RU692

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OCSEAP Research Unit 692
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ALASKA MARINE MAMMAL TISSUE ARCHIVAL PROJECT:

ACQUISITION AND CURATION OF ALASKA MARINE MAMMAL TISSUES FOR DETERMINING LEVELS OF CONTAMINANTS ASSOCIATED WITH OFFSHORE OIL AND GAS DEVELOPMENT

Principal Investigators

Paul R. Becker
Arctic Environmental Assessment Center
Office of Ocean Resources Conservation and Assessment
National Ocean Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce
Anchorage, Alaska 99513

and

Stephen A. Wise and Rolf Zeisler
Center for Analytical Chemistry
National Institute of Standards and Technology
U.S. Department of Commerce
Gaithersburg, Maryland 20889

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1.0 INTRODUCTION

The goal of the Outer Continental Shelf Environmental Assessment Program (OCSEAP) Research Unit 692 (Alaska Marine Mammal Tissue Archival Project) is to archive a representative collection of Alaska marine mammal tissues for future contaminant analyses and documentation of long term trends in environmental quality.

The concept of archiving biological and environmental samples for retrospective analysis is recognized as a major component of systematic environmental monitoring. The long-term storage of carefully selected, representative samples in an environmental specimen bank is an important complement to the real-time monitoring of the environment. These archived samples permit:

1. the use of new and innovative analytical technology that was not available at the time the samples were collected, for clear state-of-the-art identification and quantification of analytes of interest, and

2. the identification and quantification of analytes that are of interest at the present, but that were not of interest at the time the samples were collected.

The retrospective analysis of archived samples allows the comparison of present and past analytical techniques and values, thus providing continued credibility of past analytical values, and allowing flexibility in environmental monitoring programs.

Marine mammals are long-lived and are generally considered as top predators in the marine environment. Chemical analysis of their tissues can be particularly useful in determining whether bioaccumulation of contaminants (and potential biological effects) associated with human industrial activities, including offshore petroleum and mineral extraction, is occurring in marine food chains. The collection of marine mammal tissues over a period of several years will provide an archive of samples that can be used to determine baseline contaminant levels against which future contaminant measures can be compared. The project has two objectives:

1. Collect Alaska marine mammal tissues that are suitable for determining levels of organic and inorganic contaminants associated with offshore mineral extraction.

2. Transport, catalog, and curate the tissues in a condition suitable for long-term storage and eventual contaminant analyses.

The marine mammals of principal interest include: ringed seals (*Phoca hispida*), spotted seals (*P. largha*), harbor seals (P. *vitulina*), bearded seals (*Erignathus barbatus*), Steller or northern sea lions (*Eumatopias jubatus*), northern fur seals (*Callorhinus ursinus*), Pacific walrus (*Odobenus rosmarus divergens*), bowhead whales (*Balaena mysticetus*), belukha or northern white whales (*Delphinapterus leucas*), Dan's porpoise (*Phocoenoides dalli*), polar bears (*Ursus maritimus*), and sea otters (*Enhydra lutris*). These animals represent a range of sizes, habitat use, and subsistence values.

Archived tissues are being limited to those collected from freshly killed animals, primarily those taken in native subsistence hunts. Tissue samples are collected according to the standard protocols designed for the project (Becker et *al., 1988).* These protocols are consistent with those employed by the National Biomonitoring Specimen Bank (NBSB), National Institute of Standards and Technology (NIST).

The cataloging and archiving of samples are being conducted by the NBSB, NIST, Gaithersburg, Maryland. Procedures are consistent with those employed by the NBSB in support of the National Status and Trends Program. Samples are stored at the NBSB under liquid nitrogen vapor at -150°C, which is the best condition available for minimizing sample degradation.

Samples will be selected in the future for contaminant analysis by OCSEAP/MMS. Emphasis will be on those trace elements and organic contaminants associated with offshore mineral extraction.

2.0 REPORTING PERIOD ACTIVITIES

Project activities during the reporting period were:

1. Archival support
2. Planning and coordination
3. Field collection of tissue samples
4. Protocol development

FY 90 milestones for project activities are presented in Table 1.

2.1 ARCHIVAL SUPPORT

The Alaska Marine Mammal Tissue Archive is maintained by NIST in the National Biomonitoring Specimen Bank (NBSB), Gaithersburg, Maryland. The NBSB is the result of over 10 years development involving cooperative efforts between NIST and EPA, and several years of comparative studies with specimen archiving programs in Europe and Canada (Wise and Zeisler, 1984; Wise *et al., 1989).* Other agencies using the NBSB include EPA, U.S. Department of Agriculture, Food and Drug Administration (FDA), National Cancer Institute (NCI), the National Status and Trends Program of NOAA, and National Marine Fisheries Service (NMFS).

NIST supports the AMMTAP by providing facilities and expertise required for the cataloging and storage of marine mammal tissues, and by providing the expertise and advice for the development and testing of protocols. More specifically, NIST is performing the following tasks:

- Aid the Arctic Environmental Assessment Center (AEAC) in the development and evaluation of protocols for the collection, transport, cataloging, and long-term storage of tissue samples.
- Provide facilities for the cryogenic storage of these samples. This includes the purchase, installation, and maintenance of liquid nitrogen vapor freezers.
- Provide the materials and implements required for the collection and shipment of samples to the specimen archive.
- Conduct on-site evaluation of the collection procedures by collaborating with the AEAC during the sample collections in the field.
- Maintain an inventory of archived samples identified by type, date of collection, collection site, weight,

Table 1. Activity milestones for RU 692, Alaska Marine Mammal Tissue Archival Project, FY 90.

1989:

October:

- FY 89 Annual Report submitted to MMS.

December:

- The *AMMTAP* was represented at a meeting of the National Marine Mammal Tissue Bank Team of Experts, Monterey, California.

1990:

January:

- Coordination meeting with the ADF&G Subsistence Division regarding the ADF&G Subsistence Foods Sampling Program.
- Presentation at the North Slope Borough Fish and Game Management Committee meeting, Barrow.

February:

- Planning and coordination meetings with the village councils of English Bay, New Chenega Bay, and Tatitlek.

March:

- Presentation at the Eskimo Walrus Commission (EWC) meeting, Anchorage; endorsement of the *AMMTAP* received from the EWC.
- Harbor seal tissue collection, New Chenega Bay.

April:

- Steller sea lion tissue collection English Bay.
- Harbor seal tissue collection, Tatitlek.

June:

- The *AMMTAP* was represented at a meeting of the National Marine Mammal Tissue Bank Team of Experts, Gaithersburg, Maryland.

July:

- Belukha whale tissue collection, Point Lay
- Northern fur seal tissue collection, St. Paul Island.

identification numbers, and other information provided by the collector.

- Evaluate specimen stability through regular monitoring of concentrations of selected contaminants in sample aliquots. NIST is an active participant in NOAA's Quality-Assurance Program.

2.2 PLANNING AND COORDINATION

Sampling in FY 90 required extensive coordination with numerous individuals and organizations, including: the Alaska Department of Fish and Game; the North Slope Borough Department of Wildlife Management; the North Slope Borough Fish and Game Management Committee; the subsistence hunters of Point Lay and St. Paul Island; the village councils and subsistence hunters of English Bay, New Chenega Bay, and Tatitlek; the Eskimo Walrus Commission; and the National Marine Fisheries Service.

2.2*1 Alaska Department of Fish and Game (ADF&G)

The *AMMTAP* was requested by the ADF&G Subsistence Division to provide assistance to their Subsistence Foods Sampling Program in collecting tissue samples from native subsistence hunts of harbor seals and sea lions in areas affected by the EXXON VALDEZ oil spill. The Subsistence Foods Sampling Program was set up to monitor possible contaminants in the food resources of affected native villages.

Based on a January coordination meeting with the ADF&G Subsistence Division staff (Pippa Coiley, Lee Stratton, and Ron Stanik), and subsequent meetings with the village councils of English Bay, New Chenega Bay, and Tatitlek in February, 1990, plans were developed to accompany subsistence hunters from these three villages during the spring of 1990, and to obtain tissue samples using the AMMTAP protocol from the animals taken during the hunts. The sampling conducted in this work is described in Section 2.3.1.

2.2.2 Eskimo Walrus Commission

At the request of Matthew Iya, Executive Director of the Eskimo Walrus Commission, the *AMMTAP* was presented to the Commission at a meeting held in Anchorage (March 1990). This meeting provided us the opportunity to discuss with representatives of various native villages the possibility of obtaining marine mammal tissues from several species, including walrus. The Fish and Wildlife Service also

presented results recently published on heavy metal concentrations in tissues of walrus (Taylor *et al.*, 1989) . The Commission indicated their support for the continued work on monitoring toxicants in marine mammals and recommended cooperation of subsistence hunters with the *AMMTAP* .

2.2.3 North Slope Borough (NSB)

Since the beginning of the *AMMTAP* in 1987, the NSB Department of Wildlife Management has continued to provide valuable support to the *Project.* Plans for sampling belukha whales during the Point Lay subsistence hunt were developed in cooperation with the NSB Department of Wildlife Management's belukha harvest survey. The planning and successful accomplishment of this work was due in large part to the efforts of Robert Suydam and Clarence Itta, NSB Department of Wildlife Management, and Geoff Carroll, ADF&G, and to the support of Amos Agnasagga, Point Lay mayor and member of the NSB Fish and Game Management Committee. The sampling conducted in this work is described in Section 2.3.2.

The Project continues to maintain close contact with the NSB Fish and Game Management Committee and periodically briefs this group. The Committee has prov-ided many 'helpful comments and suggestions which have guided the development of the *Project.* In addition, keeping the members informed on the *AMMTAP* is critical to maintaining regional support for the *Project.*

2.2.4 National Marine Fisheries *Service* (NMFS)

During the reporting period, the *Project* worked very closely with three individual NMFS offices: the Environmental Conservation Division, Northwest Fisheries Center, Seattle, Washington; the Habitat and Conservation Division, NMFS Regional Office, Juneau, Alaska; and the Office of Protected Resources and Habitat Programs, Silver Spring, Maryland.

Subsamples collected in support of the ADF&G Subsistence Foods Sampling Program were provided to the Environmental Conservation Division, Northwest Fisheries Center, for determining levels of organic compounds indicative of crude oil contamination. Samples of bile and subsamples of selected tissues collected during the northern fur seal harvest on St. Paul Island were also provided to the Northwest Fisheries Center for analyses. The data from these analyses will be provided to the *AMMTAP*.

The field sampling of northern fur seals was planned and carried out through the cooperation and aid of Dr. Steve

Zimmerman, Chief, and Brad Hanson, Protected Resources Management Division, Alaska Regional Office, and Dr. Terry Spraker, Colorado State University. This included field and laboratory SUpport as well as liaison with the Aleut Community of St. Paul Island. The sampling conducted in this work is described in Section 2.3.3.

During the reporting period, we began working with the Office of Protected Resources and Habitat Programs to develop a national program to establish and maintain a bank of selected marine mamma 1 tissues for retrospective analysis. The sampling protocol for this program, the *National Marine Mammal Tissue Bank (NMMTB) Program, is* based on that developed for the *AMMTAP*. All three principal investigators of the *AMMTAP* are represented on the *NMMTB* Team of Experts, an ad hoc group that provides advice and overview to the NMFS Program. Meetings of the Team of Experts occurred during FY 90 in Monterey, California (December) and Gaithersburg, Maryland (June).

2.2.4 University of Ülm and Nuclear Research Center, Jülich, Germany

The *AMMTAP* participated in the 11th and 12th US-German Seminar of State and Planning on Environmental Specimen Banking (1988 and 1989). Coordination activities initiated at these meetings has resulted in cooperative work with researchers in Germany that has been of great benefit to the *Project.*

Dr. Karlheinz Ballschmiter, Chairman of the Department of Analytical Chemistry, University of Ülm, accompanied the *AMMTAP* investigators to St. Paul Island in July, 1990, and participated in the sampling of the northern fur seals. Dr. Ballschmiter, one of the world's foremost analytic organic chemists, is particularly interested in the global transport and fate of PCBS and similar anthropogenic compounds. Data exchange with Dr. Ballschmiter's lab will be a valuable component of the quality assurance checks of the *AMMTAP* generated analytical data.

The Institute of Applied Physical Chemistry, Nuclear Research Center, Jülich, has provided additional data on samples selected fOr quality control analysis with no additional cost to the *Project.* The neutron activation analysis (NAA) used by NIST to quantify trace elements is not appropriate for Pb and Ni. Concentrations of these elements were determined by Jülich using voltametry. Voltametry measures of Zn, Cd, Cu, and Co were also made for comparison with measurement of these same trace elements using NAA. In addition the Jülich lab provided estimates of Hg and Methyl-Hg for these samples. These data are presented in the *Appendix,* pages 87-88.

2.3 FIELD COLLECTIONS

2.3.1 Harbor Seals and Steller Sea Lions, Prince William Sound and Cook Inlet

The AMMTAP provided assistance to the ADF&G Subsistence Foods Sampling Program in collecting tissue samples from harbor seals and sea lion taken in native subsistence hunts in areas affected by the EXXON VALDEZ oil spill. Logistics were funded by NOAA's Hazardous Materials Response Branch. During the period, March 9 - April 23, Paul Becker accompanied subsistence hunters from the villages of New Chenega Bay (John Totemoff, Peter Selanoff, and Paul Kompkoff, Jr.), English Bay (Nick Tanape), and Tatitlek (Fred Kompkoff and Dave Totemoff) on seal and sea lion hunts. The hunters proceeded to areas frequented by the animals, usually near haulout areas. Once on location and if seals were spotted, the hunters usually went ashore and took a "stand" in order to have a steady place from which to shoot . This is unlike the previous hunts in Norton Sound and Chukchi Sea where the seals were shot from the boats.

Animals were killed by a shot to the head. Measurements of the animals were made and bile and tissue samples were collected from the animals in the field according to the AMMTAP protocols. These samples were brought back to the temporary lab set up for sample processing. In the case of New Chenega Bay and English Bay, the processing lab was set up in the community schools. In the case of Tatitlek, it was set up in the Tatitlek Community Center apartment.

Samples of liver, kidney, and blubber were collected from three harbor seals in Prince William Sound and one Steller sea lion from Lower Cook Inlet and archived at the NBSB. Stomach contents were identified and canine teeth collected for age determinations.

In support of the ADF&G Subsistence Foods Sampling Program, the following tissues and fluids were sampled according to the AMMTAP protocols and shipped to the Environmental Conservation Division, Northwest Fisheries Center, NMFS , Seattle, for determining levels of aromatic compounds and metabolizes indicative of EXXON VALDEZ oil: bile, liver, kidney, blubber, muscle, lung, ovaries, and brain. Materials and supplies for these samples were provided by the NMFS lab and are compatible with the AMMTAP protocol. The data resulting from these analyses will be provided to the AMMTAP.

John Totemoff and Peter Selanoff were given instructions and collecting materials for obtaining samples from other animals which they might obtain in future hunts. We later learned that they were able to collect tissue samples from

three additional seals in Prince William Sound. We were able to expedite the shipment of these samples to the NMFS lab for analysis.

2.3.2 Belukha Whales, Point Lay

On July 2 - 14, 1990, Paul Becker, AEAC, collected tissues from belukha whales taken in the subsistence hunt at Point Lay. A processing lab was set up in the Culley Camp facilities in Point Lay. Becker worked with Robert Suydam and Clarence Itta, NSB DWM, and Geoff Carroll, ADF&G, to obtain the samples and to make meristic measurements for the NSB belukha whale subsistence survey program.

Although the Point Lay hunt usually occurs on or about July 4, the 1990 season was somewhat unusual in that the animals tended to congregate far to the south of Point Lay and would not move past the village. Finally on July 10, the village hunters decided to proceed south along the Chukchi coast, find the whales, and drive them back to Point Lay. Becker accompanied Mike Neakok in one skiff and Robert Suydam accompanied Gordon Neakok in a second skiff. The entire party consisted of nine boats. By midnight, July 11, a pod of whales was located off Cape Beaufort. These animals were driven back to Point Lay, arriving at the harvest site in Kasegaluk Lagoon at noon, July 11. The place in lagoon were the animals are traditionally dispatched is the shallow area opposite the old Point Lay village site which is located on the barrier island separating the lagoon from the Chukchi Sea.

The harvest began at 12:30 P.M. Each animal was dispatched by rifle shot to the head just behind the blowhole. Only the mature (white) animals were targeted for harvest. After being shot, a marker buoy was immediately attached to each dead and floating whale. After all animals that were to be harvested were taken, each dead whale was located by the buoy, a line was attached to the fluke of the animal, and the whale towed to the beach at the foot of the old village site. They remained floating in the shallow water at the beach until butchering. After all harvested animals had been towed to this site (62 animals), the butchering began (5:00 P.M.).

The sequence of butchering involved attaching a double line to the flukes of the animal, pulling the animal out of the water and up the gravel beach by 20-30 men equally distributed between the two lines, removal of the "magtak" (blubber plus skin) from just behind the head to the flukes, and removal of some cuts of meat. No internal organs were taken for consumption; therefore, the body cavity remained intact until samples were obtained for the AMMTAP. After all the animals were thus butchered, the magtak was equally

divided among the villagers. This food was carried up the beach to the ice cellars in the old village site just above the butchering site.

During the butchering, Becker worked with Robert Suydam and Geoff Carroll to obtain samples for the AMMTAP and collected data for the NSB belukha whale harvest program. Data recorded for the harvest program included: sex, coloration, physical scars, degree of maturation, whether or not the animal was lactating or pregnant, length, and fluke width. In addition, samples of skin for genetics work, female reproductive organs, and jaws for age determination were collected. An attempt was made to insure that these data and samples were collected from the same animals sampled for the AMMTAP archive.

Samples of liver, blubber, and kidney were collected for the from 10 animals for archival using the AMMTAP protocols. These samples were returned to the temporary lab at Culley Camp where they were processed and frozen. These samples were shipped to Anchorage (July 14) and stored in the U.S Fish and Wildlife ultra freezers (-SO°C) until transferred to the NBSB in LN_2 shippers.

2.3.4 Northern Fur Seals, St. Paul Island

On July 21 - 25, Paul Becker, AEAC, Steve Wise, NIST, and Karlheinz Ballschmiter, University of Ülm, collected tissue samples from the subsistence harvest of northern fur seals on St. Paul Island. Procedures were the same as described in the 1987 Annual Report for this species. The samples were collected in cooperation with Terry Spraker, Veterinarian, Colorado State University, Brad Hanson, NMFS Alaska Regional Office, and Richard Zaharoff, harvest foreman. The sample processing lab was set up at the NMFS laboratory at St. Paul.

Samples of blubber, liver, kidney, and bile were collected from four animals (immature males) during the harvest on July 23 at Zapadni Rookery, and from six animals (immature males) during the harvest on July 24 at Reef Rookery. Subsamples of the tissues and the bile samples *were* shipped to the Conservation Division, NWFC, NMFS, Seattle. The AMMTAP samples were processed, frozen, and shipped to the NBSB , Gaithersburg, Maryland, using the standard AMMTAP protocols.

Subsamples of liver and blubber were also provided to Ballschmiter for analysis for PCBS and chlorinated pesticides. Ballschmiter working Terry Spraker also collected tissues from seal pups found dead on the rookeries for additional analysis for PCBS and chlorinated pesticides. The results of these analyses will provided to the AMMTAP.

2.4 PROTOCOL DEVELOPMENT

The collection protocol used by RU 692 was originally published in a project description document in 1988 (Becker *et al.,* 1988). Since that time, additional field experience with several species in various geographic areas of Alaska has resulted in some refinements of the original procedures. It was also felt that more detail on the methods of cleaning and maintaining the specialized equipment was needed in the protocol description. As a result, a draft revision of the original protocol description was produced in November 1990. This report, *Alaska Marine Mammal Tissue Archival Project: Revised Collection Protocol, will* be published in 1991.

3.0 ALASKA **MARINE MAMMAL** TISSUE INVENTORY

The geographic locations of the species sampled by RU 692 *(AMMTAP)* are presented in Figure 1. A listing of the tissue samples archived for each of the geographic locations are presented in Tables 2-4. It is apparent that the *Project* has emphasized marine mammals from the Arctic. Since the interest of the sponsor is to obtain materials from areas of principal oil and gas industry interest, this emphasis on the Arctic will probably continue.

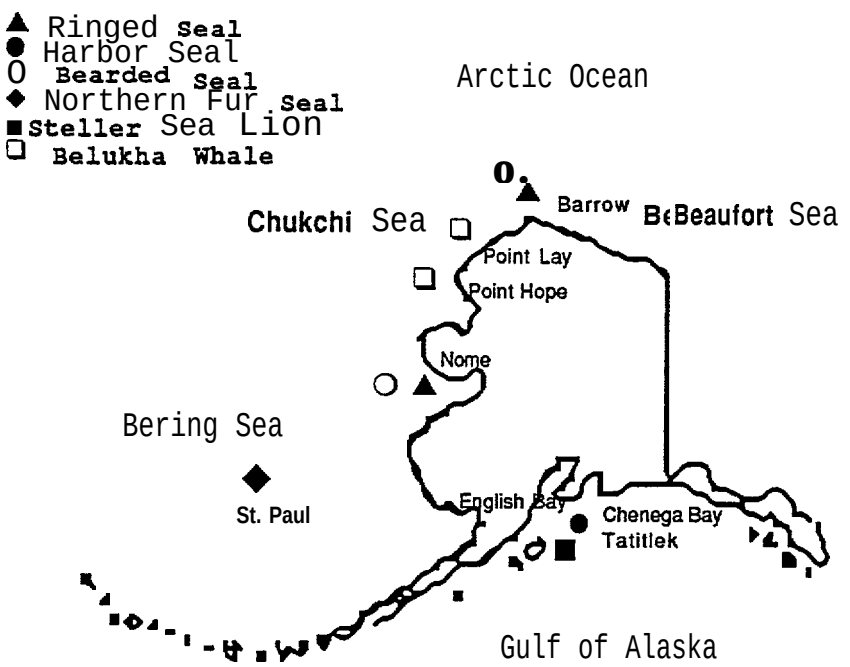

Figure 1. Geographic locations of sample collections.

Table 2. Marine mammals sampled in the Arctic Ocean. (x = samples archived. ■ = samples archived; subsample B homogenized and divided into aliquots for analyses).

Species	Sex	Individual ID	Location	Date	Tissue L	K	B	M
Ringed seal	M	692-RGSL-001	Barrow	7/88	x	x	x	
Ringed seal	F	692-RGSL-002	Barrow	7/88	x	x	x	
Ringed seal	M	692-RGSL-003	Barrow	7/88	x	x	x	
Ringed seal	M	692-RGSL-004	Barrow	7/88	■	■	■	
Ringed seal	F	692-RGSL-005	Barrow	7/88	x	x	x	
Ringed seal	F	692-RGSL-006	Barrow	7/88	x	x	x	
Ringed seal	M	692-RGSL-007	Barrow	7/88	x	x	x	
Ringed seal	M	692-RGSL-008	Barrow	7/88	■	m	m	
Ringed seal	M	692-RGSL-009	Barrow	7/88	x	x	x	
Ringed seal	F	692-RGSL-010	Barrow	7/88	x	x	x	
Bearded seal	M	692-BDSL-002	Barrow	7/89	x	x	x	
Bearded seal	M	692-BDSL-003	Barrow	7/89	x		x	
Belukha whale	F	692-BLKA-001	Pt. Hope	5/89	■	x	■	
Belukha whale	F	692-BLKA-002	Pt. Hope	5/89	■	x	m	
Belukha whale	F	692-BLKA-003	Pt. Hope	5/89	■	x		
Belukha whale	M	692-BLKA-004	Pt. Hope	5/89	■			
Belukha whale	M	692-BLKA-005	Pt. Lay	7/90	x	x	x	
Belukha whale	M	692-BLKA-006	Pt. Lay	7/90	x	x	x	
Belukha whale	F	692-BLKA-007	Pt. Lay	7/90	■	x	m	
Belukha whale	M	692-BLKA-008	Pt. Lay	7/90	x	x	x	
Belukha whale	M	692-BLKA-009	Pt. Lay	7/90	x	x	x	
Belukha whale	M	692-BLKA-010	Pt. Lay	7/90	x	x	x	
Belukha whale	M	692-BLKA-011	Pt. Lay	7/90	x	x	x	
Belukha whale	F	692-BLKA-012	Pt. Lay	7/90	■	X	=	
Belukha whale	M	692-BLKA-013	Pt. Lay	7/90	x	x	x	
Belukha whale	F	692-BLKA-014	Pt. Lay	7/90	x	x	x	

Table 3. Marine mamma 1s sampled in the Bering Sea. (x = samples archived. ■= samples archived; subsample B homogenized and divided into aliquots for analyses).

Species	Sex	Individual ID	Location	Date	Tissue L	K	B	M
Ringed seal	M	692-RGSL-011	Nome	5/89	■	x	m	
Ringed seal	F	692-RGSL-012	Nome	5/89	x	x	x	
Ringed seal	M	692-RGSL-013	Nome	5/89	■	x	m	
Ringed seal	M	692-RGSL-014	Nome	5/89	x	x	x	
Ringed seal	F	692-RGSL-015	Nome	5/89	x	x	x	
Bearded seal	M	692-BDSL-001	Nome	5/89	x	x	x	
N. fur seal	M	692-FRSL-001	St. Paul	7/87	X	x	x	x
N. *fur* seal	M	692-FRSL-002	St. Paul	7/87	X	x	x	x
N. fur seal	M	692-FRSL-003	St. Paul	7/87	X	x	x	x
N. fur seal	M	692-FRSL-004	St. Paul	7/87	■	m	s	m
N. fur seal	M	692-FRSL-005	St. Paul	7/87	■	m	D	m
N. fur seal	M	692-FRSL-006	St. Paul	7/90	x	x	x	
N. fur seal	M	692-FRSL-007	St. Paul	7/90	■	x	x	
N. fur seal	M	692-FRSL-008	St. Paul	7/90	x	x	x	
N. fur seal	M	692-FRSL-009	St. Paul	7/90	x	x	x	
N. fur seal	M	692-FRSL-010	St. Paul	7/90	■	x	x	
N. fur seal	M	692-FRSL-011	St. Paul	7/90	■	x	x	
N. fur seal	M	692-FRSL-012	St. Paul	7/90	x	x	x	
N. fur seal	M	692-FRSL-013	St. Paul	7/90	x	x	x	
N. fur seal	M	692-FRSL-014	St. Paul	7/90	x	x	x	
N. fur seal	M	692-FRSL-015	St. Paul	7/90	x	x	x	

Table 4. Marine mammals sampled in the Gulf of Alaska. (x = samples archived. ■ = samples archived; subsample B homogenized and divided into aliquots for analyses).

Species	Sex	Individual ID	Location	Date	Tissue L	K	B	M
Harbor seal	M	692-HBSL-001	Prince William S.	3/90	x	x	x	
Harbor seal	F	692-HBSL-002	Prince William S.	4/90	x	x	x	
Harbor seal	M	692-HBSL-003	Prince William S.	4/90	x	x	x	
S. sea lion	F	692-STSL-001	Cook Inlet	3/90	x	x	x	

A detailed inventory of samples contained in the *Alaska Marine Mammal Tissue Archive is* presented on pages 17-36. This inventory lists the *AMMTAP* samples by species, presents meristic information on the animals sampled, lists additional samples taken by other researchers, where these additional samples are presently located, as well as other miscellaneous information regarding the individual samples or the animal sampled. Also, those subsamples that have been homogenized and divided into aliquots for analysis are identified. The format used to present this data is explained in Table 5. A list of acronyms used in the inventory is presented in Table 6.

Table 5. *AMMTAP* sample inventory format.

INDIVIDUAL ID NO. Geographic Area, Village Lat.-Long. Date

age/sex weight (W)
standard length (SL) fluke width (FW)
blubber thickness (BT) axillary girth (AG)

NBSB Samples tissue type	NBSB ID number	subsample A weight in grams	/	subsample B weight *in grams	Histo-Section yes or no

Additional Samples Collected for Other Researchers

Organization, individual and *ID number,* if appropriate
Present location of samples
List of samples

Table 6. Acronyms used in the *AMMTAP* sample inventory.

ADF&G - Alaska Department of Fish and Game
AEAC - Arctic Environmental Assessment Center (NOAA)
NBSB - National Biomonitoring Specimen Bank
NCRC - National Cancer Research Center
NMFs - National Marine Fisheries Service
NSB DWM - North Slope Borough Department of Wildlife Management
NWFC - Northwest Fisheries Center

**Thosesamples that have been homogenized and divided into aliquots for analyses are indicated by an asterisk (*) .*

3.1 Ringed Seal (*Phoca hispida*)

692-RGSL-001 Chukchi Sea, Barrow 71°19′ 156°50′
11July88

l-yr male w = 19.5 kg
SL = 99.0 cm AG = 60 cm BT = 3.5 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM2L021	187.5 / 163.5	Yes
Kidney	MM2K022	64.6 / 69.0	Yes
Blubber	MM2B023	121.0 / 137.0	
Tooth			
Stomach Contents (present location, AEAC, Anchorage)			

Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC NMFS, Seattle, WA:

Bile	1-10 mL	Liver	10 g
Blood	5-15 mL	Muscle	10 g

692-RGSL-002 Chukchi Sea, Barrow 71°19′ 156°50′
11July88

<1-yr female w = 12.7 kg
SL = 75.0 cm AG = 48 cm BT = 2.5 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM2L024	120.5 / 129.5	Yes
Kidney	MM2K025	45.0 / 42.0	Yes
Blubber	MM2B026	70.0 / 78.0	
Tooth			
Stomach Contents (present location, AEAC, Anchorage)			

Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC NMFS, Seattle, WA:

Bile	1-10 mL	Liver	10 g
Blood	5-15 mL	Muscle	10 g

692-RGSL-003 Chukchi Sea, Barrow 71°19′ 156°50′
11July88

2-yr male w = 35.4 kg
SL = 118.0 cm AG = 70 cm BT = 2.5 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM2L027	155.0 / 150.0	Yes
Kidney	MM2K028	110.0 / 110.5	Yes
Blubber	MM2B029	98.0 / 113.0	
Tooth			
Stomach Contents (present location, AEAC, Anchorage)			

Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Bile 1-10 mL Liver 10 g Muscle 10 g

692-RGSL-004 Chukchi Sea, Barrow 71°19′ 156°50′
11July88

2-yr male w = 32.2 kg
SL = 108.0 cm AG = 84 cm BT = 2.0 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM2L030	154.0 /*187.0	Yes
Kidney	MM2K031	106.0 /*113.0	Yes
Blubber	MM2B032	98.3 / *98.9	
Tooth			
Stomach Contents (present location, AEAC, Anchorage)			

Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Bile 1-1o mL Muscle 10 g
Liver 10 g

692-RGSL-005 Chukchi Sea, Barrow 71°19′ 156°50′
11July88

1-yr female W = 15.4 kg
SL = 84.5 cm AG = 63 cm BT = 2.7 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM2L033	127.0 / 130.6	Yes
Kidney	MM2K034	48.0 / 49.0	Yes
Blubber	MM2B035	141.4 / 150.2	
Tooth			
Stomach Contents (present location, AEAC, Anchorage)			

Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Bile 1-10 mL Muscle 10 g
Liver 10 g

692-RGSL-006 Chukchi Sea, Barrow 71°19′ 156°50′
12July88

<1-yr female w = 15.4 kg
SL = 88.0 cm AG = 58 cm BT = 2.8 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM2L036	129.3 / 128.8	Yes
Kidney	MM2K037	54.5 / 58.0	Yes
Blubber	MM2B038	102.6 / 118.6	
Tooth			
Stomach Contents (present location, AEAC, Anchorage)			

Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Bile 1-10 mL Liver 10 g
Blood 5-15 mL Muscle 10 g

692-RGSL-007 Chukchi Sea, Barrow 71°23′ 156°32′
12July88

2-yr male w = 23.1 kg
SL = 94.0 cm AG = 75 cm BT = 2.9 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM2L039	165.6 / 162.5	Yes
Kidney	MM2K040	86.6 / 84.8	Yes
Blubber	MM2B041	138.5 / 133.6	
Tooth			
Stomach Contents (present location, AEAC, Anchorage)			

Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC NMFS, Seattle, WA:

Bile	1-1o mL	Liver	10 g
Blood	5-15 mL	Muscle	10 g

692-RGSL-008 Chukchi Sea, Barrow 71°23′ 156°32′
13July88

2-yr male w = 23.1 kg
SL = 104.0 cm AG = 63.5 BT = 2.8 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM2L042	154.2 /*168.6	Yes
Kidney	MM2K043	89.5 / *95.5	Yes
Blubber	MM2B044	129.2 /*131.0	
Tooth			
Stomach Contents (present location, AEAC, Anchorage)			

Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC NMFS, Seattle, WA:

Bile	1-1o mL	Liver	10 g
Blood	5-15 mL	Muscle	10 g

692-RGSL-009 Chukchi Sea, Barrow 71°22′ 156°37′
14July88

<1-yr male w = 15.0 kg
SL = 75.0 cm AG = 63 cm BT = 2.4 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM2L045	128.1 / 130.8	Yes
Kidney	MM2K046	46.6 / 47.6	Yes
Blubber	MM2B047	86.9 / 94.1	
Tooth			
Stomach Contents (present location, AEAC, Anchorage)			

Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC NMFS, Seattle, WA:

Bile	1-1o mL	Liver	10 g
Blood	5-15 mL	Muscle	10 g

692-RGSL-010 Chukchi Sea, Barrow 71°22′ 156°37′
14July88

2-yr female W = 25.4 kg
SL = 98.0 cm AG = 83.5 BT = 3.0 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM2L048	168.5 / 146.7	Yes
Kidney	MM2K049	78.4 / 76.4	Yes
Blubber	MM2B050	146.7 / 161.0	
Tooth			

Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Bile 1-1o mL Liver 10 g Blood 5-15 mL

692-RGSL-011 Norton Sound, Nome 64°19′ 165°15′
26May89

1-yr male w = 33.6 kg
SL = 119.5 cm AG = 82.?5 cm BT = 4.0 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM3L054	142.2 /*147.0	Yes
Kidney	MM3K055	115.1 / 104.5	Yes
Blubber	MM3B056	128.0 /*145.0	
Tooth	(present location, ADF&G, Nome, AK)		
Stomach Contents	(present location, ADF&G, Nome, AK)		

Additional Samples Collected for Other Researchers
ADF&G; present location, ADF&G, Nome AK:
Front claws Reproductive organs

NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Bile 1-1o mL Blood 5-15 mL

692-RGSL-012 Norton Sound, Nome 64°19′ 165°00′
26May8 9

2-yr female w = 36.3 kg
SL = 124.5 cm AG = 100.0 cm BT = 3.5 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM3L057	160.0 / 141.4	Yes
Kidney	MM3K058	104.8 / 104.4	Yes
Blubber	MM3B059	147.0 / 148.0	
Tooth	(present location, ADF&G, Nome, AK)		
Stomach Contents	(present location, ADF&G, Nome, AK)		

Additional Samples Collected for Other Researchers
ADF&G; present location, ADF&G, Nome, AK:
Front claws Reproductive organs

NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Bile 1-10 mL Blood 5-15 mL

692-RGSL-013 Norton Sound, Nome 64°18′ 165°00′
3lMay89

l-yr male w = 31.75 kg
SL = 103.5 cm AG = 79 cm BT = 4.5 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM3L060	95.2 /*110.2	Yes
Kidney	MM3K061	93.2 / 101.3	Yes
Blubber	MM3B062	149.2 /*167.2	
Tooth	(present location, ADF&G, Nome, AK)		
Stomach Contents	(present location, ADF&G, Nome, AK)		

Additional Samples Collected for Other Researchers

ADF&G; present location, ADF&G, Nome, AK:
Front claws Reproductive organs

NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Bile 1-10 mL Blood 5-15 mL

692-RGSL-014 Norton Sound, Nome 64°19′ 164°44′
3lMay89

1-yr male w = 29.5 kg
SL = 101.0 cm AG = 74 cm BT = 3.0 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM3L063	50.9 / 50.6	Yes
Kidney	MM3K064	67.5 / 62.6	Yes
Blubber	MM3B065	108.4 / 123.8	
Tooth	(present location, ADF&G, Nome, AK)		
Stomach Contents	(present location, ADF&G, Nome, AK)		

Additional Samples Collected for Other Researchers

ADF&G; present location, ADF&G, Nome, AK:
Front claws Reproductive organs

NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Blood 5-15 mL

692-RGSL-015 Norton Sound, Nome 64°18′ 165°00′
3lMay89

<1-yr female w = 20.0 kg
SL = 83.2 cm AG = 66 cm BT = 3.25 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM3L066	123.8 / 114.9	Yes
Kidney	MM3K067	68.5 / 68.2	Yes
Blubber	MM3B068	110.1 / 103.0	

Tooth (present location, ADF&G, Nome, AK)
Stomach Contents (present location, ADF&G, Nome, AK)

Additional Samples Collected for Other Researchers

ADF&G; present location, ADF&G, Nome, AK:
Front claws Reproductive organs

NWFC, NMFS; present location, NWFC NMFS, Seattle, WA:
Bile 1-10 mL Blood 5-15 mL

3.2 Harbor Seal (*Phoca vitulina*)

692-HBSL-001 Prince William Sound 60°10.9′ 147°55.3′
New Year Island 10Mar90

l-yr male W = 2a kg
SL = 105.4 cm AG = 74.5 cm BT = 4.0 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L083	165.3 / 163.1	Yes
Kidney	MM4K084	72.05 / 37.3	Yes
Blubber	MM4B085	136.0 / 153.4	
Tooth (present location, AEAC, Anchorage)			

[1]Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC NMFS, Seattle, WA:

Bile	1-1o mL	Muscle	10 g
Liver	10 g	Lung	10 g
Blubber	10 g	Rt. Cerebrum	10 g
Kidney	10 g	Cerebellum	10 g

692-HBSL-002 Prince William Sound 60°55.45′ 146°36.2′
Galena Bay 22April90

2-yr female w = 47.6 kg
SL = 125.1 cm AG = 94.5 cm BT = 3.8 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L092	138.1 / 139.05	Yes
Kidney	MM4K093	120.3 / 94.3	Yes
Blubber	MM4B094	149.4 / 151.85	
Tooth (present location, AEAC, Anchorage)			

[1]Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC NMFS, Seattle, WA:

Bile	1-1o mL	Lung	10 g
Liver	10 g	Ovaries	10 g
Blubber	10 g	Muscle	10 g

[1]*These samples were collected for analysis of petroleum hydrocarbon compounds as part of the ADF&G sponsored Subsistence Foods Sampling Program.*

692-HBSL-003 Prince William Sound 60°55.45′ 146°36.2′
Galena Bay 22Apri190

2-yr male w = 39.9 kg
SL = 125.1 cm AG = 85.0 cm BT = 3.0 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L089	160.35 / 164.4	Yes
Kidney	MM4K090	80.2 / 112.9	Yes
Blubber	MM4B091	125.4 / 105.3	
Tooth	(present location, AEAC, Anchorage)		

[2]Additional Samples Collected for Other Researchers

NWFC NMFS; present location, NWFC NMFS, Seattle, WA:

Bile	1-1o mL	Lung	10 g
Liver	10 g	Blubber	10 g
Muscle	10 g	Kidney	10 g

[2]*These samples* were collected *for analysis of petroleum hydrocarbon compounds as part of the ADF&G sponsored Subsistence Foods Sampling Program.*

3.3 Bearded Seal (*Erignathus barbatus*)

692-BDSL-001 Norton Sound, Nome 64°19′ 165°0′
26May8 9

1-yr male w = 60-90 kg
SL = 166.7 cm AG = 99 cm BT = 4.5 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM3L051	154.0 / 159.0	Yes
Kidney	MM3K052	147.0 / 129.5	Yes
Blubber	MM3B053	158.0 / 163.0	

Tooth (present location, ADF&G, Nome, AK)
Stomach Contents (present location, ADF&G, Nome, AK)

Additional Samples Collected for Other Researchers
ADF&G; present location, ADF&G, Nome, AK:
Front claws Reproductive organs

NWFC NMFS; present location, NWFC NWFC, Seattle, WA:
Bile 1-10 mL Blood 5-15 mL

692-BDSL-002 Chukchi Sea, Barrow 71°31′ 157″00′
20July89

4-yr male w = 200 kg
SL = 210 cm AG = 130 cm BT = 4.5 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM3L078	149.9 / 157.2	Yes
Kidney	MM3K079	152.6 / 166.9	Yes
Blubber	MM3B080	126.9 / 125.1	

Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Liver 10 g Kidney 10 g

692-BDSL-003 Chukchi Sea, Barrow 71°31′ 157″00/
20July89

5-yr male w = 225 kg
SL = 240 cm AG = 138 cm BT = 5 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM3L081	155.4 / 167.8	Yes
Blubber	MM3B082	128.5 / 119.7	

Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Liver 10 g

3.4 Northern Fur Seal (*Callorhinus ursinus*)

692-FRSL-001 Bering Sea, St. Paul I. 57°10.5′ 170″09.5′
Polovina 28July87

3-yr male W = *56.3* kg SL = 114.0 cm BT = 1.5 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM1L001	135.0 / 125.0	Yes
Kidney	MM1K002	93.0 / 97.0	Yes
Muscle	MM1M0 03	125.0 / 132.5	
Blubber	MM1B004	119.0 / 114.5	
Tooth			

Additional Samples Collected for Other Researchers
L. Rotterman; present location, NCRC, Frederick, MD:
Blood 5-15 mL Heart 10 g Liver 10 g Spleen 10 g

692-FRSL-002 Bering Sea, St. Paul I. 57°10.5′ 170″09.5′
Polovina 28July87

3-yr male W = 77.6 kg SL = 117.3 cm BT = 2.5 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM1L005	117.8 / 110.5	Yes
Kidney	MM1K006	137.2 / 137.0	Yes
Muscle	MM1M007	170.0 / 143.0	
Blubber	MM1B008	156.0 / 158.0	
Tooth			

Additional Samples Collected for Other Researchers
L. Rotterman; present location, NCRC, Frederick, MD:
Blood 5-15 mL Heart 10 g Muscle 10 g
Spleen 10 g Liver 10 g Skin (genetics)

692-FRSL-003 Bering Sea, St. Paul I. 57″10.5J 170″09.5/
Polovina 28July87

3-yr male W = 84.0 kg SL = 124.0 cm BT = 3.0 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM1L009	132.0 / 140.0	Yes
Kidney	MM1K010	112.0 / 103.0	Yes
Muscle	MM1M011	152.5 / 136.0	
Blubber	MM1B012	156.5 / 144.5	
Tooth			

Additional Samples Collected for Other Researchers
L. Rotterman; present location, NCRC, Frederick, MD:
Blood 5-15 mL Heart 10 g Muscle 10 g
Spleen 10 g Liver 10 g Skin (genetics)

692-FRSL-004 Bering Sea, St. Paul I. 57°14.85′ 170°05.9′
Northeast Point 29July87

3-yr male W = *64.7* kg SL = 111.4 cm BT = 2.5 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM1L013	129.5 /*149.0	Yes
Kidney	MM1K014	92.0 / *93.5	Yes
Muscle	MM1M015	129.2 /*148.0	
Blubber	MM1B016	105.5 /*101.0	
Tooth			

Additional Samples Collected for Other Researchers
L. Rotterman; present location, NCRC, Frederick, MD:
Blood 5-15 mL Heart 10 g
Spleen 10 g Skin (genetics)

692-FRSL-005 Bering Sea, St. Paul I. 57°14.85′ 170°05.9′
Northeast Point 29July87

2-yr male W = 58.7 kg SL = 110.4 cm BT = 3.o Cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM1L017	145.0 /*136.0	Yes
Kidney	MM1K018	118.5 /*112.0	Yes
Muscle	MM1M019	103.0 /*105.0	
Blubber	MM1B020	157.0 /*141.0	
Tooth			

Additional Samples Collected for Other Researchers
L. Rotterman; present location, NCRC, Frederick, MD:
Blood 5-15 mL Heart 10 g Skin (genetics)
Spleen 10 g Liver 10 g

692-FRSL-006 Bering Sea, St. Paul I. 57°09′ 170°20.11
Zapadni 23July90

Subadult male W = 21.8 kg SL = 97.8 cm BT = 1.2 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L095	138.0 / 166.3	Yes
Kidney	MM4K096	88.0 / 95.3	Yes
Blubber	MM4B097	144.4 / 145.8	
Tooth			

Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Blubber 10 g Liver 10 g

692-FRSL-007 Bering Sea, St. Paul I. Zapadni 57°09′ 170°20.1′ 23July90

Subadult male W = 23.0 kg SL = 103.5 cm BT = 0.9 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L098	56.9 / *68.2	Yes
Kidney	MM4K088	97.5 / 98.6	Yes
Blubber	NM4B100	150.8 / 142.9	
Tooth			

Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Bile 1-1o mL Blubber 10 g

692-FRSL-008 Bering Sea, St. Paul I. Zapadni 57°09′ 170°20.1′ 23July90

Subadult male W = 21.3 kg SL = 103.5 cm BT = 1.1 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L101	124.2 / 126.0	Yes
Kidney	MM4K102	81.2 / 80.3	Yes
Blubber	MM4B103	140.0 / 141.7	
Tooth			

Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC, NMFS, Seattle, WA:
Bile 1-10 mL Liver 10 g
Blubber 10 g

692-FRSL-009 Bering Sea, St. Paul I. Zapadni 57°09′ 170°20.1′ 23July90

subadult male w = ? kg SL = ? cm BT = ? cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L104	137.5 / 144.5	Yes
Kidney	MM4K105	90.2 / 86.1	Yes
Blubber	MM4B106	139.8 / 156.2	
Tooth			

Additional Samples Collected for Other Researchers
NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Bile 1-10 mL Liver 10 g
Blubber 10 g

692-FRSL 010 Bering Sea, St. Paul I. Reef 57°06.6′ 170°17.6′ 24July90

Subadult male W = 15.8 kg SL = 94.6 cm BT = 0.8 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L107	146.0 /*111.9	Yes
Kidney	MM4K108	66.6 / 68.5	Yes
Blubber	MM4B109	90.0 / 96.7	
Tooth			

Additional Samples Collected for Other Researchers

NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Bile 1-10 mL Blubber 10 g

692-FRSL-011 Bering Sea, St. Paul I. Reef 57°06.6′ 170°17.6′ 24July90

Subadult male W = 17.3 kg SL = 43.2 cm BT = 0.7 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L110	71.6 / *89.1	Yes
Kidney	MM4K111	70.8 / 69.8	Yes
Blubber	MM4B112	64.1 / 54.4	
Tooth			

Additional Samples Collected for Other Researchers

NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Bile 1-10 mL Blubber 10 g

692-FRSL-012 Bering Sea, St. Paul I. Reef 57006.6/ 170°17.6′ 24July90

Subadult male W = 20.2 kg SL = 99.1 cm BT = 1.0 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L113	136.0 / 132.4	Yes
Kidney	MM4K114	92.0 / 90.3	Yes
Blubber	MM4B115	94.4 / 107.6	
Tooth			

Additional Samples Collected for Other Researchers

NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Bile 1-1o mL

692-FRSL-013 Bering Sea, St. Paul I. Reef 57006.6/ 170°17.6′ 24July90

Subadult male W = 20.2 kg SL = ? cm BT = 1.0 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L116	154.1 / 127.0	Yes
Kidney	MM4K117	90.7 / 98.0	Yes
Blubber	MM4B118	129.3 / 98.6	
Tooth			

Additional Samples Collected for Other Researchers

NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Bile 1-10 mL

692-FRSL-014 Bering Sea, St. Paul I. Reef 57°06.6′ 170°17.6′ 24July90

Subadult male W = 15.9 kg SL = 95.9 cm BT = 0.9 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L119	119.3 / 124.2	Yes
Kidney	MM4K120	92.4 / 91.5	Yes
Blubber	MM4B121	100.0 / 103.7	
Tooth			

Additional Samples Collected for Other Researchers

NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Liver 10 g Blubber 10 g

692-FRSL-015 Bering Sea, St. Paul I. Reef 57°06.6′ 170°17.6′ 24July90

subadult male W = 17.4 kg SL = 104.1 cm BT = 1.2 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L122	117.2 / 148.3	Yes
Kidney	MM4K123	70.3 / 70.2	Yes
Blubber	MM4B124	126.0 / 116.5	
Tooth			

Additional Samples Collected for Other Researchers

NWFC NMFS; present location, NWFC NMFS, Seattle, WA:
Bile 1-10 mL

3.5 Steller (Northern) Sea Lion (*Eumetopias jubatus*)

692-STSL-001 Cook Inlet, English Bay 59"19.9' 151"59.7'
Flat Island **26March89**

Mature female (with fetus) w = 250 kg
SL = 254 cm AG = ? cm BT = 3.0 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L086	142.5 / 152.9	Yes
Kidney	MM4K087	155.2 / 154.9	Yes
Blubber	MM4B088	141.4 / 156.0	

Tooth (present location, AEAC, Anchorage, AK)

[3]Additional Samples Collected for Other Researchers

NWFC NMFS; present location, NWFC NMFS, Seattle, WA:

Bile	1-1o mL	Lung	10 g
Liver	10 g	Muscle	10 g
Kidney	10 g	Blubber/Skin	10 g
Blubber	10 g	Left Cerebrum	10 g

[3]*These samples were collected for analysis of petroleum hydrocarbon compounds as part of the ADF&G sponsored Subsistence Foods Sampling Program.*

3.6 **Belukha** Whale (*Delphinapterus leucas*)

692-BLKA-001 Chukchi Sea, Pt. Hope 68°20′ 166°50′
26May8 9

<5-yr female - light gray (immature)
SL = 342.9 cm FW = 74.9 cm BT = ? cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM3L069	178.6 /*169.6	Yes
Kidney	MM3K070	148.0 / 169.0	Yes
Blubber	MM3B071	121.9 /*132.5	
Tooth	(present location, DWM, Barrow, AK)		

Additional Samples Collected for Other Researchers
NSB DWM, ID No. *HDL-5-89;*
present location, DWM, Barrow, AK:

Lower jaw with teeth	Blubber	Liver
Reproductive organs	Kidney	Skin (genetics)

692-BLKA-002 Chukchi Sea, Pt. Hope 68°20′ 166°50′
25May8 9

>5-yr female - mottled (mature)
SL = 303.9 cm FW = 71.1 cm BT = 7.6 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM3L072	178.3 /*166.6	Yes
Kidney	MM3K073	155.6 / 163.1	Yes
Blubber	MM3B074	129.9 /*132.0	
Tooth	(present location, DWM, Barrow, AK)		

Additional Samples Collected for Other Researchers
NSB, DWM, ID No. *HDL-3-89;*
present location, DWM, Barrow, AK:

Lower jaw with teeth	Blubber	Liver
Reproductive organs	Kidney	Skin (genetics)

692-BLKA-003 Chukchi Sea, Pt. Hope 68°20′ 166°50′
25May8 9

>5-yr female - mottled (mature)
SL = 348 cm FW = ? cm BT = ?cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM3L075	156.1 /*170.1	Yes
Kidney	MM3K076	176.3 / 175.0	Yes
Tooth	(present location, DWM, Barrow, AK)		

Additional Samples Collected for Other Researchers
NSB DWM, ID No. *HDL-2-89;*
present location, DWM, Barrow, AK:

Lower jaw with teeth	Liver
Reproductive organs	Kidney

692-BLKA-004 Chukchi Sea, Pt. Hope 68°20′ 166°50′
19May89

>5-yr male - mottled (mature)
SL = 348 cm FW = ? cm BT = 7 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM3L077	125.1 /*130.4	Yes
Tooth	(present location, DWM, Barrow, AK)		

Additional Samples Collected for Other Researchers
NSB DWM, ID No. *HDL-5-89;*
present-location, DWM, Barrow, AK:
Lower jaw with teeth Blubber Stomach contents
Reproductive organs Liver Skin (genetics)

692-BLKA-005 Chukchi Sea, Pt. Lay 69°05′ 163°45′
11July90

>5-yr male - white (mature)
SL = 394 cm FW = 103 cm BT = 3.7 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L125	175.75 / 169.6	Yes
Kidney	MM4K126	169.2 / 160.85	Yes
Blubber	MM4B127	131.1 / 131.85	
Tooth	(present location, DWM, Barrow, AK)		

Additional Samples Collected for Other Researchers
NSB DWM, ID No. *LDL-2-90:*
present-location, DWM, Barrow, AK:
Lower jaw with teeth Skin (genetics)

692-BLKA-006 Chukchi Sea, Pt. Lay 69°05′ 163°45′
11July90

>5-yr male - white (mature)
SL = 430 cm FW = 102 cm BT = 6.5 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L128	184.9 / 180.8	Yes
Kidney	MM4K129	154.65 / 176.75	Yes
Blubber	MM4B130	152.8 / 146.2	
Tooth	(present location, DWM, Barrow, AK)		

Additional Samples Collected for Other Researchers
NSB DWM, ID No. *LDL-31-90;*
preSent location, DWM, Barrow, AK:
Lower jaw with teeth

692-BLKA-007 Chukchi Sea, Pt. Lay 69°05′ 163°45′
11July90

>5-yr female - white (mature)
SL = 363 cm FW= 88 cm BT = 7.7 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L131	174.5 /*158.25	Yes
Kidney	MM4K132	159.75 / 159.8	Yes
Blubber	MM4B133	140.9 /*137.2	
Tooth	(present location, DWM, Barrow, AK)		

Additional Samples Collected for Other Researchers
NSB DWM, ID No. *LDL-10-90;* present location, DWM,
present location, DWM, Barrow, AK:
Lower jaw with teeth Reproductive organs

692-BLKA-008 Chukchi Sea, Pt. Lay 69°05′ 163°45′
11July90

>5-yr male - white (mature)
SL = 364 cm FW=?cm BT = ? cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L134	172.0 / 160.15	Yes
Kidney	MM4K135	149.6 / 139.25	Yes
Blubber	MM4B136	130.0 / 135.9	
Tooth	(present location, DWM, Barrow, AK)		

Additional Samples Collected for Other Researchers
NSB DWM, ID No. *LDL-62-90;*
present location, DWM, Barrow, AK:
Lower jaw with teeth

692-BLKA-009 Chukchi Sea, Pt. Lay 69°05′ 163°45′
11July90

>5-yr male - grey-white (mature)
SL = 348 cm FW = 82 cm BT = 3.7 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L137	169.3 / 168.1	Yes
Kidney	MM4K138	167.3 / 160.9	Yes
Blubber	MM4B139	139.0 / 141.9	
Tooth	(present location, DWM, Barrow, AK)		

Additional Samples Collected for Other Researchers
NSB DWM, ID No. *LDL-34-90;*
present location, DWM, Barrow, AK:
Lower jaw with teeth

692-BLKA-010 Chukchi Sea, Pt. Lay 69°05′ 163°45′
11July90

>5-yr male - white (mature)
SL = 400 cm FW = 105 cm BT = ? cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L140	164.7 / 173.5	Yes
Kidney	MM4K141	176.2 / 171.5	Yes
Blubber	MM4B142	116.3 / 116.9	
Tooth	(present location, DWM, Barrow, AK)		

Additional Samples Collected for Other Researchers
NSB DWM, ID No. *LDL-60-90;* present location, DWM,
present location, DWM, Barrow, AK:
Lower jaw with teeth

692-BLKA-011 Chukchi Sea, Pt. Lay 69°05′ 163°45′
11July90

>5-yr male - white (mature)
SL = 433 cm FW = 100 cm BT = ? cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L143	162.7 / 143.0	Yes
Kidney	MM4K144	154.35 / 165.6	Yes
Blubber	MM4B145	95.5 / 80.6	
Tooth	(present location, DWM, Barrow, AK)		

Additional Samples Collected for Other Researchers
NSB DWM, ID No. *LDL-59-90;*
present location, DWM, Barrow, AK:
Lower jaw with teeth

692-BLKA-012 Chukchi Sea, Pt. Lay 69°05′ 163°45′
11July90

>5-yr female - white (mature)
SL = 375 cm FW = 84 cm BT = ? cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L146	185.2 /*169.75	Yes
Kidney	MM4K147	156.6 / 172.25	Yes
Blubber	MM4B148	142.55 /*133.45	
Tooth	(present location, DWM, Barrow, AK)		

Additional Samples Collected for Other Researchers
NSB DWM, ID No. *LDL-8-90;*
present location, DWM, Barrow, AK:
Lower jaw with teeth Reproductive organs

692-BLKA-013 Chukchi Sea, Pt. Lay 69°05′ 163°45′
11July90

>5-yr male - white (mature)
SL = 434 cm FW = 98 cm BT = 8.4 cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L149	161.0 / 168.1	Yes
Kidney	MM4K150	179.8 / 160.95	Yes
Blubber	MM4B151	147.1 / 148.25	
Tooth	(present location, DWM, Barrow, AK)		

Additional Samples Collected for Other Researchers
NSB DWM, ID No. *LDL-16-90;*
present location, DWM, Barrow, AK:
Lower jaw with teeth Skin (genetics)

692-BLKA-014 Chukchi Sea, Pt. Lay 69°05′ 163°45′
11July90

>5-yr female - white (mature)
SL = 351 cm FW = 82 cm BT = ? cm

NBSB Samples	NBSB ID	A (g) / B (g)	Histo-Section
Liver	MM4L152	169.4 / 172.85	Yes
Kidney	MM4K153	158.1 / 156.2	Yes
Blubber	MM4B154	146.7 / 149.9	
Tooth	(present location, DWM, Barrow, AK)		

Additional Samples Collected for Other Researchers
NSB DWM, ID No. *LDL-9-90;*
present location, DWM, Barrow, AK:
Lower jaw with teeth Reproductive organs

4.0 QUALITY CONTROL ANALYSES

In order to evaluate the stability of the archived tissues, NIST monitors the concentrations of selected trace elements and organic compounds in 10-15 % of the tissue specimens. Aliquots of those specimens selected for monitoring are initially analyzed to establish the baseline levels. Re-analyses of aliquots of these tissues on a regular basis (every 3-5 years) will provide a measure of any change from the initial baseline concentrations. Besides providing a baseline to evaluate sample storage stability, these analyses also serve two other purposes:

1. They provide some real-time measure of contaminant concentrations for monitoring purposes.

2. They provide a baseline for comparing contaminant levels using present analytical techniques with those measured in the future by other laboratories using different methods.

Of the two subsamples (samples A and B) of each tissue which are archived, sample "A" is maintained in long-term storage in the liquid nitrogen freezer while sample "B" is used for the initial baseline analyses and storage stability evaluation. Samples to be analyzed are homogenized using a cryogenic homogenization procedure designed to reduce the likelihood of changes in sample composition due to thawing and refreezing (Zeisler *et al.*, 1983). The sample homogenate is then aliquoted into small Teflon jars (15 mL and 90 mL) for analysis and for storage as the homogenate.

The analytical approach for the baseline determinations of trace elements focuses on the use of a multi-element analytical technique, neutron activation analysis (NAA), to provide data on a large number of trace elements using only a limited amount of sample. Additional analytical techniques (voltametry and atomic absorption spectroscopy) are used to provide data on elements of high priority (Becker et *al.*, 1988) that are not routinely measured by NAA (e.g., Pb and Ni) and to provide quality control data for selected elements by comparing data from two different analytical techniques. High performance liquid chromatography with fluorescence detection are used to measure aromatic hydrocarbons and capillary gas chromatography with electron capture detection to measure selected chlorinated hydrocarbons.

As part of the sample stability monitoring, aliquots of selected tissue samples collected from northern fur seals in 1987 (Bering Sea), ringed seals in 1988 (Chukchi Sea), ringed seals in 1989 (Norton Sound), and belukha whales in 1989 (Chukchi Sea) have been analyzed (Table 7).

Table 7. Aliquots analyzed as part of the quality control analyses (O = organic analyses; T = trace element analyses) .

Species	Animal No.	Sample	Sample No.	Results
N. Fur seal	692-FRSL-004	liver	MM1L013	O T
N. Fur seal	692-FRSL-004	kidney	MM1K014	O T
N. Fur seal	692-FRSL-004	muscle	MM1M015	O T
N. Fur seal	692-FRSL-004	blubber	MM1B016	o
N. Fur seal	692-FRSL-005	liver	MM1L017	O T
N. Fur seal	692-FRSL-005	kidney	MM1K018	O T
N. Fur seal	692-FRSL-005	muscle	MM1M019	O T
N. Fur seal	692-FRSL-005	blubber	MM1B020	o
Ringed seal	692-RGSL-004	liver	MM2L030	O T
Ringed seal	692-RGSL-004	kidney	MM2K031	O T
Ringed seal	692-RGSL-004	blubber	MM2B032	o
Ringed seal	692-RGSL-008	liver	MM2L042	O T
Ringed seal	692-RGSL-008	kidney	MM2K043	O T
Ringed seal	692-RGSL-008	blubber	MM2B044	o
Ringed seal	692-RGSL-011	liver	MM3L054	**O T
Ringed seal	692-RGSL-011	blubber	MM3B056	**O
Ringed seal	692-RGSL-013	liver	MM3L060	**() T
Ringed seal	692-RGSL-013	blubber	MM3L062	**O
belukha whale	692-BLKA-002	liver	MM3L072	T
belukha whale	692-BLKA-003	liver	MM3L075	T

The results are presented in the *Appendix,* pages 45-89. Please note that the results from organic and trace element analyses of two northern fur seals from St. Paul Island and organic analyses of two ringed seals from the Chukchi Sea were reported in last year's Annual Report along with some preliminary interpretation of the data. This data is repeated in the *Appendix* along with this year's results from trace element analyses of ringed seal (Chukchi Sea and Norton Sound) and belukha whale (Chukchi Sea) tissues. Although the organic analyses of ringed seals from Norton Sound and belukha whales from the Chukchi Sea have been completed, the data is being verified at this time and will not be included in this report.

Unlike last year's annual report this report provides only the data with no interpretation. A draft report, *Alaska Marine Mammal* Tissue *Archival Project: Sample Inventory and Results of Analyses of Selected Samples for Trace Elements and Organic Compounds, is scheduled for completion in March, 1991. This report, which will include all of the analytical*

**Data not presented in the Appendix.*

data generated by the Project with interpretations and conclusions, will be published in the NIST Interagency Report Series. The projected publication date is June, 1991.

5.0 FUTURE ACTIVITIES

The following activities will occur during FY 91; their projected completion dates are:

1. Archival Support:
   - Sample cataloging- continuous
   - Cryogenic storage- continuous
   - Evaluation of protocols- continuous
   - Monitoring sample stability- continuous

2. Planning and Coordination:
   - Plans for FY 91 sample collections- 3/91

3. Field Collections:
   - Norton Sound (tentative)- 5-7/91

Reports and their due dates are:

Revised Collection Protocol, draft- 11/90
final- 3/91

Sample Inventory and Chemical Analyses, draft- 3/91
final- 6/91

Project Annual Report- 10/91

Both the *Revised Collection Protocol* and *Sample Inventory and Chemical Analyses* reports will be published in the NIST Interagency Report Series. We anticipate that the *Sample Inventory and Chemical Analyses* report will be revised and published annually. The sample inventory provides the current inventory of tissues maintained in the Archive and includes tissues by species, type of tissue, collection date and location, method of preservation, sex, size, and other parameters that may be obtainable from the collecting agency. The report on chemical analyses will include detailed description of methods, data, quality assurance, and an interpretation of the results.

The *Project Annual Report will* be a summary report of all project activities occurring during FY 91. It will also include an up-to-date sample inventory plus the most recent analytical data.

6.0 REFERENCES

Becker, P. R., S. A. Wise, B. J. Koster, and R. Zeisler. 1988. Alaskan Marine Mammal Tissue Archival Project: A Project Description Including Collection Protocols. NBSIR 88-3750. U.S. Department of Commerce, National Bureau of Standards, Gaithersburg, Maryland. 46 p.

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APPENDIX: QUALITY CONTROL ANALYTICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
GAITHERSBURG, MARYIAND 20899

552-88-079

REPORT OF ANALYSIS

Determination of Organic Contaminants in Northern Fur Seal Samples from the 1987 Collection

Submitted to:

Paul R. Becker
Ocean Assessments Division
National Oceanic and Atmospheric Administration
Anchorage, AK 99513

INTRODUCTION

As part of the NOAA Marine Mammal Tissue Archival Project, NBS analyzes a fraction of the archived specimens to determine selected organic and inorganic contaminants. These analyses provide accurate baseline data for the following purposes: (1) for use in evaluating the stability of the specimens during long-term storage, (2) for comparison with data obtained from other laboratories analyzing similar samples collected at the same time from the same sites (i.e., quality assurance), and (3) for comparison with data from samples collected in the future to monitor long-term trends in pollution. The results of the analyses of muscle, liver, kidney, and blubber from two northern fur seals collected during the 1987 sample collection are described in this Report of Analysis.

EXPERIMENTAL SECTION

Sample Description. Muscle, liver, kidney, and blubber samples from two northern fur seals were analyzed. The fur seals were harvested during a subsistence hunt on St. Paul Island (Pribilof Islands) in July 1987.

Sample Preparation. The "B" portions of the eight tissue samples were cryogenically homogenized and divided into subsamples of 30 g for organic and inorganic analysis. For organic analysis, a sample of 14-16 g of wet tissue was weighed to the nearest tenth of a milligram. The weighed sample was placed in a mortar containing approximately 50 g of sodium sulfate and then covered with another approximately 50 g portion of sodium sulfate. The tissue plus sodium sulfate was then ground to absorb the water in the tissue. At this point, the sodium sulfate mixture was placed in a glass extraction thimble and Soxhlet extracted for 16 h using 250 mL of methylene chloride.

After Soxhlet extraction, the methylene chloride extract was evaporatively concentrated to approximately 1 mL. The fraction containing the polychlorinated biphenyls (PCBs) and pesticides was separated from the majority of the lipid and biogenic material using size exclusion chromatography. (In the case of the blubber samples, the extract could only be

concentrated to approximately 6 mL; therefore, six size exclusion fractionation were done. The six fractions were then combined and evaporatively concentrated to approximately 1 mL. Another size exclusion fractionation was performed for the combined sample.) This fraction was then evaporatively concentrated to approximately 400 µL for fractionation by normal-phase liquid chromatography on a semi-preparative aminosilane column ($LC-NH_2$). For the $LC-NH_2$ fractionation, hexane was used as the mobile phase for the isolation of the PCBs and lower polarity pesticides, and 5% methylene chloride in hexane was used for the isolation of the more polar pesticides. These separate fractions were evaporatively concentrated to approximately 500 µL for GC analysis using electron capture detection (ECD) for the PCB and pesticide fractions.

Nonvolatile Extractable Weight Determination. The percent of nonvolatile extractable was determined for each sample after Soxhlet extraction.[1] The extract was evaporatively concentrated to approximately 15 mL (weight known), and an aliquot of 90 µL (weight known) was placed on an aluminum pan. The extract on the pan was air dried, and the weight of the dried extract was noted. By doing a ratio of weights, the percent of nonvolatile extractable material was calculated.

GC Analysis. For the determination of the PCBS and pesticides, two extracts from each sample were analyzed by GC-ECD. PCB #198 (2,2′,3,3′,4,5,5′ ,6-octachlorobiphenyl) and perdeuterated 4,4′-DDT were added to the samples prior to extraction as internal standards for the analysis of the PCB and pesticide fractions, respectively. Calibration solutions were Soxhlet extracted, concentrated, and fractionated in the same manner as the tissue samples. The GC conditions for the analysis of the PCB fraction were as follows:

Column:	Immobilized nonpolar stationary phase (DB-5 J&W Scientific) fused silica capillary 60 m x 0.25 mm id.; 0.25µm film thickness
Injector:	Manual, all glass-splitting
Sample size:	2 µL
Injection:	Split
Injector temperature:	280 "C
ECD temperature:	320 'C
Initial column temperature:	200 "C for 30 min
Temperature programming rate:	2 °C/min
Final temperature:	270 "C for 30 min
Carrier gas:	Helium at 580 kPa (40 psig)
split flow:	25 mL/min
Nitrogen make-up gas:	30 mL/min

For the analysis of the pesticide fraction, the following temperature program was used:

Injector temperature:	250 "C
Initial column temperature:	190 "C for 50 min
Temperature programming rate:	1,5 °C/min to 215°C then 45 °C/min
Final temperature:	270 "C for 5 min

RESULTS AND DISCUSSION

The percent of nonvolatile extractable material in each sample is summarized in Table 1. The range of percents is from 3% for muscle tissue to 26% for blubber tissue. There is excellent agreement between the results for similar tissues from the two different animals.

PCB and Pesticide Determinations. The results of the PCB and pesticide measurements by GC are summarized in Tables 2, 3, 4 and 5 in terms of nonvolatile extractable weight of the sample. Concentrations were determined for all 20 PCB and all 15 pesticide analytes contained in the NOAA calibration solutions (SRM's 1492 and 1493). In general, the blubber and, in some cases, the kidney have higher concentrations than the liver and muscle samples from the same fur seal. Appendices I to IV contain the concentrations in terms of wet weight of tissue extracted.

Further details and data from these analyses can be found in the notebooks: MMS #12, pages 142-162 and magnetic data disks MMS 71-75.

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[1] Parris, R. M., private communication.

Michele M. Schantz, Ph.D.
Research Chemist
Organic Analytical Research Division
Center for Analytical Chemistry

Barbara J. Koster
Physical Science Technician
Organic Analytical Research Division
Center for Analytical Chemistry

Stephen N. Chesler, Ph.D.
Supervisory Research Chemist
Organic Analytical Research Division
Center for Analytical Chemistry

Stephen A. Wise, Ph.D.
Supervisory Research Chemist
Organic Analytical Research Division
Center for Analytical Chemistry

Willie E. May, Ph.D.
Chief
Organic Analytical Research Division
Center for Analytical Chemistry

September 27, 1988

Table 1. Percent of Nonvolatile Extractable in Fur Seal Tissue Samples

Tissue I.D.	Tissue Tvue	Percent Nonvolatile Extractable
MM1M015	Muscle	3.2 ± 0.2
MM1K014	Kidney	4.0 ± 0.3
MM1L013	Liver	6.9 ± 0.5
MM1B016	Blubber	25.6 ± 1.0
MM1M019	Muscle	3.4 ± 0.3
MM1K018	Kidney	3.8 ± 0.3
MM1L017	Liver	7.0 ± 0.6
MM1B020	Blubber	25.5 ± 0.9

Table 2. Concentration (rig/g nonvolatile extractable weight) of PCBS in Northern Fur Seal Tissue Samples (Animal No. 1)[a,b]

PCB #	MM1L013 (Liver)	MM1K014 (Kidney)	MM1M015 (Muscle)	MM1B016 (Blubber)
8 (2,4′)	<1	4.6 (0.2)	2.6 (0.1)	7.0 (0.1)
18 (2,2′,5)	1.0 (0.1)	5.7 (0.2)	2.0 (0.1)	3.5 (0.1)
28 (2,4,4′)	6.2 (0.2)	22 (0.8)	17 (0.4)	45 (2.5)
52 (2,2′,5,5′)	19 (0.3)	30 (0.7)	26 (1.6)	85 (1.7)
(22′,3,5′)	<1	<1	<1	11 (0.5)
66 (2,3′,4,4′)	40 (0.6)	36 (1.0)	38 (1.4)	120 (0.8)
101 (2,2′,4,5,5′)	5.3 (0.1)	19 (0.7)	11 (0.3)	31 (0.6)
77 (3,3′,4,4′)	<2	<2	<2	<2
118 (2,3′,4,4′,5)	21 (0.6)	24 (1.2}	26 (1.5)	94 (5.7)
153 (2,2′,4,4′,5,5′)	83 (2.0)	130 (3.0)	150 (8.6)	360 (18)
105 (2,3,3′,4,4′)	7.4 (0.5)	15 (0.5)	13 (0.7)	46 (2.0)
138 (2,2′,3,4,4′,5′)	62 (2.9)	90 (2.0)	100 (2.5)	350 (2.6)
126 (3,3′,4,4′,5)	<2	<2	<2	<1
187 (2,2′,3,4′,5,5′,6)	<2	<2	<2	<1
128 (2,2′,3,3′,4,4′)	<3	<3	<3	<2
180 (2,2′,3,4,4′,5,5′)	16 (0.3)	34 (1.4)	33 (1.3)	145 (1.0)
170 (2,2′,3,3′,4,4′,5)	5.6 (0.3)	16 (0.6)	13 (0.4)	36 (0.7)
195 (2,2′,3,3′,4,4′,5,6)	<1	<1	<1	<2
206 (2,2′,3,3′,4,4′,5,5′,6)	<2	<2	<2	<1
209 (deca)	<3	<3	<3	<2

[a]Two tissue extracts analyzed in triplicate; concentrate on value is the mean value, and numbers in parentheses are ±1 standard deviation of a single measurement.

[b]The < values indicate the minimum detectable level for this compound in this sample.

Table 3. Concentration (rig/g nonvolatile extractable weigl) of PCBs in Northern Fur Seal Tissue Samples (Animal No. 2)[a,b]

PCB #	MM1L017 (Liver)	MM1K018 (Kidney)	MM1M019 (Muscle)	MM1B020 (Blubber)
8 (2,4')	<3	<4	<4	<13
18 (2,2',5)	<2	9.0 (0.3)	<3	<10
28 (2,4,4')	11 (0.3)	62 (1.2)	21 (0.6)	53 (1.5)
52 (2,2',5,5')	14 (0.2)	46 (1.7)	16 (0.5)	49 (1.2)
(2$,3,5')	<1	<2	<2	<5
66 (2,3',4,4')	75 (3.9)	200 (7.5)	91 (1.8)	430 (14.)
101 (2,2',4,5,5')	13 (0.9)	78 (2.3)	25 (2.0)	32 (1.4)
77 (3,3',4,4')	<3	<3	<4	<13
118 (2,3',4,4',5)	96 (3.0)	237 (3.1)	39 (2.2)	380 (20)
153 (2,2',4,4',5,5')	230 (13)	810 (14)	360 (30)	750 (24)
105 (2,3,3',4,4')	19 (0.8)	100 (2.5)	37 (1.6)	73 (4.0)
138 (2,2',3,4,4',5')	150 (3.8)	540 (18)	210 (3.0)	360 (7.1)
126 (3,3',4,4',5)	<17	<20	<23	<70
187 (2,2', 3,4',5,5',6)	<4	<5	<5	<lo
128 (2,2',3,3',4,4')	<5	<7	<7	<20
180 (2,2', 3,4,4',5,5')	50 (1.6)	150 (2.8)	67 (1.7)	130 (4.9)
170 (2,2',3,3',4,4',5)	20 (1.5)	46 (2.6)	25 (0.8)	47 (1.5)
195 (2,2', 3,3',4,4',5,6)	<1	<1	<1	<3
206 (2,2',3, 3',4,4',5,5',6)	<1	<1	<1	<3
209 (deca)	<1	<1	<1	<3

[a]Two tissue extracts analyzed in triplicate; concentration value is the mean value, and numbers in parentheses are ±1 standard deviation of a single measurement.

[b]The < values indicate the minimum detectable level for this compound in this sample.

Table 4. Concentration (ng/g nonvolatile extractable weight) of Pesticides in Northern Fur Seal Tissue Samples (Animal No. 1)[a,b]

Pesticide	MM1L013 (Liver)	MM1K014 (Kidney)	MM1M015 (Muscle)	MM1B016 (Blubber)
Hexachlorobenz ene	<1	11 (0.2)	<1	7.0 (0.1)
Aldrin	<1	<1	<1	<1
2,4′-DDE	<1	<1	<1	4.4 (0.4)
4,4*-DDE	530 (6.0)	860 (34)	1100 (44)	4000 (140)
2,4′-DDD	17 (0.6)	<1	<1	47 (1.9)
4,4′-DDD	51 (1.4)	74 (3.1)	91 (2.3)	460 (16)
2,4′-DDT	<1	<1	<1	<1
4,4′-DDT	40 (1.1)	47 (1.9)	55 (2.4)	140 (8.0)
Lindane	14 (0.3)	35 (1.4)	31 (1.0)	100 (2.2)
Heptachlor Epoxide	16 (0.7)	51 (2.0)	72 (3.7)	130 (3.3)
α-Chlordane	2.3 (0.2)	6.0 (0.3)	5.8 (0.5)	17 (0.2)
Trans-nonachlor	85 (2.6)	200 (15)	270 (9.1)	1200 (53)
Dieldrin	14 (0.4)	28 (1.1)	23 (0.8)	100 (2.9)
Heptachlor	<1	<1	<1	<1
Mirex	<2	<2	<2	<1

[a]Two tissue extracts analyzed in triplicate; concentration value is the mean value, and numbers in parentheses are ±1 standard deviation of a single measurement.
[b]The < values indicate the minimum detectable level for this compound in this sample.

Table 5. Concentration (ng/g nonvolatile extractable weight) of Pesticides in Northern Fur Seal Tissue Samples (Animal No. 2)[a,b]

Pesticide	MM1L017 (Liver)	MM1K018 (Kidney)	MM1M019 (Muscle)	MM1B020 (Blubber)
Hexachlorobenzene	<1	<2	<2	<5
Aldrin	<2	<2	<2	<5
2,4'-DDE	<3	<4	<4	<lo
4,4'-DDE	1200 (62)	4900 (180)	2100 (140)	4100 (170)
2,4'-DDD	13 (0.5)	12 (0.8)	4.3 (0.3)	1.6 (0.1)
4,4'-DDD	60 (2.8)	240 (11)	96 (2.8)	75 (4.7)
2,4'-DDT	<1	<1	<1	<1
4,4'-DDT	48 (1.5)	190 (8.4)	85 (2.8)	65 (2.6)
Lindane	5.7 (0.2)	49 (1.4)	14 (0.4)	11 (0.6)
Heptachlor Epoxide	35 (1.0)	114 (5.6)	52 (3.4)	58 (1.7)
α-Chlordane	<1	<1	<1	<1
Trans-nonachl or	98 (2.5)	860 (23)	330 (lo)	250 (11)
Dieldrin	4.0 (0.1)	20 (0.9)	8.1 (0.4)	4.6 (0.2)
Heptachlor	<1	<2	<2	<5
Mirex	<1	<2	<2	<4

[a]Two tissue extracts analyzed in triplicate; concentration value is the mean value, and numbers in parentheses are ±1 standard deviation of a single measurement.
[b]The < values indicate the minimum detectable level for this compound in this sample.

Appendix I. Concentration (rig/g wet weight) of PCBS in Northern Fur Seal Tissue Samples (Animal No. 1)[a,b]

PCB #	MM1L013 (Liver)	MM1K014 (Kidney)	MM1M015 (Muscle)	MM1B016 (Blubber)
8 (2,4')	<1	0.2 (0.0)	0.1 (0.0)	1.8 (0.0)
18 (2,2',5)	0.1 (0.0)	0.2 (0.0)	0.1 (0.0)	0.9 (0.0)
28 (2,4,4')	0.4 (0.0)	0.9 (0.0)	0.5 (0.0)	11.5 (0.7)
52 (2,2',5,5')	1.3 (0.0)	1.2 (0.0)	0.8 (0.0)	21.7 (0.4)
44 (2,2',3,5')	<1	<1	<1	2.8 (0.1)
66 (2,3',4,4')	2.7 (0.0)	1.4 (0.0)	1.2 (0.0)	29.7 (0.2)
101 (2,2',4,5,5')	0.4 (0.0)	0.8 (0.0)	0.4 (0.0)	7.8 (0.2)
77 (3,3',4,4')	<1	<1	<1	<1
118 (2,3',4,4',5)	1.4 (0.0)	0.9 (0.0)	0.8 (0.0)	31.3 (1.9)
153 (2,2',4,4',5,5')	5.7 (0.1)	5.2 (0.1)	4.7 (0.3)	120 (6.0)
105 (2,3,3',4,4')	0.5 (0.0)	0.6 (0.0)	0.4 (0.0)	15.2 (0.7)
138 (2,2',3,4,4',5')	4.3 (0.2)	3.6 (0.1)	3.2 (0.1)	17.5 (0.9)
126 (3,3',4,4',5)	<1	<1	<1	<1
187 (2,2', 3,4',5,5',6)	<1	<1	<1	<1
128 (2,2',3,3',4,4')	<1	<1	<1	<1
180 (2,2',3,4,4',5,5')	1.1 (0.0)	1.4 (0.1)	1.1 (0.0)	1.5 (0.0)
170 (2,2',3,3',4,4',5)	0.4 (0.0)	0.6 (0.0)	0.4 (0.0)	12.0 (0.2)
195 (2,2',3,3',4,4',5,6)	<1	<1	<1	<1
206 (2,2',3,3',4,4',5,5',6)	<1	<1	<1	<1
209 (deca)	<1	<1	<1	<1

[a]Two tissue extracts analyzed in triplicate: concentration value is the mean value, and numbers in parentheses are ±1 standard deviation of a single measurement.

[b]The < values indicate the minimum detectable level for this compound in this sample.

Appendix II. Concentration (rig/g wet weight) of PCBs in Northern Fur Seal Tissue Samples from (Animal No. 2)[a,b]

PCB #	MM1L017 (Liver)	MM1K018 (Kidney)	MM1M019 (Muscle)	MM1B020 (Blubber)
8 (2,4')	<1	<1	<1	<3
18 (2,2',5)	<1	0.3 (0.0)	<1	<3
28 (2,4,4')	0.8 (0.0)	2.3 (0.0)	0.7 (0.0)	13.5 (0.4)
52 (2,2',5,5')	1.0 (0.0)	1.8 (0.1)	0.5 (0.0)	12.5 (0.3)
44 (2,2',3,5')	<1	<1	<1	<2
66 (2,3',4,4')	5.2 (0.3)	7.8 (0.3)	3.1 (0.1)	111 (3.7)
101 (2,2',4,5,5')	0.9 (0.1)	3.0 (0.1)	0.8 (0.1)	8.5 (0.9)
77 (3,3',4,4')	<1	<1	<1	<3
118 (2,3',4,4',5)	6.7 (0.2)	9.0 (0.1)	1.3 (0.1)	95.5 (5.0)
153 (2,2',4,4',5,5')	15.8 (0,9)	30.8 (0.5)	12.4 (1.0)	191 (6.1)
105 (2,3,3',4,4')	1.3 (0.1)	3.9 (0.1)	1.3 (0.0)	18.6 (1.0)
138 (2,2',3,4,4',5')	10.8 (0.3)	20.4 (0.7)	7.1 (0.1)	91.6 (1.8)
126 (3,3',4,4',5)	<2	<2	<2	<lo
187 (2,2',3,4',5,5',6)	<1	<1	<1	<3
128 (2,2',3,3',4,4')	<1	<1	<1	<5
180 (2,2',3,4,4',5,5')	3.7 (0.1)	5.9 (0.1)	2.3 (0.1)	32.6 (1.2)
170 (2,2',3,3',4,4',5)	1.4 (0.1)	1.8 (0.1)	0.9 (0.0)	11.9 (0.4)
195 (2,2',3,3',4,4',5,6)	<1	<1	<1	<2
206 (2,2',3,3',4,4',5,5',6)	<1	<1	<1	<2
209 (deca)	<1	<1	<1	<2

[a]Two tissue extracts analyzed in triplicate; concentration value is the mean value, and numbers in parentheses are ±1 standard deviation of a single measurement.

[b]The < values indicate the minimum detectable level for this compound in this sample.

Appendix III. Concentration (rig/g wet weight) of Pesticides in Northern Fur Seal Tissue Samples (Animal No. 1)[a,b]

Pesticide	MM1L013 (Liver)	MM1K014 (Kidney)	MM1M015 (Muscle)	MM1B016 (Blubber)
Hexachlorobenz ene	<1	0.2 (0.0)	<1	1.8 (0.0)
Aldrin	<1	<1	<1	<1
2,4′-DDE	<1	<1	<1	1.1 (0.1)
4,4′-DDE	36.6 (0.4)	34.4 (1.4)	36.0 (1.4)	1330 (46.9)
2,4′-DDD	1.2 (0.0)	<1	<1	12.1 (0.5)
4,4′-DDD	3.5 (0.1)	3.0 (0.1)	2.9 (0.1)	118 (4.2)
2,4′-DDT	<1	<1	<1	<1
4,4′-DDT	2.8 (0.1)	1.9 (0.1)	1.8 (0.1)	34.8 (2.0)
Lindane	1.0 (0.0)	1.4 (0.1)	1.0 (0.0)	25.7 (0.6)
Heptachlor Epoxide	1.1 (0.1)	2.0 (0.1)	2.3 (0.1)	34.1 (0.8)
α-Chlordane	0.2 (0.0)	0.2 (0.0)	0.2 (0.0)	4.3 (0.1)
Trans-nonachlor	5.9 (0.2)	8.0 (0.2)	8.8 (0.3)	302 (13.6)
Dieldrin	0.9 (0.0)	1.1 (0.0)	0.7 (0.0)	26.3 (0.7)
Heptachlor	<1	<1	<1	<1
Mirex	<1	<1	<1	<1

[a]Two tissue extracts analyzed in triplicate; concentration value is the mean value, and numbers in parentheses are ±1 standard deviation of a single measurement.
[b]The < values indicate the minimum detectable level for this compound in this sample.

Appendix IV. Concentration (rig/g wet weight) of Pesticides in Northern Fur Seal Tissue Samples (Animal No. 2)[a,b]

Pesticide	MM1L017 (Liver)	MM1K018 (Kidney)	MM1M019 (Muscle)	MM1B020 (Blubber)
Hexachlorobenz ene	<1	<1	<1	<2
Aldrin	<1	<1	<1	<2
2,4'-DDE	<1	<1	<1	<3
4,4'-DDE	85.1 (4.3)	187 (6.7)	72.0 (4.6)	1050 (42.4)
2,4'-DDD	0.9 (0.0)	0.5 (0.0)	0.2 (0.0)	0.4 (0.0)
4,4'-DDD	4.2 (0.2)	9.2 (0.4)	3.3 (0.1)	19.0 (1.2)
2,4'-DDT	<1	<1	<1	<1
4,4'-DDT	3.3 (0.1)	7.2 (0.3)	2.9 (0.1)	16.5 (0.7)
Lindane	0.4 (0.0)	1.9 (0.1)	0.5 (0.0)	2.8 (0.2)
Heptachlor Epoxide	2.4 (0.1)	4.3 (0.2)	1.8 (0.1)	14.7 (0.4)
α-Chlordane	<1	<1	<1	<1
Trans-nonachl or	6.8 (0.2)	32.7 (0.9)	11.3 (0.4)	64.8 (2.7)
Dieldrin	0.3 (0.0)	0.8 (0.0)	0.3 (0.0)	1.2 (0.0)
Heptachlor	<1	<1	<1	<2
Mirex	<1	<1	<1	<2

[a]Two tissue extracts analyzed in triplicate; concentration value is the mean value, and numbers in parentheses are ±1 standard deviation of a single measurement.
[b]The < values indicate the minimum detectable level for this compound in this sample.

U.S. DEPARTMENT OF COMMERCE
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
GAITHERSBURG, MD 20899

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REPORT OF ANALYSIS

Determination of Organic Contaminants in
Seal Samples from the 1988 Collection

Submitted to:

Paul R. Becker
Ocean Assessments Division
National Oceanic and Atmospheric Administration
Anchorage, AK 99513

INTRODUCTION

As part of the NOAA Alaska Marine Mammal Tissue Archival specimen banking project, NIST analyzes a fraction of the archived specimens to determine selected organic and inorganic contaminants. These analyses provide baseline data for the following purposes: (1) for use in evaluating the stability of the specimens during long-term storage, (2) for comparison with data obtained from other laboratories analyzing similar samples, and (3) for comparison with data from samples collected in the future to monitor long-term trends in pollution. The results of the analyses of liver, kidney, and blubber from two seals collected during the 1988 sample collection are described in this Report of Analysis.

EXPERIMENTAL SECTION

Sample Description. Liver, kidney, and blubber samples from two ringed seals (*Phoca hispida*) were analyzed. Both seals were 2 year old males. The seals were harvested during a subsistence hunt near Barrow, AK in July 1988.

Sample Preparation. The "B" portions of the six tissue samples were cryogenically homogenized and divided into subsamples of 30 g for organic and 4-6 g for inorganic analysis. For organic analysis, a sample of 14-16 g of wet liver or kidney or 4-6 g of wet blubber was weighed to the nearest tenth of a milligram. The weighed sample was placed in a mortar containing approximately 50 g of sodium sulfate and then covered with another approximately 50 g portion of sodium sulfate. The tissue plus sodium sulfate was then ground to absorb the water in the tissue. At this point, the sodium sulfate mixture was placed in a glass extraction thimble and Soxhlet extracted for 16 h using 250 mL of methylene chloride.

After Soxhlet extraction, the methylene chloride extract was evaporatively concentrated to approximately 1 mL. The fraction containing the polychlorinated biphenyls (PCBs) and pesticides was separated from the majority of the lipid and biogenic material using size exclusion chromatography. (In the case of the blubber samples, the extract could only be concentrated to approximately 4 mL; therefore, three size exclusion fractionation were performed. The three fractions were then combined and

evaporatively concentrated to approximately 1 mL. Another size exclusion fractionation was performed for the combined sample.) This fraction was then evaporatively concentrated to approximately 400 µL for fractionation by normal-phase liquid chromatography on a semi-preparative aminosilane column (LC-NH_2). For the LC-NH2 fractionation, hexane was used as the mobile phase for the isolation of the PCBS and lower polarity pesticides, and 5% methylene chloride in hexane was used for the isolation of the more polar pesticides. These separate fractions were evaporatively concentrated to approximately 500 µL for GC analysis using electron capture detection (ECD) for the PCB and pesticide fractions.

Nonvolatile Extractable Weight Determination. The percent of nonvolatile extractable was determined for each sample after Soxhlet extraction.[1] The extract was evaporatively concentrated to approximately 15 mL (weight known), and an aliquot of 90 µL (weight known) was placed on an aluminum pan. The extract on the pan was air dried overnight, and the weight of the dried extract was noted. From the ratio of weights, the percent of nonvolatile extractable material was calculated. The percent water in each sample was determined by weight loss after freeze drying.

GC Analysis. For the determination of the PCBS and pesticides, two extracts from each sample were analyzedby GC-ECD. PCB #103 (2,2',4,5',6-pentachlorobiphenyl) and PCB #198 (2,2',3,3',4,5,5',6-octachlorobiphenyl) were added to the samples prior to extraction as internal standards for the analysis of the PCB fraction. Endrin and perdeuterated 4,4'-DDT were added to the samples prior to extraction as internal standards for the analysis of the pesticide fraction. Calibration solutions were Soxhlet extracted, concentrated, and fractionated in the same manner as the tissue samples. The GC conditions for the analysis of the PCB fraction were as follows:

Column:	Immobilized nonpolar stationary phase (DB-5 J&W Scientific) fused silica capillary 60 m x 0.25 mm id.; 0.25µm film thickness
Injector:	Manual, all glass-splitting
Sample size:	2 µL
Injection:	Split
Injector temperature:	280 "C
ECD temperature:	320 "C
Initial column temperature:	200 "C for 30 min
Temperature programming rate:	2 °C/min
Final temperature:	270 °C for 30 min
Carrier gas:	Helium at 280 kPa (40 psig)
Split flow:	25 mL/min
Nitrogen detector make-up gas:	30 mL/min

For the analysis of the pesticide fraction, the following temperature program was used:

Injector temperature:	250 °C
Initial column temperature:	190 'C for 50 min
Temperature programming rate:	1.5 °C/min to 215°C then 45 °C/min
Final temperature:	270 "C for 5 min

RESULTS AND DISCUSSION

The results for the determination of the percent of nonvolatile extractable material in each sample are summarized in Table 1. The range of percents is from 2% for liver tissue to 13% for blubber tissue. There is excellent agreement between the results for similar tissues from the two different animals. The results of the percent water in each tissue are provided to allow conversion of the results to a dry weight loss if desired.

PCB and Pesticide Determinations. The results of the PCB and pesticide measurements by GC are summarized in Tables 2, 3, 4 and 5 in terms of nonvolatile extractable weight of the sample. Concentrations were determined for all 20 PCB congeners and all 15 chlorinated pesticide analytes contained in the NOAA calibration solutions (SRM's 1492 and 1493). Appendices I to IV contain the concentrations in terms of wet weight of tissue extracted.

Further details and data from these analyses can be found in the notebooks: MMS #13, pages 99-111 and optical data disk DV-88.

[1] Parris, R. M., private communication.

Michele M. Schantz, Ph.D.
Research Chemist
Organic Analytical Research Division
Center for Analytical Chemistry

Barbara J. Koster
Biologist
Organic Analytical Research Division
Center for Analytical Chemistry

Stephen N. Chesler, Ph.D.
Research Chemist
Organic Analytical Research Division
Center for Analytical Chemistry

Stephen A. Wise, Ph.D.
Supervisory Research Chemist
Organic Analytical Research Division
Center for Analytical Chemistry

Michael J. Welch, Ph.D.
Supervisory Research Chemist
Organic Analytical Research Division
Center for Analytical Chemistry

Willie E. May, Ph.D.
Chief
Organic Analytical Research Division
Center for Analytical Chemistry

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Table 1. Percent of Nonvolatile Extractable Material in Seal Tissue Samples

Tissue I.D. Extractable	Tissue Type	Percent Nonvolatile	Percent Water
MM2L030	Liver	2.2 ± 0.5	71
MM2K031	Kidney	3.1 ± 0.4	78
MM2B032	Blubber	12.8 ± 0.7	6
MM2L042	Liver	2.9 ± 0.4	71
MM2K043	Kidney	2.8 ± 0.5	77
MM2B044	Blubber	14.0 ± 0.9	8

Table 2. Concentration (rig/g nonvolatile extractable weight) of PCBS in Seal Tissue Samples (Animal No. 1)[a,b]

PCB #	MM2L030 (Liver)	MM2K031 (Kidney)	MM2B032 (Blubber)
8 (2,4')	121 (3)	44 (1)	3.9 (0.1)
18 (2,2',5)	<9	<5	1.0 (0.1)
28 (2,4,4')	94 (3)	15 (1)	49 (2)
52 (2,2',5,5')	37 (3)	16 (1)	30 (1)
44 (2,2',3,5')	<6	8.7 (0.4)	4.1 (0.1)
66 (2,3',4,4')	125 (4)	66 (2)	104 (2)
101 (2,2' ,4,5,5'}	214 (4)	27 (1)	1265 (18)
77 (3,3',4,4')	<59	<25	11 (1)
118 (2,3',4,4' ,5)	111 (5)	31 (1)	686 (11)
153 (2,2',4,4' ,5,5')	224 (5)	49 (2)	1392 (35)
105 (2,3,3' ,4,4')	25 (1)	3.6 (0.2)	273 (4)
138 (2,2',3,4,4' ,5')	167 (6)	37 (2)	1037 (14)
126 (3,3',4,4' ,5)	14 (1)	4.5 (0.2)	96 (1)
187 (2,2',3,4',5,s' ,6)	46 (1)	9.8 (0.3)	1 1 7 (2)
128 (2,2',3,3' ,4,4')	5.8 (0.3)	1.8 (0.1)	71 (1)
180 (2,2',3,4,4' ,5,5')	55 (1)	17 (1)	284 (9)
170 (2,2',3,3',4,4' ,5)	19 (2)	4.1 (0.3)	94 (2)
195 (2,2',3,3',4,4' ,5,6)	<2	<1	13 (1)
206 (2,2',3,3',4,4',5,5' ,6)	<2	<1	8.8 (0.2)
209 (deca)	<2	<1	33 (1)

[a]Two tissue extracts analyzed in triplicate; concentration value is the mean value, and numbers in parentheses are ±1 standard deviation of a single measurement.

[b]The < values indicate the minimum detectable level for this compound in this sample.

Table 3. Concentration (ng/g nonvolatile extractable weight) of PCBs in Seal Tissue Samples (Animal No. 2)[a,b]

PCB #	MM2L042 (Liver)	MM2K043 (Kidney)	MM2B044 (Blubber)
8 (2,4')	70 (2)	43 (1)	386 (8)
18 (2,2',5)	<9	<5	<18
28 (2,4,4')	61 (2)	190 (4)	136 (3)
52 (2,2',5,5')	32 (1)	30 (1)	119 (2)
44 (2,2' ,3,5')	35 (1)	39 (1)	93 (3)
66 (2,3' ,4,4')	111 (4)	97 (2)	349 (lo)
101 (2,2' ,4,5,5')	26 (1)	56 (2)	1870 (63)
(3?',4,4')	<90	<66	<12
118 (2,3',4,4' ,5)	38 (1)	18 (1)	474 (8)
153 (2,2',4,4' ,5,5')	103 (2)	59 (1)	1546 (22)
105 (2,3,3' ,4,4')	12 (1)	5.5 (0.3)	126 (3)
138 (2,2',3,4,4' ,5')	84 (3)	41 (2)	837 (24)
126 (3,3',4,4' ,5)	6.7 (0.3)	3.9 (0.3)	59 (2)
187 (2,2',3,4',5,5' ,6)	16 (1)	9.8 (0.4)	100 (4)
128 (2,2',3,3' ,4,4')	9.9 (0.3)	1.4 (0.1)	143 (4)
180 (2,2',3,4,4' ,5,5')	27 (2)	19 (1)	178 (3)
170 (2,2',3,3',4,4' ,5)	9.0 (0.1)	4.3 (0.1)	41 (1)
195 (2,2',3,3',4,4' ,5,6)	<3	<2	<2
206 (2,2',3, 3',4,4',5,5' ,6)	<4	<2	<3
209 (deca)	<4	<2	<3

[a]Two tissue extracts analyzed in triplicate; concentration value is the mean value, and numbers in parentheses are ±1 standard deviation of a single measurement.

[b]The < values indicate the minimum detectable level for this compound in this sample.

Table 4. Concentration (ng/g nonvolatile extractable weight) of Pesticides in Seal Tissue Samples (Animal No. 1)[a,b]

Pesticide	MM2L030 (Liver)	MM2K031 (Kidney)	MM2B032 (Blubber)
Hexachlorobenzene	35.2 (1.0)	11.6 (0.7)	16.9 (0.7)
Aldrin	<2	<1	<2
2,4'-DDE	<4	<1	39 (1)
4,4'-DDE	465 (8)	94 (3)	210 (3)
2,4'-DDD	<7	<6	<3
4,4'-DDD	65 (1)	15 (1)	6.0 (0.1)
2,4'-DDT	7.6 (0.2)	3.2 (0.1)	8.5 (0.2)
4,4'-DDT	11 (1)	4.3 (0.3)	5.6 (0.2)
Lindane	45 (1)	<4	19 (1)
Heptachlor Epoxide	116 (3)	9.6 (0.2)	355 (5)
cis-Chlordane	<4	<3	26 (1)
Trans-nonachlor	62 (1)	19 (1)	903 (13)
Dieldrin	41 (1)	7.2 (0.3)	4.4 (0.2)
Heptachlor	<2	<1	<1
Mirex	34 (2)	4.0 (0.1)	140 (3)

[a]Two tissue extracts analyzed in triplicate; concentration value is the mean value, and numbers in parentheses are ±1 standard deviation of a single measurement.

[b]The < values indicate the minimum detectable level for this compound in this sample.

Table 5. Concentration (rig/g nonvolatile extractable weight) of Pesticides in Seal Tissue Samples (Animal No. 2)[a,b]

Pesticide	MM2L042 (Liver)	MM2K043 (Kidney)	MM2B044 (Blubber)
Hexachlorobenz ene	150 (1)	263 (1)	510 (9)
Aldrin	<5	<3	<5
2,4'-DDE	3.4 (0.1)	1.9 (0.1)	215 (8)
4,4'-DDE	233 (9)	244 (7)	3189 (110)
2,4'-DDD	<4	<4	<5
4,4'-DDD	9.3 (0.2)	4.4 (0.2)	5.5 (0.2)
2,4'-DDT	6.7 (0.2)	9.8 (0.1)	13 (1)
4,4'-DDT	6.2 (0.3)	10.6 (0.2)	16 (1)
Lindane	11 (1)	3.4 (0.1)	188 (4)
Heptachlor Epoxide	100 (2)	10 (1)	313 (4)
cis-Chlordane	4.5 (0.1)	<2	6.4 (0.1)
Trans-nonachlor	28 (1)	6.6 (0.2)	401 (1)
Dieldrin	109 (2)	11 (1)	232 (2)
Heptachlor	5.6 (0.2)	8.6 (0.3)	39 (1)
Mirex	<2	2.3 (0.1)	<4

[a]Two tissue extracts analyzed in triplicate; concentration value is the mean value, and numbers in parentheses are ±1 standard deviation of a single measurement.

[b]The < values indicate the minimum detectable level for this compound in this sample.

Appendix I. Concentration (rig/g wet weight) of PCBs in Seal Tissue Samples (Animal No. 1)[a,b]

PCB #	MM2L030 (Liver)	MM2K031 (Kidney)	MM2B032 (Blubber)
8 (2,4')	2.7 (0.1)	1.4 (0.1)	0.5 (0.1)
18 (2,2',5)	<0.2	<0.2	<0.2
28 (2,4,4')	2.1 (0.1)	0.5 (0.0)	6.3 (0.1)
52 (2,2',5,5')	0.8 (0.1)	0.5 (0.0)	3.9 (0.1)
(27',3,5')	<0.2	0.3 (0.1)	0.5 (0.1)
66 (2,3',4,4')	2.8 (0.1)	2.0 (0.1)	13 (1)
101 (2,2',4,5,5')	4.8 (0.1)	0.8 (0.1)	163 (2)
77 (3,3',4,4')	<2	<1	1.5 (0.1)
118 (2,3',4,4',5)	2.5 (0.1)	1.0 (0.1)	88.1 (1.4)
153 (2,2',4,4',5,5')	5.0 (0.1)	1.5 (0.1)	179 (5)
105 (2,3,3',4,4')	0.6 (0.1)	0.1 (0.0)	35.1 (0.5)
138 (2,2',3,4,4',5')	3.7 (0.1)	1.1 (0.1)	133 (2)
126 (3,3',4,4',5)	0.3 (0.0)	0.1 (0.0)	12.3 (0.2)
187 (2,2',3,4',5,5',6)	1.0 (0.1)	0.3 (0.0)	15.0 (0.2)
128 (2,2',3,3',4,4')	0.1 (0.0)	<0.1	9.2 (0.1)
180 (2,2',3,4,4',5,5')	1.2 (0.1)	0.5 (0.0)	36.5 (1.2)
170 (2,2',3,3',4,4',5)	0.4 (0.0)	0.1 (0.0)	12.1 (0.2)
195 (2,2',3,3',4,4',5,6)	<0.1	<0.1	1.6 (0.1)
206 (2,2',3,3',4,4',5,5',6)	<0.1	<0.1	1.1 (0.1)
209 (deca)	<0.1	<0.1	4.2 (0.1)

[a]Two tissue extracts analyzed in triplicate; concentration value is the mean value, and numbers in parentheses are ±1 standard deviation of a single measurement.

[b]The < values indicate the minimum detectable level for this compound in this sample.

Appendix II. Concentration (rig/g wet weight) of PCBs in Seal Tissue Samples from (Animal No. 2)[a,b]

PCB #	MM2L042 (Liver)	MM2K043 (Kidney)	MM2B044 (Blubber)
8 (2,4')	2.0 (0.1)	1.2 (0.1)	42 (1)
18 (2,2',5)	<0.2	<0.1	<2
28 (2,4,4')	1.8 (0.1)	5.3 (0.1)	15 (1)
52 (2,2',5,5')	0.9 (0.1)	0.8 (0.1)	13 (1)
44 (2,2' ,3,5')	1.0 (0.1)	1.1 (0.1)	10 (1)
66 (2,3' ,4,4')	3.3 (0.1)	2.7 (0.1)	38 (1)
101 (2,2' ,4,5,5')	0.8 (0.1)	1.6 (0.1)	205 (7)
77 (3,3',4,4')	<3	<2	<2
118 (2,3',4,4' ,5)	1.1 (0.1)	0.5 (0.1)	52 (1)
153 (2,2',4,4' ,5,5')	3.0 (0.1)	1.6 (0.1)	170 (3)
105 (2,3,3' ,4,4')	<0.4	<0.2	14 (1)
138 (2,2',3,4,4' ,5')	2.5 (0.1)	1.1 (0.1)	92 (3)
126 (3,3',4,4' ,5)	<0.2	<0.1	6.5 (0.2)
187 (2,2',3,4',5,5' ,6)	0.5 (0.1)	0.3 (0.1)	11 (1)
128 (2,2',3,3' ,4,4')	0.3 (0.1)	<0.1	16 (5)
180 (2,2',3,4,4' ,5,5')	0.8 (0.1)	0.5 (0.1)	20 (1)
170 (2,2',3,3',4,4' ,5)	0.3 (0.1)	0.1 (0.0)	4.5 (0.1)
195 (2,2',3,3',4,4' ,5,6)	<0.1	<0.1	<0.2
206 (2,2',3,3',4,4',5,5' ,6)	<0.1	<0.1	<0.3
209 (deca)	<0.1	<0.1	<0.3

[a]Two tissue extracts analyzed in triplicate; concentration value is the mean value, and numbers in parentheses are ±1 standard deviation of a single measurement.

[b]The < values indicate the minimum detectable level for this compound in this sample.

Appendix III. Concentration (rig/g wet weight) of Pesticides in Seal Tissue Samples (Animal No. 1)[a,b]

Pesticide	MM2L030 (Liver)	MM2K031 (Kidney)	MM2B032 (Blubber)
Hexachlorobenzene	0.8 (0.1)	0.4 (0.1)	2.2 (0.1)
Aldrin	<1	<1	<1
2,4'-DDE	<1	<1	5.0 (0.1)
4,4'-DDE	10.4 (0.3)	2.9 (0.1)	27.0 (0.3)
2,4'-DDD	<0.2	<0.2	<1
4,4'-DDD	1.5 (0.1)	0.5 (0.1)	0.8 (0.1)
2,4'-DDT	<0.2	<0.2	1.1 (0.1)
4,4'-DDT	<0.3	<0.2	0.7 (0.1)
Lindane	1.0 (0.1)	<0.2	2.4 (0.1)
Heptachlor Epoxide	2.6 (0.1)	0.3 (0.1)	46 (1)
cis-Chlordane	<0.1	<0.1	3.4 (0.1)
Trans-nonachlor	1.4 (0.1)	0.6 (0.1)	116 (2)
Dieldrin	0.9 (0.1)	<0.3	0.6 (0.1)
Heptachlor	<1	<1	<1
Mirex	0.8 (0.1)	<1	18.0 (0.4)

[a]Two tissue extracts analyzed in triplicate; concentration value is the mean value, and numbers in parentheses are ±1 standard deviation of a single measurement.

[b]The < values indicate the minimum detectable level for this compound in this sample.

Appendix IV. Concentration (rig/g wet weight) of Pesticides in Seal Tissue Samples (Animal No. 2)[a,b]

Pesticide	MM2L042 (Liver)	MM2K043 (Kidney)	MM2B044 (Blubber)
Hexachlorobenzene	4.4 (0.1)	7.3 (0.1)	56 (1)
Aldrin	<0.1	<0.1	<0.5
2,4*-DDE	<0.1	<0.1	24 (1)
4,4'-DDE	6.8 (0.3)	6.8 (0.2)	350 (12)
2,4'-DDD	<0.1	<0.1	<0.5
4,4'-DDD	0.3 (0.1)	0.1 (0.0)	0.6 (0.1)
2,4'-DDT	0.2 (0.0)	0.3 (0.0)	1.4 (0.1)
4,4'-DDT	0.2 (0.0)	0.3 (0.1)	1.8 (0.1)
Lindane	0.3 (0.0)	<0.1	21 (1)
Heptachlor Epoxide	2.9 (0.1)	0.3 (0.1)	34 (1)
cis-Chlordane	<0.2	<0.1	0.7 (0.1)
Trans-nonachlo r	0.8 (0.1)	0.2 (0.1)	44 (1)
Dieldrin	3.2 (0.1)	0.3 (0.1)	26 (1)
Heptachlor	0.2 (0.0)	0.2 (0.0)	4.3 (0.1)
Mirex	<0.1	<0.1	<0.4

[a]Two tissue extracts analyzed in triplicate; concentration value is the mean value, and numbers in parentheses are ±1 standard deviation of a single measurement.

[b]The < values indicate the minimum detectable level for this compound in this sample.

U.S. DEPARTMENT OF COMMERCE
NATIONAL INSTITUTE Of STANDARDS ANCTECHNOLOGY
GAITHERSBURG, MARYLAND 20699

90/551/NUCLM/169

REPORT OF ANALYSIS

May 24, 1990

TO: Paul Becker
National Ocean Services
701 C Street
Box 56 Module G
Anchorage, Alaska 99513

SUBJECT : Analysis of 1987 and 1988 Alaska Marine Mammal Tissue Samples

CONSTITUENTS : Na, Mg, Al, Cl, K, Ca, Sc, V, Cr, Mn, Fe, Co, Cu, Zn, As, Se, Rb, Sr, Mo, Ag, Cd, Sb, I, Cs, La, Ce, Sm, Eu, Tb, Hf, Ta, Au, U.

METHOD : Instrumental Neutron Activation Analysis

3ACKGROUND: This report contains results on selected samples from the Alaska Marine Mammal Tissue Archival Project. Liver, kidney, and muscle tissue of two Northern Fur Seals and liver and kidney tissue of two Ringed Seals were analyzed. The Northern Fur Seals had been collected during the 1987 Pribilof Islands subsistence harvest, and the Ringed Seals had been collected during the 1988 subsistence hunt in Barrow. (Ref. 1 & 2) The identification numbers are: 692-FRSL-004, 692-FRSL-005, 692-RGSL-004, and 692-RGSL-008.

SAMPLE PREPARATION: The selected frozen tissue samples were removed from their Teflon containers and cryogenically homogenized following the NBSB Cryogenic Homogenization SOP (3). The tissues from 692-RGSL-004 warmed during shipping and were re-frozen on arrival at NIST. It was impossible to remove these tissues from the teflon storage jars by the usual procedure. Therefore, the frozen capped teflon jars were placed in clean teflon bags, wrapping the bags several times around the sample, and placing it on the bottom plate -of the crusher, the jars split *in* one straight crack on impact.. There was no apparent loss of teflon into the sample. The sample was then placed in the teflon smasher and the normal cryogenic homogenization was done. It should be noted that the thawed tissue was visibly different from the tissue that had remained frozen, the thawed tissue appeared dark red. After

homogenization, the frozen homogenate was portioned into 20 subsamples, placed in Teflon jars, and stored at -150 "C. Subsamples #B005 from each tissue were selected for INAA and dried in a freeze-dryer at 1 Pa, -20 'C shelf temperature and -50 ●C condenser temperature for five days. The selected samples and their dry/wet ratios (C.F. or concentration factor values) are listed in Table 1:

TABLE 1. Marine Mammal Tissues Selected

Animal ID#	TISSUE	SAMPLE#	C.F.
92-FRSL-004	Liver	MM1L013	0.2946
	Kidney	MM1K014	0.2450
	Muscle	MM1M015	0.2549
92-FRSL-005	Liver	MM1L017	0.3072
	Kidney	MM1K018	0.2643
	Muscle	MM1M019	0.2651
92-RGSL-004	Liver	MM1L030	0.2873
	Kidney	MM1K031	0.2186
92-RGSL-008	Liver	MM1L042	0.2915
	Kidney	MM1K043	0.2258

PROCEDURE: Duplicate quantities of material were taken from each of the teflon jars and were pelletized using a Perkin-Elmer pellet press (#186-0025) . The pellets were weighed and packaged in acid-cleaned linear polyethylene film (LPE) for lNAA. Certified biological reference materials were prepared in a similar method and included in the INAA scheme as controls. Standard solutions dried on filter paper were also pelletized and sealed in LPE.

For the assay of short lived nuclides, the samples and controls were irradiated, one each together with one of the standards, for 120 s *in* the NIST reactor pneumatic facility RT-4 at 20 MW reactor power. The samples and controls were repackaged in clean LPE after the short irradiation for counting and the subsequent long irradiation. The high count rate gamma-spectrometer system in conjunction with the pneumatic shuttle system was used for the counting of the short half life nuclides. The counting geometry was 10 cm. Counting was started after approximately 90 s of decay. Spectral data collections were controlled via the VAX 730 computer and a Nuclear Data micro multichannel analyzer system (ND µMCA). The counting time was 300 s clock time, a 16384 channel fixed conversion time ADC (ND 581) was used in conjunction with a ND 599 1oss free counting module linked to the ND µMCA. This count was followed by a second count (600s) after approximately 2 hours decay to

better assay longer lived nuclides at lower count rates, i. e., without applying the loss free technique. The VAX 730 computer was also used for storage of the data and for processing with ND peak search and NAA software.

The quantitative evaluation was done by the comparator method, utilizing all standards from the individual irradiations. The ND peak search and activation analysis software was used to calculate specific activities of the nuclides in standards, i.e. "Standard Constants", and to calculate the unknown concentrations in the samples. The standard constants of the irradiations showed no deviations exceeding counting statistics (0.2 to 2 % relative uncertainty depending on nuclide). Therefore, all standards and samples were treated for quantitation as if they were from one irradiation, corrected for the different decay times.

For the assay of intermediate and long lived nuclides, the samples, controls and standards were re-irradiated in sets for 16 hours in the NBSR pneumatic facility RT-4 at 20 MW reactor power (Irradiation ID: Nil, N12, N16 and N17). The samples from the previous assay for short-lived nuclides were used except for one set of samples in irradiation N16, when the imminent reactor shutdown did not allow sufficient decay of the samples before re-irradiation. The GAMMAX-2 gamma spectrometer/sample changer system was used for counting of the intermediate half life nuclides. Counting was started after six days of decay to assay for the nuclides with intermediate half lives. The counting time was 4 hours, sample geometry 10 cm, and a 16384 channel fixed conversion time ADC (ND 581) was used linked to the Nuclear Data ND 6700 multichannel analyzer system. The samples were counted again after four to eight weeks decay for the assay of longer lived nuclides on the high count rate gamma spectrometer at 2 cm, 8192 channels ADC conversion gain and live time corrected counting. Counting times were at least 12 hours for each sample, 1 to 2 hours for standards. The ND systems and their software were used for the calculations of elemental concentrations and the initial statistical evaluations. The quantitative evaluation was also accomplished by the comparator method, utilizing all standards from the two irradiation sets.

CALIBRATION / QUALITY ASSURANCE: Gamma energy and half life data of the nuclides were taken from Ref. 4. Uncertainties of results due to uncertainties in these data are negligible in this application. The multi-element standard solutions L310, L383, L0587, L0188, Ba/Sr/Sb, U/Tb, and 10687 had been used in previous certification and other agencies programs' analyses and had been found in good agreement with other standards and reference materials. The data obtained for the various control materials do not reveal any significant bias compared to certified or well known literature values.

RESULTS / DISCUSSION: The analytical results are listed in Tables 2 and 3. Although these samples were lyophilized, the concentrations found in this work were converted to fresh weight based values by multiplication with the respective dry/wet weight ratios. The table includes the uncertainties due to counting statistics (including propagated uncertainties of the standards) . Table 4 summarizes the results obtained for the control materials including their reference values.

The results from duplicate analyses do not reveal any significant errors that might be due to sample inhomogeneity. All elements of interest were detectable in the liver tissues. Kidney and muscle tissue have much lower trace element concentrations which in several instances are below the detection limit of the applied INAA procedure. Hg cannot be determined due to vapor contamination during irradiation that can only be avoided by sealing the samples in quartz.

REFERENCES: Pertinent sample data have been recorded in notebook RLZ-NOAA under the run numbers 880811, 880916, 890517 and 890519. The gamma spectra and activation analysis results have been stored on magnetic tape.

Ref. 1: Becker, P. R., Wise, S. A., Koster, B.J., Zeisler, R., Alaskan Marine Mammal Tissue Archival Project: A Project Description Including Collection Protocols, NBSIR 88-3750, National Institute of Standards and Technology, Gaithersburg, MD 20899, 1988, 39pp.

Ref. 2: Becker, P. R., Wise, S. A., Zeisler, R., Alaskan Marine Mammal Tissue Archival Project: Acquisition and Curation of Alaskan Marine Mammal Tissues for Determining Levels of Contamination Associated with Offshore Oil and Gas Development, Annual Report-1989, OCSEAP Research Unit 692, Alaska Office, Oceans Assessment Division, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Anchoroge, AX 99513.

Ref. 3: Zeisler, R., Langland, J.K., and Harrison, S.H., Cryogenic Homogenization of Biological Tissues. Anal. Chem., 1983, 55, pp 2431-2434.

Ref. 4: Erdtmann, G., Sayka, W., "The Gamma Rays of the Radionuclides", Verlag Chemie, Weinheim, New York, NY, 1979.

Ref. 5: Gladney, E.S., O'Malley, B.T., Roelandts, I., and Gills, T.E., Natl. Bur. Stand. (U. S.) Spec. Publ. 260-111, U.S. Government Printing Office, Washington, DC, 547pp., 1987.

Analyzed by:

Rolf Zeisler
Research Chemist

Barbara J. Koster
Biologist

Reviewed by:

James R. DeVoe, Chief
Inorganic Analytical Research Div.

Robert R. Greenberg
Supervisory Research Chemist

Table 2: Alaskan Marine Mammal Project - Northern Fur Seal, Element Concentration (µg/g)

Element	LIVER MM1L013	LIVER MM1L017	KIDNEY MM1K014	KIDNEY MM1K018	MUSCLE MM1M015	MUSCLE MM1M019
Na	760.4±6.0	699.8±5.5	1305.4±9.8	1382.3±10.2	505.4*3.7	479.4±3.6
Mg	194*4.5	213±4.4	189±5.4	168.4±4.2	231*3.9	272±4.5
Al	0.533±0.081	0.522±0.042	1.599±0.085	0.78020.053	0.313*0.041	0.712±0.049
Cl	1016±13	891±12	1578*18	1697±16	538.9±8.0	470.026.0
K	3316±50	3155*59	261O*49	2464±33	3350±33	3615±38
Ca	38.3±4.4	30.6±3.8	38.1±4.4	53.1±4.0	31.523.7	22.1±2.5
Sc	≤0.00012 -[a]	≤0.00013 50.00015	≤0.00011 ·	≤0. Ooow ≤0.00008	(1.43 ±0.07)E-4 ·	(0.87±0.06)E-4 (0.55±0.06)E-4
v	0.0843±0.0062	O.1O88*O.OO44	≤0.013	≤0.008	≤0.0073	≤0.0073
Cr	0.0251*0.0044 ·	0.0551*0.0050 0.0525±0.0057	0.0390±0.0036 ·	0.0106±0.0032 0.0136±0.0032	0.0612±0.0030 ·	0.0386±0.0030 O.0229±0.0026
Mn	4.179*0.045	3.185±0.036	1.157±0.022	1.260±0.015	0.1630±0.0058	0.1857±0.0063
Fe	171.8±1.0 ·	118.8* 0.8 109.3±0.8	74.00±0.49 ·	51.70*0.37 52.52±0.39	75.12±0.48 ·	70.58±0.45 72.19±0.46
co	0.01884*0.00016 ·	0.01624±0.00016 0.01523*0.00019	0.02501 ±0.00017 -	0.01733*0.00014 0.01784±0.00016	(5.094±0.068)E-3 ·	(3.641±0.057)E-3 (3.313±0.058)E-3
Cu	56.34±0.82	17.03±0.49	7.06±0.52	8.71*0.35	2.20±0.45	2.07±0.30
Zn	56.53±0.42 ·	57.89±0.43 53.03*0.40	63.28±0.47 ·	37.18±0.28 37.75±0.28	35.00 ±0.26 ·	33.43±0.25 34.04*0.25
As	50.092 ·	0.187±0.020 0.239*0.024	0.164±0.021 ·	0.503*0.023 0.47%0.025	0.174±0.012 ·	0.311*0.014 ·
Se	6.289±0.052 -	5.450*0.045 4.987±0.042	3.856±0.032 ·	3.066±0.026 3.085±0.026	3.1 O%O.O26 -	2.147±0.018 2.195±0.018
Rb	1.874±0.047 ·	1.759*0.049 1.598*0.045	1.368*0.033 ·	1.038*0.030 1.094±0.029	1.518±0.028 ·	1.408±0.028 1.410±0.029
Sr	≤0.89 ·	≤0.96 ≤1.1	≤0.78 ·	≤0.66 ≤0.72	≤0.54 ·	≤0.53 ≤0.56
Ho	O.38*O.1O ·	0.65±0.11 0.46±0.10	≤0.40 ·	≤0.29 ≤0.38	s0.25 ·	≤0.28 ·

Table 2: Alaskan Marine Mammal Project - Northern Fur Seal, Element Concentration (µg/g)

Element	LIVER MM1L013	LIVER MM1L017	KIDNEY MM1K014	KIDNEY MM1K018	MUSCLE MM1M015	MUSCLE MM1M019
Ag	0.1721*0.0023 ·	0.3815±0.0037 0.3472*0.0039	≤0.0044 -	0.012920.0011 0.0126±0.0013	≤0.0030 ·	≤0.0029 ≤0.0031
cd	18.51±0.29 ·	8.01±0.19 7.50±0.18	66.66±0.79 -	29.0220.39 29.02±0.39	≤0.26 ·	≤0.39 ·
Sb	O. OO1O5*O.OOO27 ·	0.00375±0.00033 0.00304*0.00037	s0.00069 -	≤0.00054 0.00115±0.00021	≤0 .00048 ·	0.00060±0.00016 0.00043±0.00012
I	0.447±0.071	1.74±0.12	≤0.323	≤0.16	≤0.199	≤0.208
Cs	0.0169120.00048 ·	0.02880±0.00053 0.02218±0.00067	0.02474*0.00050 -	0.0231220.00044 0.02229±0.00048	0. 04045±0.00046 ·	0. 04321±0.00045 0.04266±0.00047
La	≤0.0085 -	≤0.0092 ≤0.0086	≤0.011 ·	≤0.012 ≤0.011	so. 0070 ·	≤0.0070 ·
Ce	≤0.014 ·	≤0.015 ≤0.017	≤0.0095 ·	≤0.0091 ≤0.010	≤0. 0073 ·	≤0.0070 ≤0.0075
Sm	≤0 .0024 ·	≤0.0023 ≤0.0023	≤0.0019 ·	50.0017 50.0017	50.0012 ·	≤0.0013 ·
Eu	≤0 .00076 ·	≤0.00079 50.00099	50.00072 ·	≤0.00059 ≤0. 00067	≤0.00049 ·	≤0.00046 so. 00049
Ib	≤0.015 ·	≤0.017 ≤0.016	≤0.019 ·	≤0.021 ≤0.020	≤0.014 ·	≤0.014 ·
Hf	≤0.0011	≤0.00096 ≤0.0014	≤0.00094 ·	≤0.00083 ≤0. 00090	≤0. 00068 ·	≤0.00067 ≤0. 00070
Ta	≤0.0015 -	≤0.0017 ≤0. 0020	≤0 . 00W8 ·	≤0. 00092 ≤0.0010	≤0.00074 ·	≤0. 00071 ≤0. 00074
Au	≤0. 00033 ·	50.00035 ≤0. 00033	≤0 .00038	≤0. 00041 ≤0. 00039	≤0. 00023 ·	≤0 .00024 ·
U	≤0. 070 -	≤0.071 ≤0. 070	≤0. 073 ·	≤0. 075 ≤0. 073	≤0. 045 ·	≤0. 047 -

*a second determination was done only on samples fran the second seal

Table 3: Alaskan Marine Mammal Project - Ringed Seal, Element Concentrations (µg/g)

Element	LIVER MM2L030	LIVER MM2L042	KIDNEY MM2K031	KIDNEY MM2K043
Na	841.6±5.0 821.5±5.0	833.4±5.0 816.3±5.0	1912±11 1922±11	2120*11 2095±11
Mg	231 .4*8.3 201 .8*8.2	223.7±8.1 250.2±9.2	124.9* 9.1 157.7* 8.9	169±10 173*12
Al	≤0.07 ≤0.07	≤0.07 ≤0.07	Solo ≤0.11	≤0.12 ≤0.12
c1	1047.1±6.0 1032.0±6.0	933.0* 5.5 907.9* 5.6	2584*14 2555±14	2939*15 2893*15
K	3114±61 2947±67	3110±60 3131*7I	1196±44 2166*78	1930±74 1852±62
Ca	42.1*2.8 ≤8.7	41.323.0 44.8±3.2	47.1±5.1 53.1*4.5	≤12 ≤13
SC	≤0 .000058 ≤0.000097	O.000084±0.000018 ≤0.000040	≤0.000031 ≤0.000053	≤0.000034 ≤0.000041
Ti	≤1 .28 ≤1.30	≤1 .27 ≤1.31	≤2.06 ≤1.93	≤2.53 ≤1 .57
v	0.199%0.0043 0.1959*0.0038	O .4042±0.0053 0.3859%0.0053	≤0 .0767 ≤0.0816	0.072920.0044 0.0565±0.0037
Cr	0.013120.0030 ≤0.011	O .0228±0.0026 0.033620.0019	0.0141±0.0020 0.0108±0.0030	0.0192±0.0022 0.0178±0.0024
Mn	3.732±0.037 3.659±0.037	3.849±0.038 3.675±0.037	1.337±0.027 1.032±0.020	1.02120.024 0.702*0.021
Fe	729.3*9.5 721.9±6.7	889±12 884±12	123.6* 1.6 121.1* 1.2	115.2% 1.5 114.5* 1.1
co	0.01841*0.00021 0.01776±0.00034	0.03377*0.00031 0.03350±0.00030	0.02070±0.00019 0.02067±0 .00023	0.05571*0.00047 0.05511*0.00048
Cu	11.21*0.37 10.92±0.35	6.40±0.31 6.54±0.32	so. 85 3.90±0.36	7.6-6*0.46 3.34±0.26
Zn	38.06*0.49 37.61±0.49	36.98*0.48 36.73±0.48	26.29±0.34 26.08±0.34	26.61 ±0.35 26.06±0.34
As	0.263±0.012 0.30020.022	0.584*0.015 0.634±0.021	0.175 0.016 0.~~407~~±0.018 0.200±0.018	o .444±0.020 0.428%0.024
Se	5.712±0.075 5 .628*O. 053	2.818±0.037 2.798±0.037	3.941±0.052 3.828*0.051	3 .205±0. 042 3.092±0.041

Table 3: Alaskan Marine Mammal Project - Ringed Seal, Element Concentrations (µg/g)

Element	LIVER MM2L030	LIVER MM2L042	KIDNEY MM2K031	KIDNEY MM2K043
Rb	2.418*0.053 2.267±0.051	3.515±0.062 3.523*0.050	1.222±0.024 1.181 ±0.032	1.718±0.032 1.720±0.028
Sr	≤0.3078±0.0031 ≤0.5627±0.0056	≤0.2723*O .0027 ≤0.2281±0.0023	≤0.1764±0.0018 ≤0.3035±0.0031	≤0.1950±0.0020 ≤0.2745±0.0028
no	0.253±0.061 0 .244*O .073	0.519*0.067 0.524±0.073	≤0.30 ≤0.30	≤0.33 ≤0.32
Ag	0.7644*0.0031 0.1656±0.0047	0.0474±0.0016 0.0472*0.0015	0.00222±0.00060 ≤0.0025	0.00224±0.00066 ≤0.0023
Cd	2.77±0.12 2.55±0.14	2.14*0.12 2.13±0.12	6.76 ± 0.16 ~~3.09~~±0.14 6.61±0.16	3.37±0.15 3.80±0.16
Sn	≤0.53 ≤1.1	≤0.45 ≤0.47	≤0 .32 ≤0.58	0.82±0.15 ≤0.60
Sb	0.0 0662±0.00034 0.00664 ±0.00052	0.005565 ±0.00027 0.005133±0.00021	0.003041 ±0.00018 0.003290 ±0.00032	0.00191 ±0.00016 0.002527±0.00023
I	0.953*0 .067 0.690±0.061	0.667±0.056 0.747*0.070	≤0.18 ≤0.17	≤0.22 ≤0.16
Cs	0.03080±0.00067 0.0306±0.0010	0.02346±0.00054 0.02375*0.00050	0.02888±0.00051 0.02812±0.00063	0.02412±0.00045 O.02402±0.00056
Ba	≤1 .2 ≤0.78	≤1.1 ≤0.25	≤0.60 ≤0.84	≤0.70 ≤0.32
La	≤0.0083 ≤0.0071	≤0.0079 ≤0.0070	≤0.011 ≤0.0W3	≤0.012 ≤0.0097
Ce	≤0.0057 ≤0 .0096	0.0050±0.0018 ≤0.0037	≤0.0034 ≤0.0059	≤0.0038 ≤0.0050
Sm	≤0.0012 ≤0.0019	≤0.0013 s0.0018	≤0.0012 ≤0.0014	≤0.0013 ≤0.0015
Eu	≤0.00038 50.00077	50.00034 ≤0.00033	≤0.00020 50.00035	≤0.00022 ≤0 .00032
Ib	≤0.00031 ≤0.00064	≤0 .00026 s0.00027	≤0.00019 ≤0.00034	≤0.00021 ≤0.00035
Hf	≤0.00052 ≤0.00084	≤0 .00046 ≤0.00034	≤0 .00029 ≤0.00049	≤0 .00032 ≤0.00041

Table 3: Alaskan Marine Mammal Project - Ringed Seal, Element Concentrations (µg/g)

Element	LIVER MM2L030	LIVER MM2L042	KIDNEY MM2K031	KIDNEY MM2K043
la	≤0.00047 ≤0.00093	≤0.00042 ≤0.00040	≤0.00020 ≤0.00035	≤0.00024 ≤0.00036
Au	≤0.0003 ≤0.0003	≤0.0003 ≤0.0003	≤0.0004 ≤0.0004	≤0.0004 ≤0.0004
Th	≤0.00078 ≤0.0012	≤0.00069 ≤0.00045	≤0.00047 ≤0.00078	≤0.00052 ≤0.00060
u	≤0.054 ≤0.060	≤0.052 ≤0.057	≤0.063 ≤0.060	≤0.069 ≤0.065

Table 4: Control Materials, Element Concentrations (µg/g)

Element	International Atomic Energy Agency, MA-B-3/TM, Fish Tissue				NIST SRM 1577, Bovine Liver		
	CERTIFIED/REF.	RANGE	#77L	#ml	CERTIFIED/REF.	TMS #34	TMS #35
Na	2160	2000-2310	2205±17	2100±16	2430±130	2300±18	·
Mg	1130	1040-1200	1208±51	1200±49	604±9	680±38	·
Al	(20.9)*		18.88±0.32	19.5*0.35	16±14**	1.4*0.14	·
Cl	2540	2330-2770	2550±24	2500±23	(2700)	2800±24	·
K	9320	9000-10000	9200± 150	901O*14	9700±600	101 OO*13O	·
Ca	3490	3180-3600	3600±81	3500±76	124±6	94±9.3	-
Sc	(0.0037)***		0.003682 ±0.000037	0.002219i0.000030	o. 0009±0 .0003**	o. 000543±0 .000035	0.000685±0.00003.7
v	(0.08)***		0.044±0.014	0.059±0.014	0.058±0.008**	0.0046±0.011	·
Cr	(0.64)		0.445±0.0093	0.493±0.011	0.088*0.012	0.068*0.012	0.245±0.013
Mn	*2.62*	*2.22-3.03*	2.70±0.065	2.3690±0.054	10.3±1.0	10.092 ±0.011	·
Fe	95.4	87.3 -107.2	94±0.65	67.14±0.54	268±8	242.7±1.6	246.0±1.6
co	(0.041)***		O. 034±0. 00023	0.02814 ±0.00024	(0.18)	0.2251±0.0011	0.2270 ±0.0011
Cu	3.08	2.85-3.57	<3.8	3.4650	193*1O	190±2.6	·
Zn	109.2	106.4 -111.9	102.2±0.80	98.32±0.73	130±13	125.3±0.9	126.4±0.9
As	2.11	1.42-2.51	2.378±0. 096	2.235±0.050	0.055±0.005	0.032 ±0.011	0.0437±0.0049
Se	1.46	1.35-1.70	1.384*0.013	1.356±0.013	1.1±0.1	1.022 ±0.013	1.081 ±0.014

Table 2: Control Materials, Element Concentrations (µg/g)

Element	International Atomic Energy Agency, MA-B-3/TM, Fish Tissue				NIST SRM 1577, Bovine Liver		
	CERTIFIED/REF	RANGE	#77L	#77M	CERTIFIED/REF.	TMS #34	TMS #35
Rb	1.49	1.34-2.00	1.353*0.058	1.476±0.065	18.3±1.0	17.52 ±0.22	17.82±0.19
Sr	29.9	24.9-37.9	33.53±0.42	34.06±0.47	(0.14)	<2.3	<2.2
Mo			<1.3	<0.85	(3.4)	3.014±0.067	3.189±0.055
Ag			<0.0067	<0.0078	(0.06)	0.0467±0.0038	0.0656±0.0043
Cd			<1.6	<1.1	0.27±0.04	<0.15	<0.11
Sb	(0.214)***		0.02730±0.00081	0.02119±0.00083	(0.005)	0.00484±0.0084	0. 00517±0.00071
I	(1.3)***		1.94±0.32	1.41±0.29	(0.18)	<0.7	.
Cs	(0.08)*		o .07085 *0.00095	0.687*0.0010	0.017*0.007**	0.0100±0.0012	0.0127±0.0012
Ba	(1.95)***		<7.9	<7.4	0.94±1.1**	<11	<6.9
La			<0.044	<0.021	0.01620.004'"	0.0278 ±0.0012	0.0476±0.0011
Ce	<0.018		o .0208±0.0056		0. 020±0 . 004**	<0. 035	0.0299±0. 0085
Sm			<0.008	<0.0043	0.0016±0.0003**	<0.0009	<0.0006
Eu	(0.00046)***		<2.4E-04	<2.4E-04	(3.3* 0.6) E-4**	<5E-4	<6E -4
Hf			0.00372*0.00044	0.00834±0.00057	0.00415**	<0.003	<0.003
Ia			0.0985±0.0013	0.04660±0.00082	0.003**	0.0112 ±0.0008	0.0146±0.0009
Au			<8.5E-4	<7.8E-4	O. 0028±0 . 003**	(9.0±0.1)E-5	(6.2±0.1)E-5
Th	(0.004)***		<0 .0023	<0.0025	0.004P*	0.0704*0.0017	0.0236±0.0014
u			<0.2	<0.14	(0.0008)	<0.020	<0.014

* information Only Value
** Value from Gladney et al. (Ref. 4)
***previous Results by INAA

NIST INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF THE 1989 AMMTAP LIVER SAMPLES

Liver tissue from two ringed seals (692-RGSL-Oil; 692-RGSL-013) sampled in Norton Sound and two belukha whales (692-BLKA-002; 692-RGSL-003) sampled at Point Hope in 1989 were analyzed by NIST for the following trace elements using instrumental neutron activation analysis: Na, Mg, Al, Cl, K, Ca, Se, V, Cr, Mn, Fe, Co, Cu, Zn, As, Se, Rb, Sr, Mo, Ag, Cd, Sb, I, CS, La, Ce, Sm, Eu, Tb, Hf, Ta, Au, and U. Procedures were the same as described in the *NIST Report of Analysis* of May 24, 1990 (page 71). Although these analyses have just been completed and a *Report of Analysis* for this work has yet to be written, the data are presented in table below.

Alaska Marine Mammal Project - Ringed Seal and Belukha Whale Liver (µg/g, wet weight). Plus or minus values are uncertainties due to counting statistics.

	Ringed Seal		Belukha Whale	
Animal	692-RGSL-011	692-RGSL-013	692-BLKA-002	692-BLKA-003
NIST #	MM3L054	MM3L060	MM3L072	MM3L075
Na	869.9 ±6.9	880.2 ±7.0	1214.6 ±9.5	
	880.1 ±6.9	878.0 ±7.0	1199.1 ±9.2	1048.7 ±8.4
Mg	220.1 *4.7	191.7 *4.5	151.4 *4.7	-
	230.0 ±4.4	174.7 ±4.5	161.9 ±4.7	78.5±3.1
Al	0.877 ±0.094	0.977 *0.059	0.421 ±0.062	-
	0.742 ±0.058	0.605 ±0.064	0.534 *0.057	0.440±0.056
cl	810 ±7	1108 ±8	1390 *lo	-
	828 ±7	1100 ±8	1394 ±10	1496 *11
K	2568 ±85	2559 ±91	2531 ±82	
	2761 ±85	2663 ±70	2576 ±95	2704 ±114
Ca	30.06 *2.76	31.25 ±2.79	23.94 ±2.49	-
	30.89 *4.14	31.25 ±2.79	29.43 *3.74	26.92 ±3.65
Sc	0.000196 ±0.000044	0.000206 ±0.000044	≤0.000130	≤0.000175
	0.000323 ±0.000050	0.000123 ±0.000033	≤0.000140	≤0.000177

	Ringed Seal		Belukha Whale	
Animal	692- F? GSL-011	692-FIGS L-013	692-B LKA-002	692- BLKA-003
NIST #	MM3L054	MM3L060	MM3L072	MM3L075
v	0.3803 ±0.0072	0.1258 ±0.0050	0.0888 *0.0040	-
	0.3949 *0.0074	0.1242 ±0.0056	0.0955 ±0.0052	0.0948 ±0.0056
Cr	0.0885 ±0.0074	0.0815 ±0.0078	0.0663 *0.01 00	≤0.0303
	0.0527 ±0.0074	0.0918 ±0.0073	0.1067 *0.01 15	0.0446 tO.0123
Mn	4.222 ±0.039	2.865 ±0.036	3.327 *0.035	·
	4.278 *0.041	3.024 ±0.033	3.387 ±0.035	3.093 *0.039
Fe	573 *5	314 *3	363 ±3	627 ±6
	582 ±5	315 *3	362 ±3	618 ±6
Co	0.04479 ±0.00066	0.02388 *0.00050	0.01175 ±0.00067	0.01783 iO.00112
	0.04611 ±0.00069	0.02352 ±0.00050	0.01107 *0.00070	0.01778 ±0.00101
Cu	8.00 ±0.55	7.95 *0.45	14.52 ±0.45	·
	7.72 ±0.44	8.82 ±0.47	14.27 ±0.50	13.15 ±0.53
Zn	32.35 ±0.28	27.61 ±0.24	38.53 ±0.32	30.30 ±0.27
	33.01 *0.28	27.77 ±0.24	38.53 ±0.32	30.19 ±0.27
As	2.46 ±0.03	2.15 ±0.03	0.132 *0.015	0.294 ±0.024
	2.37 *0.03	2.06 ±0.03	o.194 *0.020	0.209 ±0.021
se	3.707 ±0.036	2.730 ±0.028	3.993 *0.040	14,272 ±0. 129
	3.767 ±0.036	2.736 ±0.027	3.988 ±0.040	14.230 ±0.129
Rb	1.613 ±0.058	2.254 ±0.056	1.152 *0.070	1.458 tO.104
	1.663 ±0.066	2.235 ±0.056	1.197 *0.072	1.579 *0.101
Sr	≤1.33	≤1.26	≤2.47	≤3.69
	≤1.41	≤1.21	≤2.5	3.98 ±0.84
Mo	0.403 ±0.080	0.416 ±0.086	0.606 *0.087	≤0.275
	≤0.306	0.299 ±0.078	0.416 *0.090	0.275 ±0.084
Ag	0.0734 ±0.0030	0.0935 *0.0039	14.365 ±0.085	30.527 ±0.177
	0.0753 *0.0033	0.0898 ±0.0031	14.363 ±0.095	30.494 ±0. 177
cd	1.72 *0.15	1.95 ±0.18	0.33 to.11	1.97 ±0.18
	1.94 *0.20	1.74 *0.17	0.58 *O. 15	1.71 ±0.18

	Ringed Seal		Belukha Whale	
Animal	692- RGSL-011	692- RGSL-013	692- BLKA-002	692- BLKA-003
NIST #	MM3L054	MM3L060	MM3L072	MM3L075
Sb	0.0129 ~0.00110	0.00608 tO.00106	0.00915 ±0.00237	≤0.00953
	0.01100 ±0.00116	0.00575 ±0.00078	≤0.00648	≤0.00981
I	7.64 ±0.72	6.03 ±0.81	4.46 *0.75	·
	9.38 ±0.85	6.72 ±0.73	5.16 *0.62	5.30 ±0.76
Cs	0.0464 ~0.0013	0.0470 *0.001 3	0.0315 *0.0015	0.0390 *0.001 9
	0.0491 *0.001 2	0.0442 tO.0011	0.0306 ±0.0015	0.0364 AO.0018
La	≤0.00745	≤0.00725	≤0.00723	≤0.00757
	≤0.01076	≤0.00698	≤0.00698	≤0.00869
Ce	≤0.0164	<0.0167	0.0114 *0.0055	≤0.0225
	≤0.0172	S().()157	<0.0175	≤0.0223
Sm	≤0.00091	<0.00103	≤0.00102	≤0.00112
	≤0.00099	≤0.00095	≤0.00107	≤0.00109
Eu	≤0.00097	≤0.00086	≤0.00130	≤0.00191
	≤0.00102	≤0.00081	≤0.00132	≤0.00193
Tb	<00.01"4	≤0.0012	<0.0016	≤0.0023
	≤0.0015	≤0.0011	<0.0017	≤0.0023
Hf	<0.0011	<0.0011	≤0.0022	≤0.0034
	<0.0011	<0.0010	≤0.0023	≤0.0035
Ta	≤0.00083	≤0.00064	≤0.00299	≤0.00449
	≤0.00088	≤0.00067	≤0.00299	0.00477
Au	≤0.00030	≤0.00028	0.00235 ±0.00013	0.00288 ~0.00018
	≤0.00041	≤0.00028 *o.00015	0.00340 *0.0001 5	0.00275 tO.00019
u	≤0.085	≤0.092	≤0.090	≤0.101
	≤0.099	≤0.086	≤0.095	≤0.101

ANALYSIS OF THE 1987, 1988, AND 1989 AMMTAP LIVER SAMPLES BY THE NUCLEAR RESEARCH CENTER, JÜLICH

Subsamples of those liver aliquots analyzed by NIST for the quality control program were also analyzed by the Institute of Applied Physical Chemistry, Nuclear Research Center Jülich, Germany, fOr: Zn, Cd, Pb, Cu, Ni, and Co using voltametry, total Hg using cold vapor atomic absorption spectroscopy (AAS) , and methyl-Hg using ion chromatography separation plus cold vapor AAS (the methods are presented in "Guidelines for Environmental Specimen Banking in the Federal Republic of Germany," Umweltbundesamt, Berlin, September 11, 1989) . Although these analyses were only recently completed and a *Report of Analysis* for this work has yet to be written, the preliminary data are presented in the tables below. The results for Zn, Cd, Cu, and Co by NIST using INAA and Jülich using voltametry appear to agree.

Alaska Marine Mammal Project - results of mercury analysis of liver using cold vapor atomic absorption spectroscopy (AAS) and ion chromatography separation plus cold vapor AAS. Values are µg/g, wet weight. (from the Nuclear Research Center, Julich, Germany)

Animal	NIST #	Hg	Methyl-Hg
692-FRSL-004	MM1L013	10.84 (0.71)	
692-FRSL-005	MM1L017	7.65 (0.12)	0.94
692-RGSL-004	MM2L030	6.35 (0.1 1)	0.28
692-RGSL-008	MM2L042	1.95 (0.29)	0.17
692-RGSL-011	MM3L054	1.627 (0.083)	0.70
692-RGSL-013	MM3L060	1.423 (0.028)	0.49
692-BLKA-002	MM3L072	1.397 (0.012)	0.41
692-BLKA-003	MM3L075	10.18 (0.36)	0.75

Alaska Marine Mammal Project - results of voltametry measurements of trace elements in liver. Values are µg/g, wet weight. (from the Nuclear Research Center, Julich, Germany)

Animal	NIST #	Zn	Cd	Pb
692-FRSL-004	MM1L013	61.6 (2.9)	16.85 (0.1 8)	0.02204 (0.0001 8)
692-FRSL-005	MM1L017	52.6 (1.2)	6.14 (0.18)	0.0467 (0.0034)
692-RGSL-004	MM2L030	37.9 (2.0)	2.425 (0.01 7)	0.0287 (0.0014)
692-RGSL-008	MM2L042	37.0 (2.0)	2.180 (0.061)	0.0312 (0.0012)
692-RGSL-011	MM3L054	33.37 (0.55)	1.840 (0.002)	0.0287 (0.0033)
692-RGSL-013	MM3L060	26.39 (0.89)	1.992 (0.039)	0.02372 (0.0001 1)
692-BLKA-002	MM3L072	39.2 (1.0)	1.112 (0.012)	0.11847 (0.00025)
692-BLKA-003	MM3L075	32.8 (1 .7)	2.448 (0.01 7)	0.0460 (0.0090)

Animal	NIST #	Cu	Ni	co
692-FRSL-004	MM1L013	53.91 (1.18)	0.04242 (0.00029)	0.0158 (0.001 1)
692-FRSL-005	MM1L017	14.87 (0.80)	0.0777 (0.0022)	0.0150 (0.0021)
692-RGSL-004	MM2L030	9.452 (0.029)	0.05085 (0.00057)	0.0221 (0.0020)
692-RGSL-008	MM2L042	6.296 (0.029)	0.0315 (0.0015)	0.0472 (0.0023)
692-RGSL-011	MM3L054	7.69 (0.1 7)	0.01768 (0.00025)	0.0458 (0.0022)
692-RGSL-013	MM3L060	7.98 (0.1 7)	0.03850 (0.00251)	0.0430 (0.001 1)
692-BLKA-002	MM3L072	13.842 (0.075)	0.0521 (0.0025)	0.01042 (0.00057)
692-BLKA-003	MM3L075	12.17 (0.17)	0.04178 (0.00028)	0.0317 (0.0014)

HPLC ANALYSIS OF RINGED SEAL BILE FOR FLUORESCENT AROMATIC COMPOUNDS

The Environmental Conservation Division, Northwest Fisheries Center, NMFS, Seattle, analyzed an initial set of ringed seal bile samples for fluorescent aromatic compounds using the HPLC technique developed for fish bile. The bile was obtained during the AMMTAP sampling of ringed seals in the Chukchi Sea in 1988. The results are presented in the table below (Varanasi, personal communication, 1989).

	FAC (µg/ml bile)		
Animal #	Naphthalene wavelengths	Phenanthrene wavelengths	Benzo(a)pyrene wavelengths
692-RGSL-001	0.81	0.74	0.008
692-RGSL-002	2.5	0.89	0.009
692-RGSL-003	7.2	4.2	0.008
692-RGSL-004	3.2	2.5	0.020
692-RGSL-005	3.7	2.4	0.006
692-RGSL-006	3*1	2.0	0.003
692-RGSL-007	4.9	1.1	0.014
692-RGSL-008	0.11	1.5	0.006
692-RGSL-009	2.4	1.3	0.003
692-RGSL-010	4.3	0.14	0.003
English sole[a]	77.0	43.5	1.1

The values were determined by converting the observed detector response to the concentration of known naphthalene, phenanthrene or benzo(a)pyrene standards that would give an equivalent response. Because this analytical method yields relative concentrations, one can only establish the baseline level of detector response by analyzing bile samples from organisms not suspected of being exposed to any aromatic hydrocarbons. The peak pattern, or lack thereof, in the bile samples from the ringed seals suggest that these animals have not been exposed to aromatic compounds. Thus, these values are considered to be baseline values representing background response due to endogenous bile components in ringed seal bile.

These ringed seal bile samples have been important in establishing an interim reference value for marine mammals thought not to be exposed to petroleum hydrocarbons; in fact, these values have provided the reference for bile samples collected from harbor seals and sea lions following the EXXON VALDEZ oil spill.

[a] *English sole (Parophyrys vetulus) were sampled from a contaminated site in Puget Sound, Washington. Samples of bile were analyzed concurrently with the ringed seal bile samples.*