Characterization Of The Biological Expedition And Sample Preparation Phase

SUMMARY

The biological sampling at Amchitka and Kiska Islands was a key aspect of the Amchitka expedition. It involved the extensive and balanced collection of biological specimens (biota) for radiological analysis. In this chapter we address the following points subsequent to approval of the Amchitka *Science Plan*:

1) The stakeholder input necessary to refine the biological component of the Amchitka Science Plan
2) The implementation plans necessary to assure appropriate collection and preparation of samples during the expedition
3) Additional sample preparation needed before material could be sent for radiological analysis
4) Sample tracking from the field to the Rutgers preparation laboratory, and to the analytical laboratories, and data management and analysis
5) Maintenance of sample integrity
6) Assurance of the health and safety of all personnel during the expedition and the sample analysis

Planning for the expedition included not only developing implementation plans for the biological sampling in the approved Amchitka *Science Plan*, but holding a series of meetings with stakeholders, including Aleut communities on four islands (Adak, Atka, Nikolski, and Unalaska) and representatives of the U.S. Fish and Wildlife Service and the State of Alaska. Meetings with Aleuts in the summer of 2003 were organized by Robert Patrick of A/PIA, where Burger and Gochfeld met with people to explain the purpose and obtain additional views on species selection that informed the sampling plan. They also agreed with the desirability of including Aleut hunters/fishers on the expedition. As a result of these meetings, additional subsistence species were added to the collection list. Meetings with State of Alaska, and US Fish and Wildlife Service (resource trustees) were critical in further refining our species collection list, taking into account several key features, including: 1) importance of particular species in the food chain, 2) importance of particular species as prey for top-level predators or as endangered species, 3) status of biota (whether collection would impact populations), and 4) importance to resource trustees (e.g. Bald eagles, Atka Mackerel).

Additional input from both the Department of Energy and the U.S. Fish & Wildlife Service informed our final choice of target species to reflect 1) species that could be

collected to reduce uncertainties in the DOE's risk and groundwater models (DOE 2002a,b) and 2) ecological equivalent species that could be collected to avoid the use of species that were sensitive or had declining populations.

Conducting a biological expedition, as well as subsequent sample preparation and analysis required the development of a number of detailed procedure and protocol manuals including:

1. An Implementation Plan for Biological Collection in the Aleutians (See Appendix 8.C)
2. The Specimen Handling and Quality Assurance Plan for the Rutgers Sample Preparation Phase (See Appendix 8.D.)
3. A Quality Assurance Manual for the Vanderbilt Sample Analysis Program (see Appendix 8.E.), and for INL (See Appendix 8.F)
4. A Quality Control Plan to ensure no cross-contamination of specimens (See Appendix 8. G)
5. A Data Management Implementation Plan (See Appendix 8.H)

Developing the implementation plan and associated quality assurance documents was critical for efficient and effective collecting while on the expedition, and to insure that appropriate sampling, specimen handling, Chain of Custody, specimen tracking, and quality assurance/quality control protocols were followed at all times, within the time constraints of the expedition. During the first expedition, the sampling and radiologic screening of water and sediment samples provided assurance that biologists on the second expedition would not encounter dangerous levels of radiation when collecting and processing organisms.[1] Collected organisms were screened with a hand-held radiation meter to ensure that no specimens were grossly contaminated. Special lead bags were available for shielding any specimens which showed high radioactivity with the hand held meter. None were needed.

Developing laboratory manuals for sample preparation at Rutgers University involved selecting individuals for weighing, dissection, homogenization, compositing, blending, packing, re-coding, and completing Chain of Custody forms, and adhering to the quality control/quality assurance procedures developed in the implementation plan for the expedition itself. Developing appropriate quality control and quality assurance measures during the sample preparation phase was an important part of this process.

Ensuring the integrity of samples throughout the process, from initial field collection through processing on the boat, transportation to Rutgers, and transportation to the analytical laboratories was of paramount importance. In addition to full identification, it was important for the samples themselves to be appropriately protected from contamination. All Geiger counter screening radiation measurements and laboratory wipe samples taken during and after the expedition were below detection levels both for the Expedition itself

[1] At all times ensuring the health and safety of all personnel during all phases of the expedition was highest priority.

and at the Rutgers laboratory, indicating that there was no cross-contamination among samples or risk to any laboratory personnel.

The process of determining the species and tissues to be analyzed, and for what radionuclides, is discussed in Chapter 9.

INTRODUCTION

The Amchitka *Science Plan* included both physical and biological sampling of the marine environment to better understand the possible transport of radionuclides through the marine ecosystem, and through the food chain to humans. The biological component of the *Science Plan* had a three-pronged approach representing stratified sampling by scientists, Aleut subsistence hunters/fishers/gatherers, and a fisheries biologist. These groups (together or separately) were responsible for collecting a range of species that represented subsistence and commercial foods, different nodes on the food chain, and species that were eaten by top-level predators (e.g. Bald Eagles, Sea Otters, Steller Sea Lions, and humans). While the Science Plan provided an overall framework for the biological collections, six additional questions were key to the expedition and the subsequent sample preparation and analysis phase, and are discussed in this chapter:

1) What stakeholder input was necessary to refine the biological component of the Amchitka Science Plan? (Appendices 8.A and 8.B).

2) What implementation plans were necessary to assure appropriate collection and preparation of samples during the expedition? (Appendix 8.C).

3) What further preparation in the laboratory at Rutgers was essential before samples were sent for analysis? (Appendix 8.D)

4) What quality assurance/quality control measures were employed during the analysis phase? (Appendix 8.E, 8.F).

5) How were samples tracked from the field to the Rutgers preparation laboratory, and to the analytical laboratories, and how were data managed during the preparation and analysis phases? (Appendices 8.H, 8.I).

6) How was the safety of all personnel and samples assured during the Expedition and during laboratory preparation? (Appendix 4.C, 8.G).

This chapter describes the procedures and protocols that were developed to ensure the success of the expedition with respect to collection of biological samples, handling and preparation of samples, quality control/quality assurance, radiological analyses, specimen and data tracking, and personnel health and safety. To do so, brief descriptions of these protocols are provided here, and detailed manuals and plans are provided in the appendices. The chapter is thus mainly a summary of our protocols and methods; Figure 8.1 shows the relationship among the different protocols and methods documents.

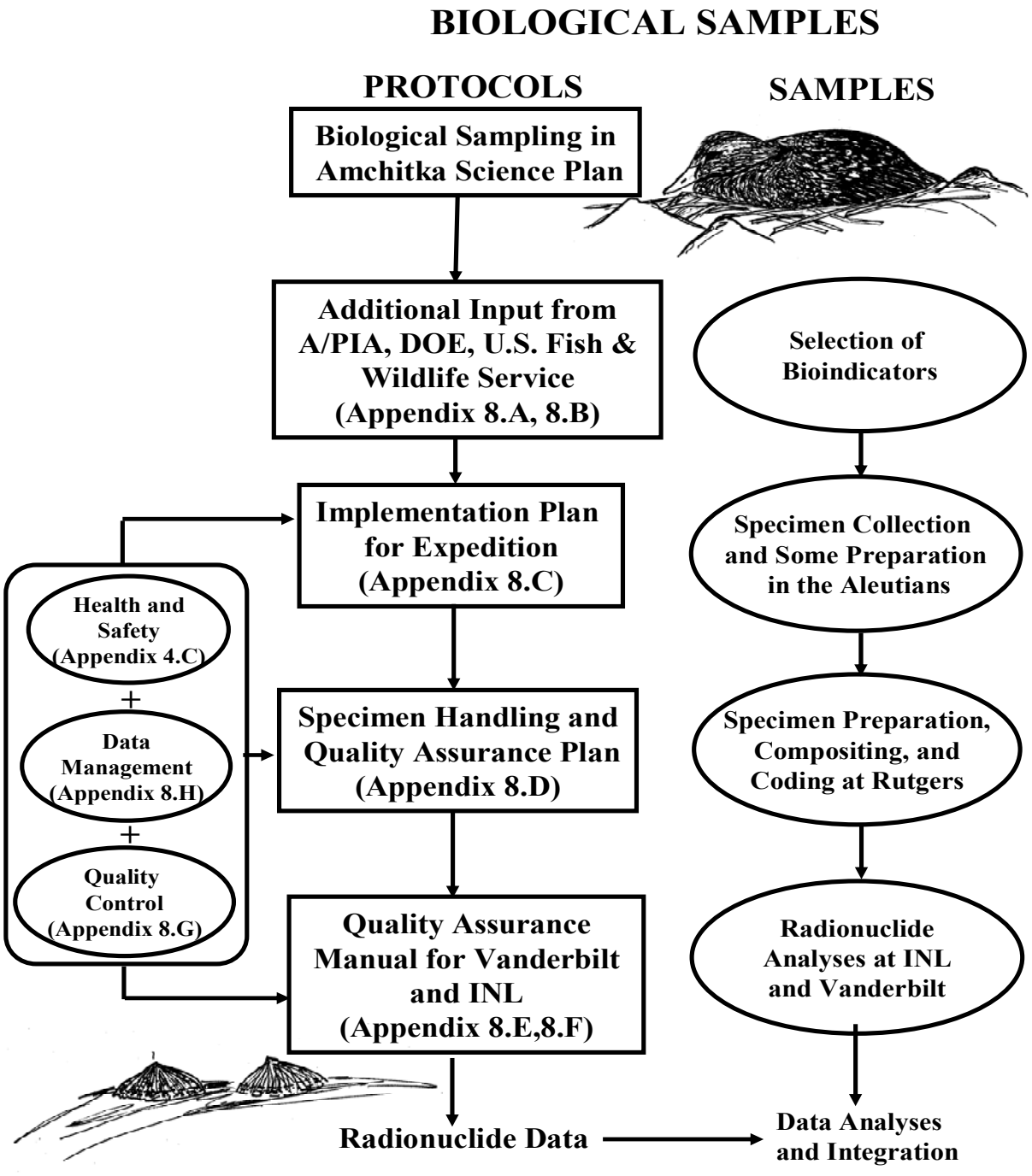


Figure 8.1 Relationship of Manuals for Biological Sampling and Samples.

METHODS AND APPROACHES

Because of the CRESP commitment to involving stakeholders at all stages in the Amchitka assessment process, the year between the approval of the *Science Plan*, and the expeditions involved a series of meetings with stakeholders, including resource trustees, Aleut communities, ADEC, and DOE. Meetings ranged from phone conferences to formal meetings with Aleut elders and communities in Adak, Atka, Nikolski, and Unalaska, and with the public and resource trustees in Anchorage.

There were a number of procedures and protocols that needed to be developed to carry out the biological aspects of the Amchitka *Science Plan*. These included developing:

1) Biological Implementation Plan (Appendix 8.C)
2) Specimen Handling and Quality Assurance Plan for the Rutgers Laboratory (Appendix 8.D).
3) Quality Assurance Plans for the Vanderbilt Laboratory and INL (Appendix 8.E, 8.F)
4) Quality Control Plan to ensure safety of specimens and laboratory personnel (Radiation Anti-cross Contamination QC/QA Report, Appendix 8.G).
5) Data Management Implementation Plan including Specimen Tracking (Appendices 8.H, 8.I)

Developing an implementation plan involved preparing standard protocols for all aspects of the biological plan, including appropriate sampling, specimen handling, Chain of Custody, specimen tracking, and quality assurance/quality control protocols linked among the participating laboratories. The specimen handling and quality assurance plan for the Rutgers laboratory involved developing procedures for handling and preparing specimens for radiological analysis. A similar quality assurance plan was then developed at Vanderbilt for handling specimens during analysis. A plan to ensure that no cross-contamination of specimens occurred was developed for both Rutgers and Vanderbilt. Insuring the integrity of samples required developing a specimen tracking system, and data management system. All plans and manuals were developed by the laboratory director in conjunction with staff, and reviewed by the other laboratory directors, as well as the overall CRESP management group. This ensured consistency and that the integrity of all samples was maintained throughout the process (refer back to Figure 8.1).

RESULTS

Refining Target Species

The approved Amchitka *Science Plan* included a list of target species that represented the marine ecosystem, food chain relationships, and Aleut foods and commercial fish. However, it was always part of the plan of CRESP to refine the target species for collection as a result of continued input by Aleut/Pribilof Islanders, resource trustees, and DOE. Refinement was essential to address the following:

1) Were there additional species (or parts thereof) that should be included to adequately address the concerns of Aleut hunters/fishers?

2) Were there additional species of particular concern to resource trustees?

3) Were there population or conservation constraints on target species that required substitutions of ecological equivalents?

4) Were there target species of particular concern for the DOE risk or groundwater models that should be included?

Subsistence Foods

CRESP researchers held a series of meetings in August of 2003 in Atka, Nikolski, and Unalaska, and in Adak in June of 2004, with Elders, tribal officials, tribal members, environmental officers and other stakeholders to insure that our list of target species (and tissues) included species of interest to them (see Appendix 8.A, 8.B). Our overall purpose was to meet with the Aleut communities in a series of one-on-one, small groups, and more formal meetings to present and discuss the Amchitka Science Plan and to solicit input regarding all phases of the plan. We were particularly interested in their views regarding our biological sampling plan, and any additional species to be added. We were accompanied by Robert Patrick of A/PIA, who coordinated the meetings.

These meetings were a success in many different ways. It was extremely important for CRESP to meet the Aleuts people in their native communities, and to talk to other stakeholders (particularly in Unalaska). We had several meetings at each of the islands, and found that the face-to-face small meetings were very fruitful. People were often much more willing to talk to us in small groups or singly, and to provide very valuable feedback, than in more formal groups. Our meeting with children in Nikolski was particularly educational. While we had expected the Aleut people in the more remote villages of Nikolski and Atka to be reticent when meeting with outsiders, this was not the case. We were warmly received everywhere we went, and there was no animosity toward us or the project. Everyone seemed to welcome the project, particularly as we got further west (closer to Amchitka). People were quite willing to discuss different aspects of the biological sampling plan (Appendix 8.A).

Figure 8.2. J. Burger meeting with Nikolski youths to learn about hunting and fishing (Photos M.Gochfeld).

The final meeting with Aleuts prior to the biological expedition occurred in Adak, just before the biological expedition, served to present the *Science Plan*, describe the relationship between the physical and biological components, solicit additional suggestions for methods or target species, and continue a dialogue between the Aleut community and researchers. Adak is the closest community to Amchitka, and some of the attendees had participated in the nuclear test shots or various phases of the clean-up (see Appendix 8.B).

Several suggestions emerged from these various meetings:

1. The Aleut people are particularly interested in bird eggs (gull and eider). Gulls obtain their food resources entirely from the marine environment and thus eggs reflect this environment. While gulls eat fish, eiders eat mainly invertebrates. Analyzing gull and eider eggs was important to the people. People also expressed interest in other contaminants

such as heavy metals and PCBs.

2. Some of the subsistence foods can also serve as top-level predators for the purposes of understanding the food chain. People in all the villages wanted Octopus added to our target species list. Other species they wanted added, by contrast, came from far down the chain, such as Chinese Hats (limpets) and Gumboot Chitons.

3. In some of the villages (particularly Nikolski, and to some extent Atka), it is the younger people who do the hunting and fishing. We found that the 13-20-year olds were particularly involved and accomplished at hunting and fishing, and often provided others in the village with their subsistence food. Many of the elders no longer hunt or fish, and rely on the youngsters. This finding suggested that it was critical to include Aleut hunters and fishers of different ages on our expedition.

4. Pacific Halibut and Pacific Cod are extremely important foods in the islands, and should be featured in our sampling and analysis phase.

Figure 8.3. Meeting with elders and community leader, Atka, Aug. 2003 (Photo J. Burger)

Expedition Collaborations

The biological expedition had on board four members from the Aleut/Pribilof Island Association community, including Robert Patrick (A/PIA, Anchorage), Ron Snigaroff (Adak), Dan Snigaroff (Atka), and Tim Stamm (Nikolski). They were invaluable members of our research team, and contributed a wealth of information about the ecology, hunting and fishing methods, and importance of the target species in their subsistence diets.

The captains and crews of both the *Ocean Explorer* and the *Gladiator* were

experienced at trawling for fish, and provided valuable information about commercial fisheries.

Resource Trustee Concerns

Our sampling plan was a three-pronged approach that addressed subsistence foods, commercial fisheries, and food chain bioaccumulation. Resource trustees were particularly interested in the latter aspect of our sampling. Two aspects emerged: U.S. Fish & Wildlife Service was interested in any radiological data for marine birds and Eagles, and ADEC was interested in several fish species, including Atka Mackerel.

A major concern of several resource trustees, however, was in ensuring that our sampling did not jeopardize sensitive bird or mammal populations in the Aleutians. Over the last few years some seabird populations, for example, have declined somewhat, and state and federal agencies suggested that we substitute ecological equivalents. Their suggestions resulted in the following changes in our initial target species list.

1. Due to population declines, Pelagic Cormorant was deleted, and Pigeon Guillemot was added.

2. Due to low populations, Horned Puffin was replaced with Tufted Puffin (a species that is at the same trophic level).

3. Bald Eagle eggs were changed to eggs or runt chicks because runt chicks seldom fledge, and the timing of our proposed expedition meant that eggs would not be available.

4. Sea Otter numbers at Amchitka have crashed and this species was deleted from our list. Other marine mammals were not collected either because of resource trustee concerns or because of long delays in the permit process.

All collecting activities were conducted under appropriate permits from the State of Alaska. All bird collecting activities were conducted under additional U.S. Fish and Wildlife Permits. Endangered species permits were required for Bald Eagles.

Department of Energy Concerns

The DOE risk models (DOE 2002a) made certain assumptions about the absence of biota in the benthic environment around Amchitka where radiation seepage might occur. Our sampling sought to reduce uncertainty surrounding the presence of ecological receptors on the ocean floor. Thus we modified our sampling strategy to ensure that we systematically examined species presence at different depths adjacent to each of the test shots, and that we included kelp species that occur at different depths. (Kelp is known to trap elements including radionuclides and samples of kelp have been analyzed in many marine environments.) We thus collected *Alaria nana* and *Fucus* in the intertidal, and

Alaria fistulosa in benthic habitats up to 90 feet (the deepest it was safe for our divers to go). We targeted Sea Urchin, a sedentary invertebrate species, as one of the primary species we could obtain at all depths, and some fish species that have low mobility.[2]

The Expedition Sampling Plan

Conducting the biological expedition and subsequent sample preparation required several protocols:

1) A biological implementation plan (Appendix 8.C)
2) A specimen handling and quality assurance plan (Appendix 8.D)
3) A quality assurance manual for handling specimens at Vanderbilt and INL (Appendix 8.E, 8.F).
4) Quality control plan (Appendix 8.G).
5) A data management plan (Appendices 8.H, 8I)

Biological Implementation Plan

The biological implementation plan dealt with the protocols and procedures necessary to collect biota for radionuclide analysis. The implementation plan applied to surface, intertidal, and benthic collections, and to all biological collections on the *Ocean Explorer* and on the NOAA research trawler (*Gladiator*). The plan included protocols for surface and underwater (diving) transects. The biological tasks in the Amchitka Science Plan involved the field collection of biota, sample preparation, homogenization and compositing, laboratory analysis, data analysis, and synthesis.

The measurement objectives and assessment goals were:

1. To collect marine organisms on and around Amchitka Island and at Kiska (reference site).
2. To collect organisms (or their ecological equivalents) that represent different trophic levels and lifestyles (migratory, sedentary).
3. To process these organisms where possible to reduce specimen volume by dissection (given limitations of freezer space on the ship), and to set up the composites of samples (time permitting) while on the ship.
4. To initiate the Chain of Custody and maintain laboratory notebooks for sample tracking.
5. To maintain adequate QA/QC for samples collected and for sample preparation (Appendix 8.C and 8.D).
6. To transport specimens, under appropriate Chain of Custody, to the Rutgers laboratory for homogenization and blending of composites (Appendix 8.C).

[2] All fish move to some extent, but some species remain within a relatively small territory in the kelp beds and near shore environments, whereas others are highly mobile or migratory.

The biological implementation plan describes in detail the following responsibilities and tasks: 1) responsibilities of different personnel, 2) time line of activities, 3) collecting teams and priorities, 4) health and safety rules, 5) decision rules and prioritization for collecting given time constraints, 6) projected daily activities, 7) collecting protocols for birds, fish, benthic organisms, and Aleut foods, 8) Chain of Custody (both in implementation plan and as a separate protocol), 9) sample preparation on the ship, 10) transportation to Rutgers, and 11) specimen handling at Rutgers. These procedures and protocols are described in detail in Appendices 8.C, and 8.D).

Collecting teams included 1) a land-based team for marine birds and intertidal organisms, 2) Aleut hunters and fishers, 3) divers for benthic organisms, 4) a fisheries biologist on the NOAA trawler. CRESP anticipated a series of sampling obstacles that included 1) weather constraints, 2) difficulty of obtaining some species because of logistics, presence or abundance, 3) personnel deployment to maximize sample collection, 4) life cycle stage (eggs vs chicks), and 5) seasonality (which species could be found). Decisions on prioritizing sampling on board were made by Burger in consultation with Jewett, Gochfeld, and Volz.

Our revised sampling plan is shown in Table 8.1.

Table 8.1. ***Revised Sampling Plan, Trophic Level, and Tissue Type***

Common Name	Scientific Name	Eaten by Aleuts	Trophic Level	Tissue
Kelps (Brown Algae)	*Alaria fistulosa*	*No*	Primary Producer	Algae
Kelps (Brown Algae)	*Alaria nana*	*No*	Primary Producer	algae
Kelps (Brown Algae)	*Hedophyllum sessile*	*No*	Primary Producer	algae
Kelps (Brown Algae)	*Fucus distichus*	*No*	Primary Producer	algae
Sea Lettuce	*Ulva latuca*	*Yes*	Primary Producer	algae
Green Sea Urchin	*Strongylocentrotus polyacanthus*	*Yes*	Grazer	soft tissue
Limpet	*Tectura scutum*	*Yes*	Grazer	soft tissue
Chiton	*Cryptochiton stelleri*	*Yes*	Grazer	soft tissue
Rock Jingle	*Pododesmus macroschisma*	*Yes*	Filter Feeder	soft tissue
Blue Mussel	*Mytilus trossulus*	*Yes*	Filter Feeder	soft tissue
Horse Mussel	*Modiolus modiolus*	*Yes*	Filter Feeder	soft tissue
Octopus	*Octopus dofleini*	*Yes*	Predator	muscle
Black Rockfish	*Sebastes melanops*	*Yes*	Predator	muscle & liver
Pacific Ocean Perch	*Sebastes alutus*	*Yes*	Predator	muscle & liver
Dolly Varden	*Salvelinus malma*	*Yes*	Predator	muscle & liver
Atka Mackerel	*Pleurogrammus monopterygius*	*Yes*	Predator	muscle & liver
Walleye Pollock	*Theragra chalcogramma*	*Yes*	Predator	muscle & liver
Rock Greenling	*Hexagrammos lagocephalus*	*Yes*	Predator	muscle & liver
Pacific Cod	*Gadus macrocephalus*	*Yes*	Predator	muscle & liver
Great Sculpin	*Myoxocephalus polyacanthocephalus*	*Yes*	Predator	muscle & liver
Yellow Irish Lord	*Hemilepidotus jordani*	*Yes*	Predator	muscle & liver
Red Irish Lord	*Hemilepidotus hemilepidotus*	*Yes*	Predator	muscle & liver
Pacific Halibut	*Hippoglossus stenolepis*	*Yes*	Predator	muscle & liver
Common Eider	*Somateria mollissima*	*Yes*	Predator (mussels)	muscle, liver & eggs
Tufted Puffin	*Fratercula cirrhata*	*Yes*	Predator (small fish)	muscle & liver
Pigeon Guillemot	*Cepphus columba*	*Yes*	Predator (invertebrates/ small fish)	muscle & liver
Glaucous-winged Gull	*Larus glaucescens*	*No*	Predator/Scavenger	muscle & liver
Glaucous-winged Gull	*Larus glaucescens*	*Yes*	Predator/Scavenger	egg contents
Bald Eagle[b]	*Haliaeetus leucocephalus*	*No*	Predator (large fish)	muscle & liver
Norway Rat	*Rattus norvegicus*	*No*	Predator/Scavenger	muscle & liver
Sea Lion[a]	*Eumetopias jubatus*	*Yes*	Predator	muscle & liver

a. Sea Lion was collected in subsistence hunt by Aleuts, and they requested that we analyze both muscle and liver.

b. Norway Rats were collected in case Eagles had high levels. Eagles eat rats, and this could be a source of radionuclides. However the analyses of rats was not required.

Decision rules for collection were: 1) Collection should reflect the need to fill each trophic level, 2) Land-based priorities were gull, eider, guillemots, eagles, and Norway Rats, 3) Diver priorities were octopus, kelp, sea urchins, mussel, fish, jingle, Chiton, others, and 4) Aleuts priorities were predatory and subsistence fish, followed by foods available in the intertidal. At the start of the expedition we recognized that we would not be able to collect all of our target species at each site. Collecting took priority over sample preparation. Our priorities are summarized below:

1. Aleut foods are a high priority
2. Balance for different test shot areas (*Long Shot, Milrow, Cannikin*)
3. Balance for Amchitka vs Kiska
4. Balance for different trophic levels
5. Balance marine birds, intertidal, and benthic

Samples were taken to the ship, screened with a hand-held counter (Ludlum Model 2241-2 Dual Detector Digital Scaler/ Ratemeter) for radionuclides before being taken to the shipboard laboratory, and placed in the freezers with appropriate Chain of Custody forms. In some cases, specimens were dissected and composited on board at four work stations. Work stations were stainless steel tables equipped with running fresh water. All surfaces and tools were cleaned with detergent, and with alcohol and water between each sample. Wipe samples were taken on at least a daily basis to ensure that there was no cross-contamination. These wipe samples all came back below detection levels, indicating no contamination of our samples or work stations on the ship.

The essential features of the implementation plan are shown in Figure 8.4, and are described below:

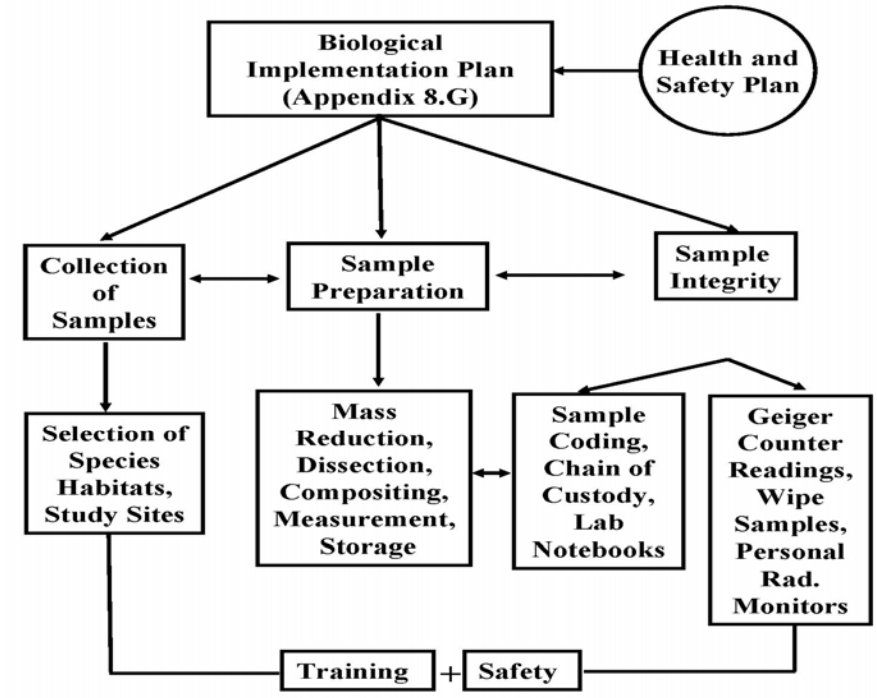
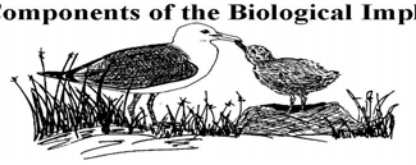


Figure 8.4 Major Components of the Biological Implementation Plan



In summary, the main features of the Biological Expedition were:

1) Conduct biological sampling using a three-pronged approach: Aleut subsistence foods, science-based sampling (including diving transects), and key commercial fishes,

2) Collect specimens to represent Aleut subsistence hunting and fishing, commercial fisheries, and the marine ecosystem; collect specimens to represent intertidal to benthic, as well as marine birds. Thus, our team included Aleut hunters and fishers,

3) Collect organisms to represent several trophic levels, and from sedentary to highly mobile species,

4) Collect organisms from adjacent to all three Amchitka test shots and the reference site (Kiska),

5) Collect sufficient samples for statistical analysis for key trophic levels, while having adequate samples to represent the range of Aleut foods and the marine ecosystem,

6) Process samples on our shipboard laboratory where possible, particularly to reduce volume,

7) Maintain appropriate specimen integrity and Chain of Custody for all specimens.

From the Expedition to Analytical Laboratories

Transportation from Adak and Storage of Samples

When the ships docked in Adak, all frozen samples were placed in coolers (each with its own Chain of Custody forms) and shipped to a secure holding facility freezer at Newark, NJ, from where they were requisitioned as needed, for inventory at Rutgers (always in the presence of two or three people for quality control). There were 38 coolers from the *Ocean Explorer* and an additional 10 coolers from the *Gladiator*. Samples were inventoried, and stored in Newark or Rutgers for sample preparation. All coolers shipped to Newark and transferred to Rutgers had chain of custody forms to ensure their integrity during storage. Specimens were maintained in freezers on ship, at Adak, in Newark, and at Rutgers.

The overall objective of the Rutgers Sample Preparation Phase was to receive, inventory, prepare, and send specimens to the analytical laboratories (Appendix 8.D), and maintain appropriate Chain of Custody and tracking records (Appendices 8.C, 8.H, 8.I). There were two main analytic streams: one to Vanderbilt University and one to INL (see Chapter 8).

Developing a Specimen Handling and Quality Assurance Plan for the Rutgers Laboratory

Specimen Handling and Quality Assurance Plan contained the protocols for specimen handling, tracking and coding from the arrival of specimens at Rutgers in coolers to their departure to analytical laboratories (either Vanderbilt or INL). This plan had several components: 1) Receive specimens (in designated coolers), 2) Inventory and sort specimens appropriately and place them in freezers, 3) Track physical specimens while at Rutgers, and maintain records of shipment to analytical laboratories, 4). Select specimens for compositing, 5). Composite, homogenize, and prepare specimens for shipment, 6). Recode samples, and 7). Pack and ship samples.

The purpose of the Rutgers Laboratory Manual (Appendix 8.D) was to document policy, and methods for sample receipt, handling, preparation and shipment, and to describe quality assurance/quality control procedures for the Rutgers laboratory preparation phase. Having detailed procedures and protocols for each of these phases ensured that all laboratory personnel followed approved methodology. Three copies of the Rutgers Laboratory Manual were made, and resided with the PI, Laboratory Director (Burger), and the preparation laboratory.

After selection of which samples were to be prepared (see Chapter 9), specimens were thawed, dissected (if necessary), combined to create composites (usually of 5 individuals of the same size), and homogenized. To reduce any errors in specimen handling during field collections, all specimens were assigned a number once they were received on the ships (*Ocean Explorer, Gladiator*) that included the species, collection location, and collection team. However, to assure that the laboratories for radiological analyses were appropriately blind to relevant specific characteristics of the samples they were to analyze, the laboratory director (Burger) assigned a new code to all composited

specimens before they left the Burger laboratory. The identity of the new code was known only to the Rutgers Laboratory Director (Burger), Vanderbilt Project Director (Kosson) and the Data Management Director (Vyas) and the CRESP PI. The code was not revealed to any analytical laboratory personnel during the analysis phase, and all QA/QC was performed by people blind to the identification of samples (as to their species, tissue, and collection location). The analytical laboratory personnel knew only whether samples were soft tissue, bone, or algae (because of their need to process samples differently by matrix type).

The main features of the plan are shown in Figure 8.5.

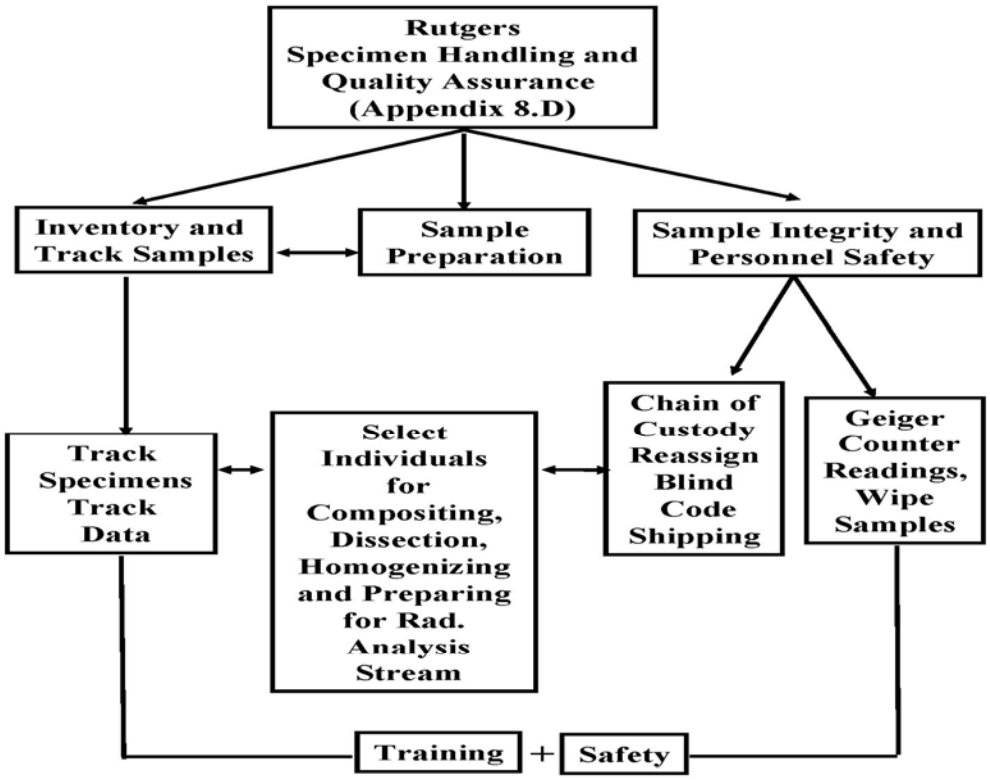


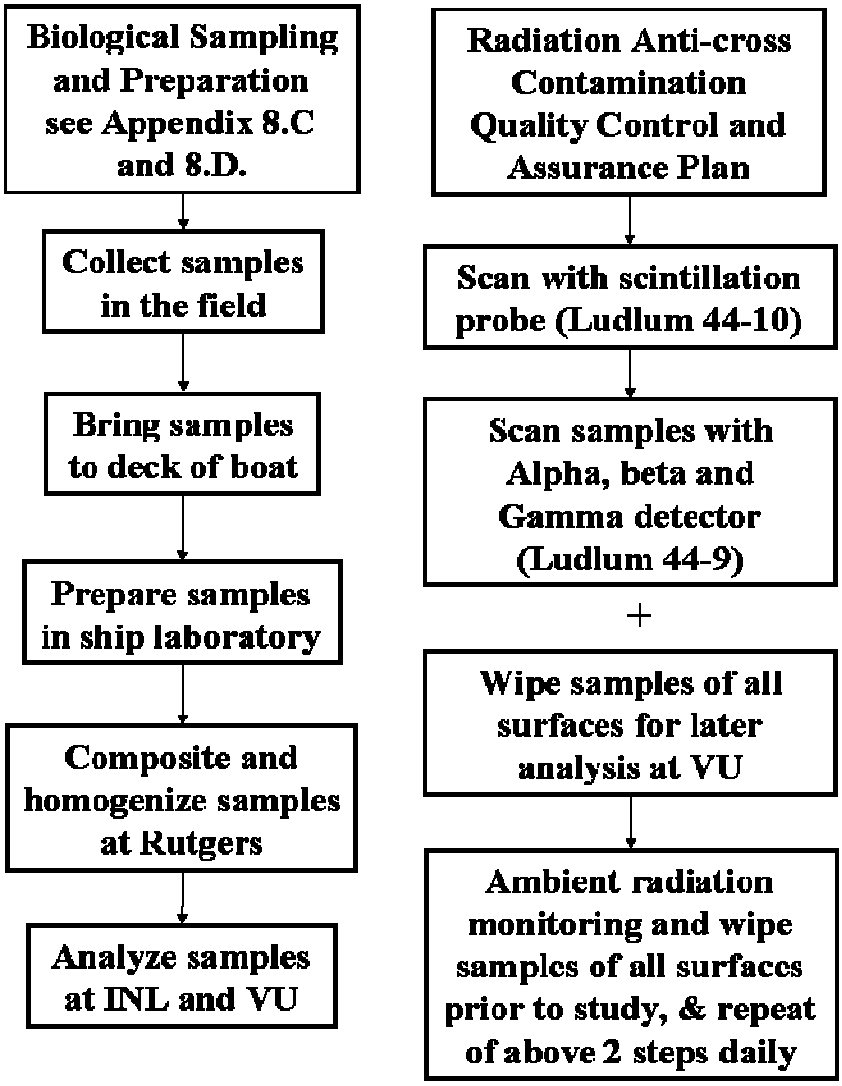
Figure 8.5 Main Components of the Specimen Handling and Quality Assurance Manual

Developing a quality control plan to ensure specimen integrity and no cross-contamination of specimens at Rutgers

This plan was developed to assess and reassure CRESP and the interested parties and public that specimen integrity was maintained and documented, and that there was no cross-contamination among samples during laboratory preparation. The manual describes the system, quality control procedures, and the personnel responsibilities. Personnel training in both the Rutgers Laboratory, the analytical laboratories and the Quality Assurance plan was completed and documented. Wipe samples were obtained at least

daily, of all laboratory surfaces and equipment. In addition, wipes were taken of all surfaces and equipment whenever there was a change in the preparation of a species or tissue type. These wipe samples were then sent to Vanderbilt University on a weekly basis and screened for radionuclides. The Rutgers Laboratory was immediately informed of the results of these tests. In fact, all samples were at or below background levels (see Appendices 8.G, 11.A and Figure 8.5A).

Figure 8.5.A. Main features of anti-cross contamination plan of specimens



Developing a Quality Assurance Plan for Vanderbilt and INL Laboratories

The purpose of these manuals was to provide program policy and oversight for the maintenance of quality assurance and quality control within the Amchitka assessment program. The manual describes administrative systems, as well as specific quality control procedures, which apply to all functional groups within the program. The manual describes responsibilities of the director and laboratory personnel, training, instrument quality control, sample Chain of Custody, analytical quality control, data quality control (including validation) and reporting, and documenting quality control (Figure 8.6, Appendix 8.E, 8.F).

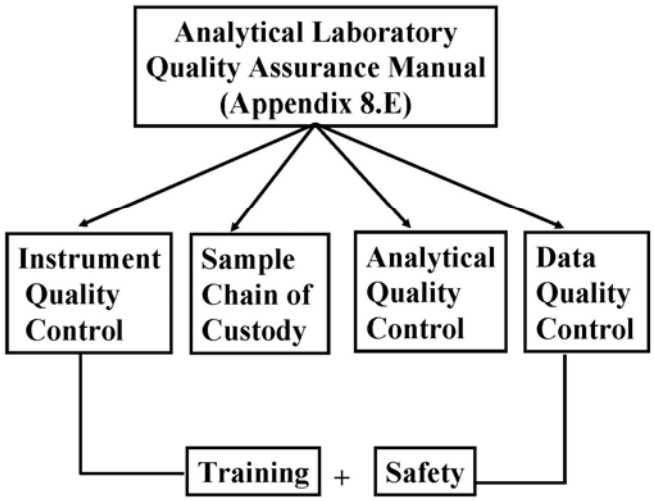


Figure 8.6 Major Components of the Analytical Laboratory Quality Assurance Manual.

Developing a Data Management Plan

With a project as large and complex as the biological component of the Amchitka Science Plan, it was deemed essential to have a database that was independent of both the biological laboratories and the analytical laboratories. Each of these laboratories, of course, had its own database, with appropriate specimen tracking and data management. The objectives of the data management plan (Appendix 8.H) were to compile and synthesize information from the biological sampling, to track specimens from point of collection to laboratory analysis, to analyze information requested, and to continue to monitor and improve data quality. This required a number of phases, shown in Figure 8.7)

and the use of web-based communication (Appendix 8.I).

In addition, an interactive electronic database integrated information for every step of the project, from specimen collection to laboratory analysis. The principal technical features were the development of a relational database query engine based on specimen Ids to keep track of individual and composite specimens, use of geographic coordinates collected by GPS locators to identify collection locations, and the use of GIS software to place the data in a geo-spatial context. The information was evaluated through quality assurance steps prior to its assimilation in the database, and the quality evaluation status of laboratory analyzed information was tracked through the use of pre-designated flags.

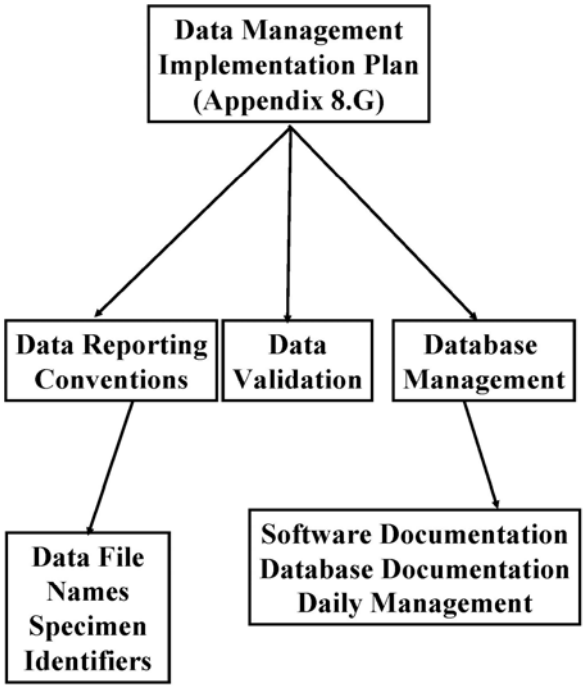


Fig. 8.7 Main components of a Data Management Implementation Plan.

DISCUSSION AND IMPLICATIONS

The main objectives of this chapter were to discuss continued stakeholder collaborations from the approval of the Amchitka *Science Plan* to the end of the biological expedition, and to summarize the protocols and methods documents developed for all phases of the expedition and subsequent radiological analysis. The review of all laboratory manuals and protocols by laboratory personnel, other laboratories, and the CRESP management team sought consistency across laboratories, and to assure quality control, such that both specimens and data could be tracked at all times. While all laboratory

directors have been involved in the development of protocols and procedures for many different projects, it was important to develop dedicated manuals for the Amchitka Project. Built-in checks, duplications, and oversight ensured the highest quality of biological collections, laboratory preparation, and radionuclide analysis on a background of health and safety, and data management.

The primary implication for implementation of the Science Plan is that high quality data were produced to answer the questions posed for the biological component. All subsequent data analyses, and implications for understanding radionuclide movement, the performing of risk analyses, the reduction of uncertainties in groundwater models and/or previous risk assessments, and for providing credible data to a range of stakeholders are dependent upon the quality of the data obtained.

APPENDICES FOR CHAPTER 8 (See attached CD-ROM)

8.A. Report of the Stakeholder Meetings with Aleuts (September 10, 2004) by J. Burger
8.B. Presentation to the Aleut Adak community (June 2004) by C.W. Powers et al.
8.C. Biological Implementation Plan by J. Burger and S. Jewett
8.D. Specimen Handling and Quality Assurance for Rutgers Sample Preparation Phase of the Amchitka *Science Plan* by J. Burger
8.E. Quality Assurance Manual for Vanderbilt Sample Analysis Program in the Amchitka Independent Assessment by D. Kosson
8.F INL Method and Quality Assurance Project Plan for the Amchitka Environmental Sample Analysis by INL Department of Chemistry
8.G Amchitka Independent Science Plan: Radiation Anti-cross Contamination Quality Control and Assurance (QC/QA) Report by C. Volz.
8. H. Data Management Implementation Plan by V.Vyas.
8.I. Data Management for the CRESP Amchitka Project by V. VYas, Y. Mun, and L. Bliss