. The β counting is described further under the cesium section.

Because the γ counting of the samples for ^{137}Cs generally gave values close to or below detection limits, ^{137}Cs was analysed by β counting after radiochemical purification in the 19 samples for which there was enough material left. In these cases, the remaining sample aliquot (20% of the original sample) was taken, cesium carrier added, and the solution adjusted to a pH of 1.0. The cesium fraction was carried on ammonium molybdophosphate crystals, dissolved in a basic EDTA solution, and run through a Biorex-40 cation exchange column. The dilute HCl eluant was concentrated and further purified by precipitation of cesium silicotungstate and, finally, cesium chloroplatinate. This precipitate was mounted, weighed for recovery, and submitted for β counting. Each ^{137}Cs measurement was performed on one of the 14 low background Geiger detectors on-line. The backgrounds were approximately 0.5 cpm and the data from each detector were corrected for individual differences in detector sensitivity. The system was directly connected to the PDP 11/84 computer for data acquisition and transfer. The nominal efficiency for ^{137}Cs, including self-absorption effects for precipitate thickness, was approximately 35%.

A very strict quality assurance programme (QAP) was applied during these analyses. In particular all the chemical separations were performed in a 'low level laboratory', which is restricted to samples with activity ranging from zero to a few Becquerels (Bq). In addition, environmental and 'zero level' samples were treated in dedicated modules inside the low level laboratory. Special coats, equipment, material, and reagents were

reserved for this area. In particular, brand-new glassware and Teflon containers were used for this project. Cross contamination was prevented by segregating the samples by activity level upon their arrival in the laboratory.

'Laboratory Intercomparison Studies Program' for various matrices, including α, β, and γ emitter isotopes, were routinely performed. Standards from the National Institute of Standards and Technology (NIST), the United Kingdom Atomic Energy Authority (UKAEA), and others were processed on a routine basis. Finally, TMA/Norcal had participated in several collaborative programmes of procedure testing and standardization of reference material.

CITY OF EUREKA
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January 17, 2014

Mr. Dan Berman, Director of Conservation
Humboldt Bay Harbor, Recreation and Conservation District
P.O. Box 1030
Eureka, CA 95502-1030

RE: Humboldt Bay Power Plant Canal Remediation Project

Dear Mr. Berman,

On December 16, 2013, the Community Development Department, Planning Division, received a request from the Humboldt Bay Harbor District for comments on the Initial Study (IS) and Draft Mitigated Negative Declaration (MND) for the above mentioned project. Below please find our comments.

Sediment and Construction Debris Removal (pages 2-5 through 2-7): According to the IS, the project will require the excavation, removal and transport to licensed disposal/recycling facilities (via almost 1,000 haul truck trips) of up to: 9,000 yd^3 of contaminated sediment and an unspecified amount of riprap from the intake and discharge canals; 4,000 yd^3 of demolished concrete from the intake structure; and an unspecified amount of discharge headwork appurtenances, sediment, riprap, and pipe from demolition of the discharge structure. For the above:

(a) The specific disposal and recycling facilities to receive this debris must be identified;

(b) Any haul routes through the City must be mapped;

(c) The number of daily haul truck trips on these routes must be identified; and

(d) The peak hour traffic impacts of these truck trips on City streets, the noise impacts of these truck trips on the City's sensitive noise receptors, and the potential health hazards on City residents associated with the hauling of contaminated/radioactive materials through the City, must be evaluated.

Please feel free to contact me should you have questions regarding this letter.

Sincerely,

Robert Hilman
Associate Planner

Certified mail: 7013 0600 0001 8891 9986

Attachment C
Responses to Comments
for the
Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project
Mitigated Negative Declaration and Draft Initial Study

California Dept. of Fish and Wildlife Comment.

No Response needed

Blue Lake Rancheria Comment:

The requested language change will be incorporated into the final document.

City of Eureka Comment:

Placeholder for Response in progress -

Staff and PG&E are not able to generate a full response in time to include in the meeting agenda packet. A response will be provided in advance of next week's District meeting and reviewed with the commenting agency/individual.

Humboldt Baykeeper Comment:

Placeholder

Response in progress -

Staff and PG&E are not able to generate a full response in time to include in the meeting agenda packet. A response will be available in advance of next week's District meeting and will be reviewed with the commenting agency/individual.

RESOLUTION NO. 2014-02

A RESOLUTION ESTABLISHING FINDINGS RELATIVE TO THE PERMIT APPLICATION BY PACIFIC GAS AND ELECTRIC COMPANY FOR THE HUMBOLDT BAY POWER PLANT INTAKE AND DISCHARGE CANAL REMEDIATION PROJECT, KING SALMON, CALIFORNIA

WHEREAS, the Board of Commissioners of the Humboldt Bay Harbor, Recreation, and Conservation District is empowered by Appendix II of the Harbors and Navigation Code, and its own ordinances and resolutions, to grant permits, leases, rights, and privileges; and,

WHEREAS, no permits, rights, leases, and privileges may be granted without first having considered certain potential impacts and without first having made findings relative to said impacts; and,

WHEREAS, the Board of Commissioners of the Humboldt Bay Harbor, Recreation, and Conservation District has been presented with certain evidence relating to the Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project proposed by Pacific Gas and Electric Company upon the air, land, environment, and ecology of the land under the jurisdiction of the Humboldt Bay Harbor, Recreation, and Conservation District.

NOW, THEREFORE, BE IT RESOLVED by the Board of Commissioners of the Humboldt Bay Harbor, Recreation and Conservation District as follows:

The Board of Commissioners of the Humboldt Bay Harbor, Recreation and Conservation District has found the following to be true and adopts the following findings with respect to the proposed use contemplated by Pacific Gas and Electric Company in Application 13-04 and supplements and amendments thereto:

1. The use proposed by Pacific Gas and Electric Company is necessary to promote the safety, health, comfort, and convenience of the public; and

2. The proposed use, as conditioned by the adopted Mitigated Negative Declaration and associated Mitigation Monitoring and Reporting Program, is consistent with CEQA and there is no substantial evidence the project will have a significant effect on the environment; and

3. The proposed use is consistent with the Humboldt Bay Management Plan; with special relevance to policies HWM-2, HFA-5, CEP-1,2,5-9, HTM-3, CAE-2, and CAE-3; and

4. The proposed use is required by the public convenience and necessity; and

5. The proposed use is reasonably required to promote growth, and to meet area demands, and does not adversely effect the environment or ecology of the area to any substantial degree; and,

6. The proposed use will not produce an unreasonable burden on the natural resources and aesthetics of the area, on the public health and safety, and air and water quality in the vicinity of Humboldt Bay, or on the parks, recreation and scenic area, historic sites and buildings, or archeological sites in the area.

PASSED AND ADOPTED by the Board of Commissioners of the Humboldt Bay Harbor, Recreation and Conservation District at a duly called meeting held on the 23rd day of January 2014, by the following polled vote:

AYES:

NOES:

ABSENT:

_____
MIKE WILSON, President
Board of Commissioners

ATTEST:

_____
PATRICK HIGGINS, Secretary
Board of Commissioners

CERTIFICATE OF SECRETARY

The undersigned, duly qualified and acting Secretary of the HUMBOLDT BAY HARBOR, RECREATION AND CONSERVATION DISTRICT, does hereby certify that the attached Resolution is a true and correct copy of RESOLUTION NO. 2013-08 entitled,

A RESOLUTION ESTABLISHING FINDINGS RELATIVE TO THE PERMIT APPLICATION BY PACIFIC GAS AND ELECTRIC COMPANY FOR THE HUMBOLDT BAY POWER PLANT INTAKE AND DISCHARGE CANAL REMEDIATION PROJECT, KING SALMON, CALIFORNIA

as regularly adopted at a legally convened meeting of the Board of Commissioners of the HUMBOLDT BAY HARBOR, RECREATION AND CONSERVATION DISTRICT, duly held on the 23rd day of January 2014; and further, that such Resolution has been fully recorded in the Journal of Proceedings in my office, and is in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand this 23rd day of January 2014.

_____

PATRICK HIGGINS, Secretary
Board of Commissioners

HUMBOLDT BAY HARBOR, RECREATION AND CONSERVATION DISTRICT

PERMIT

Permit No. 13-04

601 Startare Drive
Woodley Island Marina
P O Box 1030
Eureka, CA 95502-1030

Permittee:

Pacific Gas and Electric Company
Humboldt Bay Power Plant
1000 King Salmon Ave
Eureka Ca 95503

Project:

HUMBOLDT BAY POWER PLANT INTAKE AND DISCHARGE CANAL REMEDIATION PROJECT

The Board of Commissioners of the **Humboldt Bay Harbor, Recreation and Conservation District** hereinafter referred to as "**District",** having considered the Application herein, number 13-04, received by the **District** on July 25th 2013, and **Pacific Gas and Electric Company** hereinafter referred to as "**Permittee**", and the **District** as the lead agency, pursuant to the California Environmental Quality Act of 1970, as amended, having made a determination of a Mitigated Negative Declaration dated January 23rd 2014 and the Board of Commissioners of the **District** having on January 23rd 2014 passed Resolution No. 2014-02 establishing findings relative to the Application by **Permittee** for the development of the **Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project** provided for in this Permit, the Permittee is hereby authorized to implement the **Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project** as more particularly described in the Application filed with the **District** and the Mitigated Negative Declaration referred to above.

You are hereby authorized to implement the **Humboldt Bay Power Plant Intake and Discharge Canal Remediation Project** as described in the Permit Application and the Initial Study and Mitigated Negative Declaration of **Permittee** consisting of:

> Remove sediments contaminated with radionuclides from the intake and discharge canals of the former Humboldt Bay Power Plant to enable termination of the facility's Nuclear Regulatory Commission license. The intake and discharge control structures will be demolished and removed. The discharge canal will be permanently disconnected from Humboldt Bay by removal of the culverts embedded in the rock dike wall. Habitat mitigation and restoration measures are incorporated. The hereby permitted project is described more fully in the Application filed by **Permittee**, and the IS/MND.

That the location of the proposed work of improvement shall be located at Parcel Nos. APN 30513135, and 30513134, in Humboldt County, CA, in the uplands, tide and submerged lands of Humboldt Bay owned by **Permittee**.

SUBJECT TO THE FOLLOWING TERMS AND CONDITIONS:

1. That **Permittee** promptly report the dates when you start and finish the work authorized by this Permit. If **Permittee** cannot complete the work within the time granted by this Permit, **Permittee** shall request an extension before the Permit expires. If there are material changes to the plan and scope of the work, it will be necessary for **Permittee** to submit a detailed explanation and request a revision of the Application and plans.

2. That the Permittee shall fully implement all mitigation measures provided in the adopted Mitigated Negative Declaration and the associated Mitigation Monitoring and Reporting Program for the project.

3. That all work authorized by this Permit shall further be subject to the approval of the following public agencies:

    A. United States Army Corps of Engineers San Francisco District
    B. State of California Coastal Commission
    C. State of California Regional Water Quality Control Board, North Coast Region
    D. North Coast Unified Air Quality Management District
    E. Humboldt County

    and **Permittee** shall fully comply with all regulations and conditions affecting such work as imposed by the above agencies.

4. That no attempt shall be made by the **Permittee** to interfere or forbid the full and free use by the public of all navigable waters at or adjacent to the work;

5. That the **Humboldt Bay Harbor, Recreation and Conservation District**, its Commissioners, or any officer or employee of the **Humboldt Bay Harbor, Recreation and Conservation District** shall in no case be liable for any damages or injury of the work herein authorized which may be caused by or result from future operations undertaken by the **Humboldt Bay Harbor, Recreation and Conservation District** for the conservation or improvement of navigation, or for other purposes, and no claim or right to compensation shall accrue from any such damage.

6. That this Permit, if not previously revoked or specifically extended, shall cease and be null and void and terminate on the 23rd day of January 2015. This permit may be extended in annual increments for up to a total of nine (9) years at the discretion of the District.

7. That the Board of Commissioners of the **District** may revoke this Permit at any time upon a finding by the **District** of a violation by the **Permittee** of any condition of this Permit, or a finding of substantial new information regarding the effect of the Permitted activities. District shall notify Permittee prior to revocation and shall provide an opportunity, where possible, to resolve the situation prior to revoking this permit.

8. That the **Permittee** shall comply with any regulations, condition, or instructions affecting the work hereby authorized if and when issued by the Federal Water Pollution Control Administration and/or the State of California Water Resources Control Agency having jurisdiction to abate or prevent water pollution. Such regulations, conditions, or instruction in effect or prescribed by Federal or State Agencies are hereby made a condition of this Permit.

9. That neither the **Humboldt Bay Harbor, Recreation and Conservation District**, nor its Board of Commissioners, nor any officer of the **District** shall be liable to any extent for the injury or damage to any person or property or for the work authorized by this Permit, and the **Permittee** shall indemnify and hold harmless the **District**, its Commissioners and officers free and harmless from any liability for any such injury, death or damage.

10. That **Permittee** shall furnish to the **Humboldt Bay Harbor, Recreation and Conservation District** a written annual progress report and upon completion, a written completion report describing the completion of the project.

11. That as a condition to the issuance of this Permit, **Permittee** agrees to indemnify and hold harmless **Humboldt Bay Harbor, Recreation and Conservation District** from an against any and all liability, loss, or damage **Humboldt Bay Harbor, Recreation and Conservation District** may suffer from claims and demands for attorneys' fees, costs of suit, and costs of administrative records made against **Humboldt Bay Harbor, Recreation and Conservation District** by any and all third parties as a result of third party environmental actions against **Humboldt Bay Harbor, Recreation and Conservation District** arising out of the subject matter of this Permit, including, but not limited to attorneys' fees, costs of suit, and costs of administrative records pursuant to the California Code of Civil Procedure §1021.5 or any other applicable local, state or federal laws, whether such attorneys' fees, costs of suit, and costs of administrative records are direct or indirect, or incurred in the compromise, attempted compromise, trial appeal or arbitration of claims for attorneys' fees, costs of suit, and costs of administrative records in connection with the subject matter of this Permit.

12. That this Permit is valid as of the 23rd day of January 2014, and is made subject to the **Permittee** approving and agreeing to the conditions above set forth and executing said approval as hereinafter provided.

EXECUTED on this 23rd day of January 2014 by authority of the Board of Commissioners of the **Humboldt Bay Harbor, Recreation and Conservation District**.

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MIKE WILSON, President
Board of Commissioners
Humboldt Bay Harbor, Recreation and Conservation District

Pacific Gas and Electric Company, Permittee, in the above Permit, hereby accepts and agrees to all of the conditions hereinabove set forth. **Permittee** shall indemnify and hold harmless the **Humboldt Bay Harbor, Recreation and Conservation District**, its Board of Commissioners, officers and employees from any and all claims of any nature arising from the performance of and work of improvement contained in the Application for injury, death or damage to any person or property.

Pacific Gas and Electric Company, Permittee, in the above Permit, agrees to indemnify and hold harmless **Humboldt Bay Harbor, Recreation and Conservation District,** its Board of Commissioners, officers and employees from and against any and all liability, loss or damage **District** may suffer from claims and demands from attorneys' fees; costs of suit and costs of administrative records made against **District** by any and all third parties as a result of third party environmental actions against **District** arising out of the subject matter of this Permit including, but not limited to, attorneys' fees, costs of suit and costs of administrative records pursuant to the California Code of Civil Procedure §1021.5 or any other applicable local, state or federal laws, whether such attorneys fees, costs of suit and costs of administrative records are direct or indirect, or incurred in the compromise, attempted compromise, trial, appeal or arbitration of claims for attorneys' fees, costs of suit and costs of administrative records in connection with the subject matter of this Permit.

Pacific Gas and Electric Company

Signature _____

Name _____

Title _____

Date _____