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The Alaska Frozen Tissue Collection and Associated Electronic Database: A Resource for Marine Biotechnology

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University of Alaska Museum

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The Alaska Frozen Tissue Collection and Associated Electronic Database: A Resource for Marine Biotechnology

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Acknowledgments

Many biologists throughout Alaska have enthusiastically embraced the concept of a regional tissue archive. We cannot name all of those individuals, but sincerely appreciate the various contributions to the AFTC. At the Alaska Department of Fish and Game, Vicki Vanek and Gay Sheffield have recruited significant numbers of specimens and even funding from their colleagues. John J. Burns continues to develop extensive temporal series of specimens acquired during his late-Holocene career with ADF&G (thanks also to Ted Miller for his efforts along these lines). Lloyd Lowry and Kathy Frost continue to consistently provide samples from animals that they contact. Barbara Mahoney of the National Marine Fisheries Service in Anchorage and Steve Zimmerman in Juneau have been conscientious supporters. Also with NMFS, Jack Cesarone of the National Marine Mammal Laboratory in Seattle magnanimously facilitated the subsampling the substantive holdings of that institution. At the North Slope Borough, Todd O'Hara, Johnny Tundra, and Robert Suydam have made the Department of Wildlife Management into a regular conduit of samples from subsistence hunters to the AFTC. Various biologists with United States Fish and Wildlife Service and USGS-Biological Resources Division (e.g., Joel Miller, Steve Amstrup, Tom Evans) provided samples of walrus, polar bear and sea otters. Collaborations with Paul Becker and the Alaska Marine Mammals Archival Project (AMMTAP) resulted in several significant accessions. Malcolm Ramsay, University of Alberta, provided a large series of Canadian polar bears. Alan Springer and Amy Hirons of UAF's Institute of Marine Sciences have collaborated on many aspects of sample collection and processing. This work was accomplished under the following permits: National Marine Fisheries Service 704-1444; US Fish and Wildlife Service PRT-832903; CITES US807212; US Department of Agriculture 44014 and 44020; and annual permits from the Alaska Department of Fish and Game. We thank the permit officers for facilitating the administration of these permits.

1.0 Abstract

The Alaska Frozen Tissue Collection (AFTC) is the primary regional archive for frozen zoological samples and a major contributor to biotechnology studies of the North Pacific and Arctic oceans. It has become the world's third largest frozen tissue collection for wild mammals. In addition to expanding the scope of the collection by recruiting contributions of marine mammal, bird, fish, and invertebrate specimens from throughout the North Pacific and Arctic oceans, a collection of approximately 5,000 seals was incorporated. These specimens span three decades of field work by the Alaska Department of Fish and Game, and include samples from throughout Alaska's waters. This is the largest collection of western Arctic and North Pacific seals worldwide.

Between 1 July 1995 and 30 June 1998, the AFTC accessioned tissues from 945 marine mammals representing 26 species, as well as fish and marine invertebrate samples. Frozen tissue loans (n = 28) representing 375 individual animals have been made to ongoing research projects. Other investigators have visited the collection to study marine specimens. Cooperative agreements have been developed or continued with individual collectors and organizations, including the National Marine Fisheries Service, the U. S. Fish and Wildlife Service, the North Slope Borough, the Alaska Marine Mammal Tissue Archival Project (AMMTAP), and an ongoing Alaska Department of Fish and Game subsistence seal harvest project.

2.0 Introduction

Long-term monitoring of biological change in marine ecosystems dictates long-term accumulation of data. Because it is difficult to predict which data will be important, or even what methods may be available, accumulation of well-documented specimens is crucial to assessing change. This mandates permanent, cooperative archives with appropriate protocols for sharing specimens and associated data, such as the Alaska Frozen Tissue Collection (AFTC).

For the past three years, CMI has provided a coordinator for the AFTC in the form of a graduate student assistantship dedicated to recruiting and processing marine animals into the AFTC. CMI has also provided auxiliary support for supplies and travel, and the Museum has matched this funding by dedicating 4.4 months/year of Co-PI Jarrell's time to the AFTC. A supplement from CMI in 1996 supported processing and accessioning approximately 8,000 items, representing about 5,000 individual seals and walrus from the Alaska Department of Fish and Game. The objectives of this project were to (1) expand the marine sector of the AFTC, (2) establish an online catalog of the AFTC, and (3) to commit the University to long-term support of the AFTC Coordinator.

This project has made the AFTC into the primary regional archive for frozen zoological samples. For at least two reasons, this is a substantial contribution to the scientific infrastructure:

1. Improved methods for extracting data from DNA sequences, stable-isotope signatures, and trace-element concentrations are making the historical archives found in museums crucial to the study of long-term ecological change. Older specimens in collections are becoming important for interpreting past environments (baseline conditions). Material now being archived will serve such functions better in the future. Ultracold storage of biological tissues preserves a broad suite of biochemical characteristics and is an efficient means of preserving specimens for such studies.

2. The AFTC facilitates cost-effective use of specimens. Many assessment and inventory projects generate important sampling opportunities, frequently at tremendous expense. Such projects are usually short-term because of funding limitations and in the past, few have gathered or archived specimens. Now, through extensive cooperative efforts, the AFTC is becoming a long-term, specimen-based record of the biotic environment of the North Pacific and Arctic oceans. Unique and important material is being made available to the general scientific community in perpetuity, and AFTC specimens are being used extensively in ongoing research. The value of CMI support will be realized as future investigations call for, or are designed around, the use of archived samples.

Molecular analyses (e.g., DNA sequences) are now basic to defining and managing natural populations. These techniques are providing insight into social systems (Burke, 1989), effective population size (Lande and Barrowclough, 1987), lineage divergence (O'Corry-Crowe et al., Bickham et al. 1996) and the effects of inbreeding and outbreeding depression (O'Brien et al., 1985; Ralls et al., 1988). DNA sequencing has eclipsed much of the stock-delimiting work formerly done by electrophoresis of allelic proteins (Moritz, 1994). Improvements in sequencing technology are yielding more data per sample at lower costs, and streamlining the processing of larger sample sizes. This work relies on cryogenically archived specimens.

Frozen tissue collections are also important in studies of epidemiology in wild populations. Crises such as the distemper epidemic in North Atlantic gray and harbor seals (see Dickson 1988 for an early review) suggest that we should be building a baseline of tissue samples for Alaskan marine organisms. Blood samples archived in the AFTC were used to screen for seal (phocine) distemper subsequent to the epidemic in the North Sea. Hundreds of AFTC samples have been used in three projects screening for hantavirus and babesiosis in Alaska rodents. Epidemic diseases of wildlife can only be understood when the baseline levels of infection are known. Good baseline data require material collected over many years.

Both frozen samples and samples from standard dry museum specimens are being used to examine carbon and other stable-isotope signatures in several marine species (Don Schell, IMS, UAF; J. Burton, U. Wisconsin; M. Ben-David, IAB, UAF). These are powerful new methods for tracking biologically-important elements through ecosystems.

Frozen tissues can also be used as indicators of environmental toxicity (McBee and Bickham, 1990) particularly when high-trophic-level organisms are archived. Samples from dry museum specimens have been particularly significant when they represent pre-disturbance, baseline conditions. Temporal changes in environmental mercury, over a span of decades, are currently being examined in the annual growth segments of bowhead (*Balaena mysticetus*) baleen archived in the Mammal Collection.

In order to provide tissues for research such as this, the AFTC must continue to develop and maintain a broad coverage of Alaskan marine organisms. This can only be done by coordinating the efforts of potential collectors, and by maintaining easy access for the research community.

3.0 Methods

3.1 Collection Enhancement

The **first objective** of CMI support for the AFTC was to establish a long-term central repository and network to collect samples and voucher specimens of marine mammals. Future hypotheses about environmental change will necessarily be limited by available baseline data. In order to have statistically meaningful samples at both spatial and temporal intervals, large numbers of samples should be collected regularly.

Thus the focus of the AFTC is extensive sampling. Hypotheses about temporal or geographic variation in genetic structure of populations require samples from scores or even hundreds of individuals collected through time. Similarly, detection of the frequency or changing frequency of pathogens within a population requires extensive sampling. We are collaborating with other marine tissue archives that are more specifically oriented to archiving particular samples for specific analyses. For example, we are collaborating with the Alaska Marine Mammal Tissue Archival Project (AMMTAP) which is focused on contaminants assessment of marine mammals from Alaska. Rigorous sampling protocols are necessary to reliably measure trace concentrations of contaminants, so effort necessarily restricts the numbers of samples. The sampling strategy of AMMTAP embraces a focused approach while the AFTC emphasizes large-scale archiving.

The AFTC sampling strategy is to accept any well-documented marine mammal tissues from which DNA of usable quality might be cloned. Freshness of soft tissues is scored on a scale of one to five (1 = poor, 5 = excellent). Sterile technique and disinfectants are used to avoid cross contamination between samples. Samples are housed in two freezers run at -70C in the Museum. The freezers are monitored daily, and have alarms that sound locally and also send alarm messages to the UAF Physical Plant and to University Safety and Security.

To fulfil our goal of collection enhancement we have developed ongoing relationships with federal, state, and Native Alaskan agencies involved in both management and research.

3.1.1 National Marine Mammal Laboratory:

The National Marine Mammal Laboratory (NMML) in Seattle is the agency responsible for managing cetaceans and most pinnipeds in Alaska. Over the past several decades, they have accumulated parts of over a thousand marine mammals in their large freezers. However, as in many agencies not specifically charged with archival functions, development of a system that provides long-term access to the material has been problematic. With limited resources, it is difficult for agencies to invest in archiving large numbers of specimens. In the past year, we have worked with NMML to sub-sample and archive selected specimens.

Amy Runck archived 213 tissue samples from many marine mammals including species new for the collection, e.g., northern right whale dolphin (*Lissodelphis borealis*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), and gray whale (*Eschrichtius robustus*). Working with the NMML's Jack Cesarone, she assisted in organizing and cataloging a significant portion of the NMML collection. We estimate that there are about 1,100 animals represented in their freezers, so this should continue to be an active and productive collaboration. Already, some of this material has been used in research projects. In 1996, we fulfilled a request from NMFS SW Fisheries Science Center for tissue from Stejneger's beaked whale for identification purposes in a study of fisheries by-catch. Thus, the AFTC was able to facilitate a project at a different NMFS site.

3.1.2 Alaska Department of Fish and Game:

An important historic series of frozen marine mammal tissues and dry specimens was incorporated into the collection with CMI funds. Dr. Ted Miller, a marine mammalogist and ornithologist from the Memorial University of Newfoundland, knew from his own prior work with the Outer Continental Shelf Environmental Assessment Project (OCSEAP) that many more seal specimens had been collected than were catalogued in the Museum. His inquiries revealed that a substantial cache of OCSEAP specimens, as well as specimens collected by ADF&G subsistence monitoring projects, was stored at the Fairbanks headquarters of ADF&G. Biologists Lloyd Lowry and John Burns provided this large series to the Museum.

This accession contains at least 5,000 animals collected over a span of forty years from all coastal regions of Alaska. Ringed seals, harbor seals, spotted seals, ribbon seals, bearded seals, and walrus are included. In addition, John Burns has provided over 300 seal skulls collected during his career. CMI funding allowed Amy Runck to catalog this accession. She also provided 150 hours of volunteer effort to the project and Dani DeViche has volunteered more than 300 hours on this project.

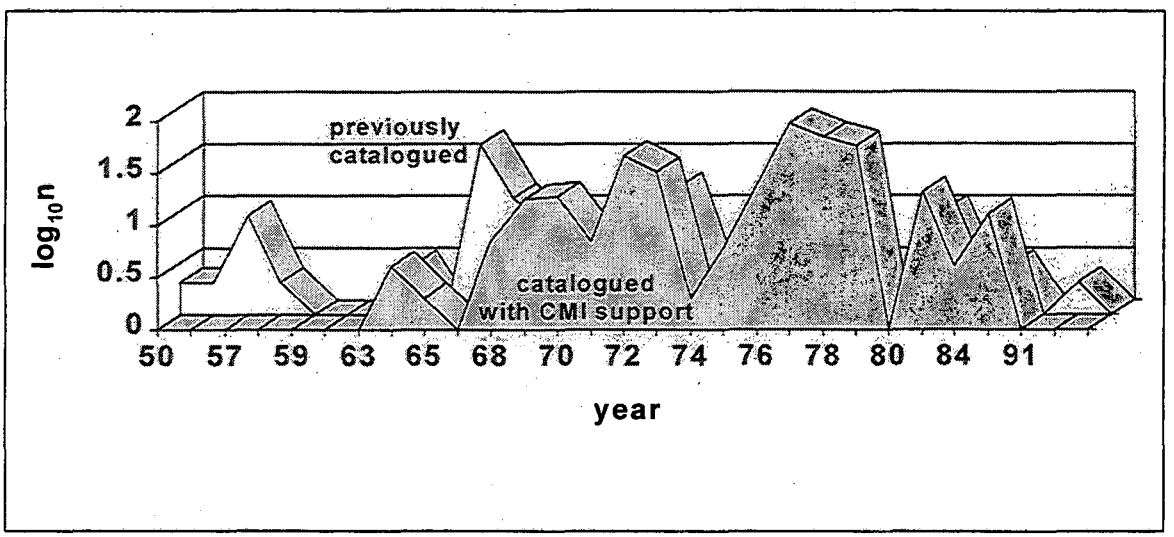
That material may be critical to long-term studies that require large samples in both time and space. Continued analysis of the changing stable-isotope signatures at different trophic levels in the Bering Sea (Schell, 1996; submitted) is an obvious example. Figure 1 shows the extent to which this accession enhanced the previous chronological sample for just one of the six main species. Material is available from as far back as 1932, and is available in quantity for nearly every year from 1957 through the mid eighties.

Some of these samples are voucher specimens for frozen tissues already in the AFTC and approximately 800 are parts from animals that were already catalogued as skulls in the Mammal Collection. Some 3,764 specimens represent new individuals.

Table 1. Number and type of marine mammals accessioned into the AFTC from 1 July 1995 to 30 June 1998.

Numbers	Common Name	Species
110	Bowhead whale	*Balaena mysticetus*
1	minke whale	*Balaenoptera acutorostrata*
21	northern fur seal	*Callorhinus ursinus*
38	beluga whale	*Delphinapterus leucas*
31	white-bellied porpoise	*Delphinus delphis*
4	gray whale	*Eschrichtius robustus*
58	sea otter	*Enhydra lutris*
95	Steller's seal lion	*Eumetopias jubatus*
1	short-finned pilot whale	*Globicephelus macrorhynchus*
1	Risso's dolphin	*Grampus griseus*
3	pygmy sperm whale	*Kogia breviceps*
20	pacific white-sided dolphin	*Lagenorhynchus obliquidens*
3	Weddell seal	*Leptonychotes weddellii*
36	northern right-whale dolphin	*Lissodelphis borealis*
1	elephant seal	*Mirounga angustirostris*
39	walrus	*Odobenus rosmarus*
2	killer whales	*Orcinus orca*
289	hair seals	*Phoca sp (vitulina, largha, fasciata, hispida)*
16	harbor porpoise	*Phocoena phocoena*
64	Dall's porpoise	*Phocoenoides dalli*
17	striped dolphins	*Stenella attenuata*
2	rough-toothed dolphin	*Steno bredanensis*
3	Atlantic bottle-nosed dolphin	*Tursiops truncatus*
88	polar bear	*Ursus maritimus*
2	California sea lion	*Zalophus californianus*
945	Total	

Figure 1. Distribution by year of 1,376 bearded seal specimens (*Erignathus barbatus*) in the UAM Mammal Collection. Note log scale.



3.1.3 Alaska Native Harbor Seal Commission:

Subsistence hunters cooperating with the ADF&G (Fall, Riedel, and Wynne, 1997) provided harbor and spotted seal tissues and skulls from 249 animals. Archiving tissue samples in the AFTC has become standard operating procedure for marine mammal projects in Alaska, and this project now uses AFTC catalog numbers as the specimen tracking number. We have been receiving frozen heads and tissue samples from seals collected by ADF&G subsistence biologists. Samples are immediately provided to ongoing projects in the laboratories of Michael Castellini and Don Schell (IMS, UAF). Frozen organ tissues are archived in the AFTC, and the skulls are cleaned and catalogued in the Mammal Collection.

3.1.4 Alaska Marine Mammal Tissue Archival Project:

We have also received tissue samples from 21 polar bears and six walrus from the National Biological Survey in Anchorage and the Alaska Marine Mammal Tissue Archival Project (AMMTAP) provided samples of two additional polar bears and seven bowhead whales.

3.1.5 North Slope Borough:

The Department of Wildlife Management at the North Slope Borough (especially Dr. Todd O'Hara) has provided subsamples of all marine mammals, including subsistence bowhead whales, sampled or necropsied by the Department's biologists. In April 1996, Jarrell, and AFTC Coordinator Steve Lewis traveled to Barrow, where they worked with North Slope Borough biologists to collect tissues from 55 bowhead whales, 5 ring seals, 2 polar bears, 18 belugas, 1 harbor porpoise, and several salmon. Since then, Borough biologists have regularly provided samples to the AFTC.

3.1.6 Other Accessions:

Additional important accessions during this 3 year project include tissues from 18 walrus (*Odobenus rosmarus*) provided by Joel Miller of Marine Mammal Management, Biological Resources Division, U.S. Geological Survey, 84 Steller's sea lion (*Eumetopias jubatus*) and 2 harbor seal (*Phoca vitulina*) skulls and tissues from Dr. Alan Springer of the Institute of Marine Science (IMS) at the University of Alaska Fairbanks, 58 bowhead whale (*Balaena mysticetus*) baleen plates from Dr. Donald Schell of IMS, and a beachcast minke whale (*Balaenoptera acutorostrata*) skull. Additional samples of sea otters from the Exxon Valdez oil spill were released by the U.S. Fish and Wildlife Service in 1998 complementing skeletal material deposited in the Mammal Collection by the Service in 1992.

We have also seen a substantial increase in the number of marine birds archived in the AFTC. Dr. Kevin Winker joined the Museum as Curator of Birds in 1997. He spent five years at the Smithsonian's Laboratory of Molecular Systematics where he made substantial use of, and contributions to, that frozen tissue collection.

Other individuals and organizations who provided tissues were Betsy Webb (Pratt Museum, Homer), Gary Freitag (Tongass Coastal Aquarium, Ketchikan), Lori Quakenbush, (USF&WS, Fairbanks), Kate Wynne (Fisheries Technology Center, Kodiak), and Linda Shaw, (NMFS, Juneau).

3.2 Computerization and Information Technology

In 1996 we achieved the **second objective** of CMI support which was to make the Collection accessible the Worldwide Web (Figure 2). This site also allows Web users to interrogate a summary database of the Museum's Mammal Collection, which provides information on all AFTC samples and conventional Museum specimens (Figure 3). It is an excellent overview of our holdings, and increasingly, new requests for tissue loans are explicit, indicating that the requestor has already become familiar with our holdings.

Protocols for tissue collecting and labeling have been fine-tuned as have policies for users of the Collection, and this information has been made available on the web. The Web Site also provides information for contributors to the Alaska Marine Mammal Stranding Network. Reorganization and consolidation of the AFTC freezers was completed. Our database management system tracks the location of samples. Between increased efficiency of new boxes acquired with CMI funding, and the increased flexibility of the new storage system, freezer space requirements were reduced by over 30%.

Most aspects of collection management have been incorporated into a relational database. For example, permit reports are generated with a query that takes permit number from the accession table and individual specimen records from the catalog table based on accession number. Similarly, in the tissue table, records represent individual cryo-tubes, and in the object-location table, records represent bar-code scans. This is a relatively simple relational system evolved from a single-flat-file legacy.

Our intent is to move into a system compliant with the architecture at the University of California's (Berkeley) Museum of Vertebrate Zoology, a project that NSF is supporting. We have implemented their structure, complete with all tables, indexes, relations, and rules in Visual FoxPro and offer "MVZ for VFP" (www.uaf.edu/museum/mammal/dbf) to anyone interested in working with a PC version of MVZ's substantial effort. Data migration and user interfaces are major challenges, but we now have a powerful tool intermediate to our FoxPro legacy and MVZ's more normalized structures.

Expanding the scope of the database will continue to increase the utility and visibility of the collections. The Alaska Native Harbor Seal Commission is supporting the programming of a "projects layer" that will relate accessions and loans to research results (in the form of publications and abstracts) and thereby incorporate information on "supported projects" into our information structure. The Aleut Marine Mammal Commission and the Subsistence Division of the Alaska Department of Fish and Game have encouraged us to provide such information. A similar "project" structure is in the Collections & Research Information System (CRIS) at Smithsonian and is being incorporated in the "OZ" system at the Kansas Museum of Natural History.

Figure 2. This is the top page for the Alaska Frozen Tissue Collection. It features logos of seven contributing agencies, and links to MMS and ADF&G pages. The left column contains links to pages with detailed instructions for both contributors and users, as well as links to the search engines. The text on the right contains links to the Mammal and Bird Collections.

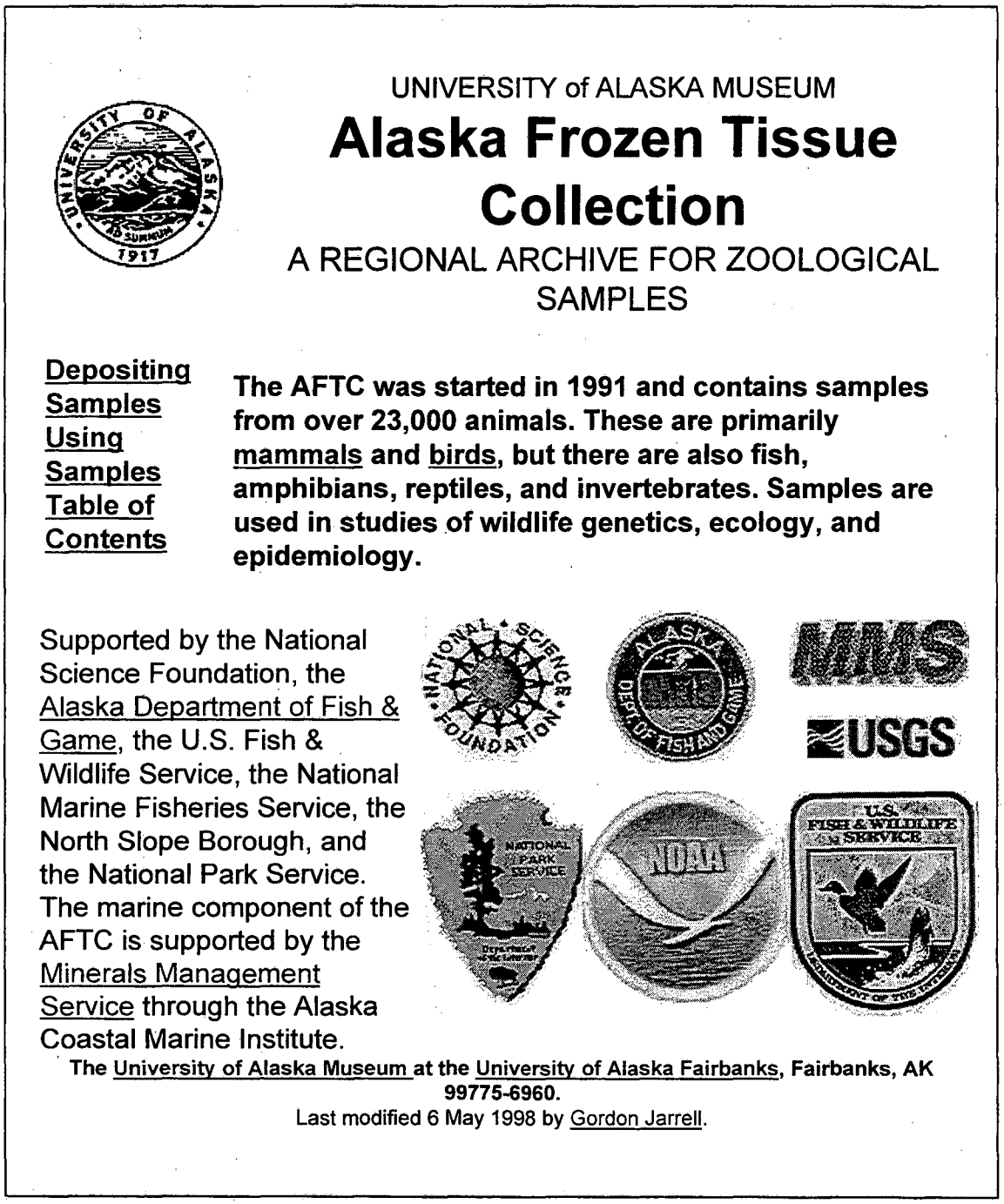


Figure 3. This is one of two search pages on the Museum web site for mammals. Links in the top segment are to a page describing the generalities of the working database, the Mammal Collection home page, the U.S. Geological Survey's Geographic Names Information System, and the other search page which included common names for Alaska mammals.

The second segment of the page contains entry fields from which web clients can interrogate the summary database. At the top of this segment is the date of the most recent update from the working database. The "Alternate Form" is yet another page compliant with some of the earlier Unix web browsers.

The results segment contains the product of a typical search on the genus of northern hair seals from Kodiak quad. The quad name is linked to a map of southwest Alaska that shows where the quad is. The search returned records of 43 harbor seals, nine of which have frozen tissues, and eleven of which are bacula obtained the 1996 accession from ADF&G.

Mammal Collection Database Queries
by scientific name

From here you can interrogate a summary database of the UAM Mammal Collection. Queries return the number of each type of specimen in the Collection, or for specific Alaskan quads. These quadrangles are the U.S. Geological Survey 1:250,000 maps. You can find the quad for many localities at the Geographic Names Information System site. There are 153 of them in Alaska. Where the quad is not specified, and particularly when specimens are from outside of Alaska, a higher geographic category has been substituted. You can also search this database using common name for Alaska species.

The summary database was last updated on 2/7/99.

You may specify:

1) a genus (all species in the genus, all localities)
2) a genus and species (one species, all localities)
3) a genus, species, and quad (all specimens of particular species from a particular place)
4) a quad (all specimens of all species from one locality)

Genus Phoca **Species**

Quad Kodiak Submit Query [Alternate Form]

Search results for:

Phoca : Kodiak

Species	Count	Object Type
vitulina	1	hyoid; baculum
vitulina	1	skull (L dentary missing)
vitulina	1	skull (broken); hyoid; frozen tissues
vitulina	1	skull (mandible partial); hyoid
vitulina	1	skull; hyoid; baculum
vitulina	1	skull; hyoid; baculum; frozen tissues
vitulina	1	skull; hyoid; facial scalp; vibrissae; frozen tissues
vitulina	2	embryo
vitulina	2	hyoid; frozen tissues
vitulina	4	hyoid; facial scalp; vibrissae; frozen tissues
vitulina	8	skull
vitulina	9	skull; hyoid
vitulina	11	baculum

Total Count: 43 computed in 3.4 seconds.

Perl

A verified database in a normalized structure, congruent to that of other major collections, will allow us to share programming with other collections, and prepare us to share data in emerging inter-institutional information systems. We will continue to enhance our public-domain clone of the MVZ information model that can be run without Unix and without a separate SQL engine (i.e., on a single PC or a large PC network).

The Internet is particularly significant for geographically remote institutions such as the University of Alaska Fairbanks. Our online database, built with CMI support, permits clients to interrogate the Mammal and Bird Collection databases and will soon include substantial information about supported projects. This has been a crucial step in building the AFTC into a widely used and internationally recognized scientific resource.

4.0 Results

4.1 Collection Use

The AFTC provided 27 tissue loans representing 372 individuals and twelve species during the year. Examples include seal tissues provided to Brian Fadely who is working with Dr. Michael Castellini to develop physiological condition indices for harbor seals to monitor changes in Gulf of Alaska ecosystems. Amy Hirons, working with Dr. Donald Schell, is using tissues from the AFTC to gain insight into ecogeographic and trophic aspects of harbor seals through stable isotope analyses. We have sent over 120 teeth from harbor seals to Mike Turek and Lauri Jemison at ADF&G for age determination from cementum annuli.

Table 2. Marine mammal tissue loans from 1 July 1995 to 30 June 1998.

Species	Number of Loans	Individuals
Enhydra lutris	1	3
Erignathus barbatus	1	2
Cystophora cristata	1	1
Delphinapterus leucas	1	2
Mesoplodon stejnegeri	1	1
Phoca sp. (vitulina and largha)	25	342
Phocoena phocoena	1	1
Ursus maritimus	1	23

4.1.1 Use by Visitors

Most collection usage is through loans but during the past three years, an increasing number of researchers have traveled to Fairbanks for extended studies, or for specialized sampling. Some examples:

Michelle Szepanski, working with Dr. James Peek at the University of Idaho, is using stable isotope analysis to determine how important marine organisms are in the diets of coastal wolves in southeastern Alaska. Michelle spent fall semester 1997 working with a large geographic sample of wolves and their prey items, and also taking Dr. Don Schell's course on isotope methods in ecology.

Dr. Masao Amano from the Otsuchi Marine Research Center, Ocean Research Institute, University of Tokyo spent a week at the Museum in early February 1996 measuring over 100 ring seal (*Phoca hispida*) skulls.

Dr. Rob MacDonald (Inst. of Ocean Sciences, Sidney, BC) and Dr. Charles Gobiel (Fisheries and Oceans Canada, Mont-Jolli, Quebec) sampled baleen from three bowhead whales previously studied by Dr. Don Schell (IMS, UAF). A plate of baleen from these long-lived whales can contain several decades of growth segments. The preliminary results show "a remarkable coincidence in the mercury and carbon 13 cycle. Very clearly, the whale's baleen reflects diet at the time of growth both in a carbon sense and in a mercury sense. ...the baleen is actually recording seasonal diet and, by inference, it would also record a trend (in mercury) if there was one. ...with the underlying data set produced so far, ...we can make a coherent, exciting story - and it will give us better insight on exactly what mercury has been doing in the food web." (Macdonald, pers. comm.)

Rob Burton, working with Dr. Paul Koch at the Department of Geology, UC Santa Cruz came to collect bone samples from 39 harbor seals and 17 northern fur seals. They are mapping stable-isotope composition of modern seals for comparison with archeological (dated) specimens of the same species from California in order to determine changes in their foraging ecology over the last 10,000 years

Joshua Snodgrass, working with Diane Gifford-Gonzalez at UC Santa Cruz, spent a week gathering materials for a guide to the post-cranial osteology of northern Pacific pinnipeds. Their main objective is to provide a useful and widely available guide for archaeologists and paleontologists, who often must try to identify isolated and/or fragmentary elements to taxon. The impetus for this project is based on Burton's work which, in addition to revealing the changing stable-isotope signatures in west coast pinnipeds, reveals that a large proportion of the pinniped bones recovered from paleoindian middens have been misidentified in the past.

Table 3.Summary of all marine-related loans and donations, 1 July 1995 to 30 June 1998: Research and Management

Investigator	Institution	Species
Michael Castellini	Institute of Marine Science, UAF	133 harbor seals
Pat Corneli	Eccles Institute of Human Genetics, UT	3 sea otters
Lauri Jemison	Alaska Dept. of Fish and Game	35 harbor seals
John Kirsch	University of Wisconsin Zoological Museum	2 walrus
Paul Koch	University of California at Santa Cruz	39 harbor seals 17 fur seals
Robie Macdonald	Institute of Ocean Science, B.C.	3 bowhead whales
Ted Miller	Memorial University of Newfoundland	222 northern hair seals
Greg O'Corry Crowe	Southwest Fisheries Center, National Marine Fisheries Service, La Jolla	11 spotted seals 3 harbor seals 1 ringed seal 1 harbor porpoise 2 beluga whale 1 Stejneger's beaked whale
Jim Peek	Dept. of Wildlife Resources, University of Idaho	281 Canis lupus
Gerald Shields	Institute of Arctic Biology, UAF	63 polar bears
Donald Schell	Institute of Marine Science, UAF	311 seals and sea lions
Andrew Trites	University of British Columbia, Vancouver	1 sea lion
Michael Turek	Alaska Dept. of Fish and Game, Juneau	84 harbor seals
Risto Vainola	Finnish Museum of Natural History, Helsinki	57 ringed seals 2 harbor seals 2 spotted seals 2 ribbon seals 2 bearded seals 1 hooded seals
Vicki Vanek	Alaska Dept. of Fish and Game, Kodiak	15 harbor seals

Table 4. Summary of all marine-related loans and donations, 1 July 1995 to 30 June 1998: Educational Donations and Loans.

Recipient	Species
Alaska Federation of Natives, Regional Education Department	3 sea otters
Alaska SeaLife Center, Seward	1 harbor seal
	2 sea otters
East Stroudsburg University, PA	1 sea otter
Indiana University	16 sea otters
Kenai Fjords Tours	2 sea otters
Long Beach Aquarium of the Pacific	1 harbor seal
	2 sea otters
University of California, Berkeley	1 sea otter
University of Calgary	1 polar bear
University of Alaska Southeast	4 bearded seals
	1 ringed seal
	4 walrus
University of Nebraska State Museum	1 sea otter
University of Wisconsin, Madison	4 sea otters
Wilbur D. Mayo Museum, Reno NV	1 bowhead whale

4.2 Examples of marine-related publications using the AFTC and/or Mammal Collection (1995 through 1 August 1998)

Arnason, U., K. Bodin, A. Gullberg, C. Ledje, and S. Mouchaty. 1995. A molecular view of pinniped relationships with particular emphasis on the true seals. Journal of Molecular Evolution 40:78-85.

Ben-David, M. 1997. Timing of reproduction in wild mink: the influence of spawning Pacific salmon. Canadian Journal of Zoology 75:376-382.

Ben-David, M., R. T. Bowyer and J. B. Faro. 1996. Niche separation by mink (*Mustela vison*) and river-otters (*Lutra canadensis*): co-existence in a marine environment. Oikos 75:41-48.

Ben-David, M., T. A. Hanley, D. R. Klein and D. M. Schell. 1997. Seasonal changes in diets of coastal and riverine mink: the role of spawning Pacific salmon. Canadian Journal of Zoology 75:803-811.

Ben-David, M., Flynn, R. W. and D. M. Schell. in press Annual and seasonal changes in diets of martens: evidence from stable isotope analysis. Oecologia.

Best, P. B. and D. M. Schell. 1996. Stable isotopes in southern right whale (*Eubalaena australis*) baleen as indicators of seasonal movements, feeding and growth. Marine Biology 124:483-494.

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5.0 Conclusions

The objectives of this project were to

1. expand the marine sector of the AFTC,
2. establish an online catalog of the AFTC, and
3. commit the University to long-term support of the AFTC Coordinator.

The AFTC has made excellent progress toward establishing mechanisms and protocols for the sharing of data regarding marine or coastal resources. The Department of Fish and Game, the North Slope Borough, and the National Marine Fisheries Service have made major contributions to the AFTC in the past three years. The collection is now the third largest of its type in the world (Dessauer et al., 1996; Hafner et al., 1997), and the AFTC Coordinator is now a state-funded position.

Marine mammal tissues, in particular, have been extensively archived and these are seeing extensive use by the scientific community. The Mammal Collection database is now available through the Internet, providing easier access to the AFTC for both contributors and users of tissues. A number of investigations with significant implications for the management of marine mammals are using material from this resource. Future investigations aimed at monitoring change in the marine environment will be enhanced by the availability of this growing archive of marine organisms.

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7.0 Study Products

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The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Royalty Management Program** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.