Quarterly Report

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The natural history and ecology of the bearded seal (Erignathus barbatus) and the ringed seal (Phoca hispida)

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I. Task Objectives

1. Summarization and evaluation of existing literature and available unpublished data on reproduction, distribution, abundance, food habits and human dependence on bearded and ringed seals in the Bering, Chukchi and Beaufort Seas.

2. Acquisition of large amounts of specimen material required for an understanding of productivity, growth rates and mortality in these two species.

3. Acquisition of baseline data on mortality (including parasitology, diseases, predation and human harvest) of ringed and bearded seal.

4. Determination of population structure of bearded and ringed seals as indicated by composition of harvest taken by Eskimo subsistence hunters.

5. Initial assessment of regional differences in density and distribution of ringed and bearded seals in relation to geographic areas and, to a lesser extent, in relation to major habitat condition.

6. Acquisition of additional information on seasonal migrations.

II. Field and Laboratory Activities

A. Schedule

Date	Location	Activity	Personnel
July-September	Fairbanks	Analyses of seal specimen and data	Burns, Eley
July-September	Fairbanks	Data management	Burns, Eley, Frost
July	Shishmaref	Collection of seal specimens	Seaman, Tremaine, Strickland
July	Wainwright	Collection of seal specimens	Seaman
July	Wales	Collection of seal specimens	Seaman, Strickland
August-September	USCGC GLACIER (Beaufort Sea)	Collection of seal specimens and data on regional densities	Burns, Frost, Shults
September	Fairbanks	Preparation of quarterly report	Burns, Eley

*We are especially grateful to L. Shults, University of Alaska, for his able assistance throughout the GLACIER cruise.

During this quarter a major field effort was undertaken in the Beaufort Sea aboard the USCGC GLACIER. We were fairly successful in acquiring a sample of ringed and bearded seals in the Beaufort during a period (August-September) and in an area (Beaufort Sea) in which our previous samples were inadequate. In addition, collections at Shishmaref during the seal harvest by Native hunters was successful.

Laboratory activities consisted mainly of processing male and female reproductive tracts and determining ages of seals by examination of claw annuli. In addition, parasitological determinations were made.

Data management was continued on an ongoing basis, as was the acquisition of information from other related studies, mainly those conducted by Soviet investigators.

B. Scientific Party

Name	Affiliation	Role
John J. Burns	ADF&G	Principal Investigator
Thomas J. Eley	ADF&G	Principal Investigator
Kathryn Frost	ADF&G	Marine Mammals Biologist
Lloyd Lowry	ADF&G	Marine Mammals Biologist
Glenn Seaman	ADF&G	Marine Mammals Technician
Dan Strickland	ADF&G	Marine Mammals Technician
Richard Tremaine	ADF&G	Marine Mammals Technician

C. Analytical Methods

From all specimens we endeavor to obtain weights, standard measurements, lower jaws, foreflipper claws, stomachs, reproductive tracts and intestines. We also obtain blubber, tissue, organ and blood samples as the situation permits.

The ages of seals are determined by examination of claw annuli (for animals generally six years or younger) and dentine or cementum annuli (for animals over six years of age). Growth rates are based on weight and standard measurements correlated with specimen age, sex and date and locality of collection. Species productivity and parasite burden are determined, respectively, through laboratory examinations of reproductive tracts and various organs and correlation of these data with age, sex, and date and locality of collection of each specimen.

Regional differences in seal density and distribution are assessed through aerial surveys following the methods of Burns and Harbo (1972).

Analytical methods are discussed in detail in our Annual Report for 1977.

III-IV. Results and Preliminary Interpretation

A. Specimens

During July-September 1977 our major efforts were devoted to collections of specimens in Bering Strait (Wales), in Chukchi Sea (Shishmaref and Wainwright) and in Beaufort Sea (USCGC GLACIER) and to laboratory analyses of specimens collected from January to September 1977.

A total of 154 male, 163 female and 5 ringed seals of undetermined sex were obtained (Table 1) yielding a 1:1 sex ratio. One hundred seventy-three bearded seals were obtained and consisted of 68 males, 99 females, and 6 of unknown sex. The sex ratio of bearded seals was 1.45 females to 1 male.

Table 1. Seal specimens obtained during July-September, 1977.

Location	Sex			Total
	Male	Female	Unknown	
Shishmaref				
Ringed seal	137	147	4	288
Bearded seal	63	88		151
Wales				
Ringed seal	9	8	1	18
Bearded seal	3	4	6	13
Wainwright				
Bearded seal		4	0	4
USCGC GLACIER				
Ringed seal	8	8		16
Bearded seal	2	3		5
Total				
Ringed seal	154	163	5	322
Bearded seal	68	99	6	173

B. Ringed Seal

1. Ringed seal sex and age composition

The sex composition of ringed seals obtained from 1975 through 1977 is presented in Table 2. The overall sex ratio is 1.24 males to 1.00 females. The sex ratio of pups does not depart significantly from unity (1:1). The sex ratio of seals one year old and older is 1.3 males to 1.0 females. The preponderance of males in our samples is probably due to our major collection efforts centering in the spring when males are more available. In the spring females are involved in birth and birth-related activities and are less readily available for collection. A 1:1 sex ratio has been found by other investigators (McLaren 1958; Johnson et al. 1966; and Smith 1973), whose collections have been spread more evenly over a year or have not centered during the spring.

The age composition of ringed seals obtained from 1975 through 1977 also are presented in Table 2. This age composition generally conforms to that of Smith (1973) for the Canadian arctic. However, there is wide variation in the age composition at various collection locations. The significance of these variations in age composition with location which may be indicative of segregation by age cohort or reproductive status is under investigation at this time.

2. Reproductive Biology

The reproductive tracts of 229 female ringed seals collected between 1962 and September 1977 have been examined. Of these 229 females, 127 (55%) were nulliparous, 34 (15%) were primaparous, and 68 (30%) were multiparous.

Table 2. Sex and age distribution of ringed seals collected under OCSEAP.

	Mekoryuk		Gambell			Savoonga		Nome			Diomede		Shishmaref 1977			Shishmaref 1976		
Ages	Male	Female	Male	Female	Unknown	Male	Female	Male	Female	Unknown	Male	Female	Male	Female	Unknown	Male	Female	Unknown
Pup	-	1	8	7	-	-	4	-	-	-	-	1	13	14	-	12	13	-
1	3	2	7	10	1	1	1	2	2	2	6	3	12	12	-	3	5	-
2	2	1	3	2	-	2	1	3	-	-	3	3	8	9	-	1	2	-
3	-	1	2	-	1	-	1	4	1	-	1	7	-	1	-	5	2	-
4	-	-	-	-	-	2	-	1	1	2	11	4	-	4	-	2	5	-
5	-	2	-	-	-	-	1	2	2	2	5	4	1	1	-	4	7	-
6	-	1	1	-	-	-	2	5	1	-	5	1	-	-	-	7	5	-
6+	-	-	-	-	-	-	-	1	-	-	2	1	-	-	-	-	-	-
7	-	-	1	-	-	-	-	6	6	1	-	-	-	1	-	3	5	-
7+	-	-	1	1	-	-	-	-	-	1	5	1	1	-	-	-	-	-
8	-	-	-	1	-	-	-	3	-	-	-	1	3	-	1	4	8	-
8+	-	1	1	-	-	-	-	1	4	-	3	2	2	2	-	-	-	-
9	-	-	-	-	-	-	-	2	2	1	-	-	2	2	-	1	3	-
9+	-	-	-	1	-	1	1	1	4	-	1	-	4	4	-	-	-	-
10	-	-	1	-	-	-	-	2	-	-	-	-	1	-	-	5	3	-
10+	-	-	-	-	-	1	-	-	1	-	1	2	3	6	-	-	-	-
11	-	-	-	-	-	-	-	1	2	-	-	-	1	1	-	1	3	-
11+	-	-	-	-	-	1	-	-	-	-	-	-	4	1	-	-	-	-
12	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	1	1	-
12+	-	-	-	-	-	1	-	-	3	-	-	-	2	2	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-
13+	-	-	-	-	-	-	-	-	2	-	-	-	2	1	-	-	-	-
14	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	1	-
14+	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	4	-
15+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-
16+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-
17+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
18+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3	-
19+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
20+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unknown	4	4	-	-	-	-	-	3	-	1	2	-	-	-	-	2	3	1
Total	9	13	25	22	2	10	11	37	33	10	45	30	60	61	1	59	83	1

Table 2 (Cont'd)

Ages	Point Hope			Cape Lisburne (Polar bear kills)			Wainwright		Barrow			USCGC GLACIER (Beaufort Sea 1977)		Total		
	Male	Female	Unknown	Male	Female	Unknown	Male	Female	Male	Female	Unknown	Male	Female	Male	Female	Unknown
Pup	-	-	-	-	-	-	3	3	3	2	-	-	-	39	45	0
1	2	-	-	-	-	-	1	2	-	-	-	1	-	38	37	3
2	1	1	1	-	-	-	-	1	-	-	-	1	-	24	20	1
3	2	2	-	1	-	-	1	1	-	1	-	-	1	16	18	1
4	6	1	-	-	-	-	2	-	1	-	1	1	-	26	15	3
5	5	4	-	-	-	-	1	1	1	-	-	-	-	19	22	2
6	5	2	-	1	-	-	1	3	2	-	-	-	-	27	15	0
6+	2	1	-	-	-	-	-	-	-	-	-	-	-	5	2	0
7	1	-	-	1	-	-	3	1	-	-	-	-	-	15	13	1
7+	3	-	-	-	-	-	-	-	-	-	-	-	-	10	2	1
8	6	-	-	1	-	-	1	2	4	1	-	3	1	25	14	1
8+	2	2	4	1	-	-	-	-	-	-	-	-	1	10	12	4
9	2	-	-	1	-	-	1	-	1	-	-	-	-	10	7	1
9+	4	-	4	1	-	-	-	-	1	-	-	-	-	13	10	4
10	4	-	-	1	-	-	1	-	2	-	-	-	-	17	3	0
10+	1	-	1	2	-	-	-	-	-	-	-	1	1	9	10	1
11	5	1	-	1	-	-	4	-	2	1	-	-	-	15	8	-
11+	-	-	-	1	-	-	-	-	-	-	-	1	-	7	1	-
12	-	-	-	-	-	-	1	-	-	-	-	1	1	4	3	-
12+	-	-	-	-	-	-	-	-	-	1	-	-	-	3	6	
13	1	-	-	-	-	-	1	-	-	1	-	-	-	5	2	-
13+	-	-	-	-	-	-	-	-	-	-	-	-	1	2	4	-
14	1	-	1	-	-	-	1	-	2	-	-	-	-	5	2	1
14+	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	-
15	1	-	1	-	-	-	-	-	-	-	-	-	-	2	4	1
15+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	1	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-
16+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	-	1	-	-	-	-	-	1	1	-	-	-	-	1	6	
17+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	1	-	-	-	-	1	2	-
18+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3	-
19+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
20+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-
22	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-
23	1	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-
29	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Unknown	2	-	-	-	-	7	-	-	2	-	1	-	-	15	7	10
Total	60	15	12	12	0	7	22	16	23	8	2	9	7	371	299	35

Some confusion of meaning may arise in terminology referring to reproductive status, therefore the terminology used in this study is defined as follows:

1. Nulliparous: A female that has never given birth to an offspring at the normal birth time.

2. Primaparous: A female that has given birth to one offspring at the normal birth time.

3. Multiparous: A female that has given birth to more than one offspring at the normal birth time.

In a sample of 33 adult female ringed seals, obtained between 1962 and 1973, 30 were or had just been pregnant (Table 3) yielding a pregnancy rate of 91 percent. The reproductive tracts of 44 adult females collected during 1975 and 1976 have been examined and 31 (71%) were pregnant or recently had given birth. Specimens examined thus far in 1977 have yielded a 68 percent pregnancy rate, with 15 pregnant females of those 22 examined.

Johnson et al. (1966) found 240 of 280 (86%) adult females (collected near Cape Thompson, Alaska during 1960 and 1961) pregnant. The decline in the pregnancy rates of our samples between 1964-1973 and 1975-1977 corresponds to the decline in the pregnancy rates reported by Stirling et al. (1975) for ringed seals in the Beaufort Sea. However, the magnitude of the decline in pregnancy rates in Canadian ringed seals from the Beaufort Sea is significantly greater; in 1972 a pregnancy rate of 59 percent was found and in 1974 and 1975 a 0 percent and 11 percent pregnancy rate was found, respectively (Stirling et al. 1975).

The reason for the decline in the pregnancy rates of female ringed seals is unknown and it is presently under investigation. Our parasitological and pathological examinations have not found evidence of parasite or disease agents which might be responsible for the decline, however this possibility is still being pursued. Blubber thickness at the sternum and total weight are good indicators of a seal's physical condition. The parameters were compared (Table 3) for sexually mature females collected from 1962 and 1977 during essentially the same seasons and locations. Blubber thicknesses of females collected during 1962-1973 are not significantly different ($P > 0.05$) than those of females collected during 1975-76 or 1977.

Total weights of adult females collected during 1962-1973 are not significantly different ($P > 0.05$) from those of females collected during 1975-76. However, females collected during 1977 are significantly heavier ($P < 0.05$) than females collected during 1962-1973 and 1975-1976. The reason for the weight change and the relationship, if any, of this change to the decline in fertility is unknown. There appears to have been no dramatic changes in ringed seal food habits between 1962 and the present. However, essentially nothing is known about changes in densities of ringed seal food species.

Table 3. Pregnancy rates, blubber thicknesses and weights of sexually mature females collected from 1962 to 1977.

	1962-1973	1975-1976	1977
Number examined	33	44	22
Number pregnant	30	31	15
Percent pregnant	91	71	68
Mean blubber thickness(cm)	5.0	3.4	5.2
Range blubber thicknesses	2.5-10.2	2.5-4.1	4.2-6.3
Number measured	16	8	14
Mean weight (kg)	45.5	37.4	69.9
Range weights	24.1-63.6	25.9-53.6	44.5-111.4
Number weighed	10	29	14

The Soviets have examined large numbers of ringed seal specimens from the Bering and Chukchi seas and suggest that there are two morphs (which may be subspecies) of ringed seals. The larger morph is supposedly found in the shorefast ice and a smaller morph in the drifting ice. It is possible that our 1962-1976 collections may have centered on the smaller morph while our 1977 collections centered on the larger morph. However, our 1962-1973 specimens were collected primarily from the shorefast ice (hence theoretically the larger morph) while specimens collected from 1975 to 1977 appear to be similarly distributed between shorefast and drifting ice. Not enough is known about the ecology and behavior of ringed seals to ascertain the relationships between the drifting and shorefast ice seals. Based on specimen material and collecting programs, there appears to be age-specific, seasonal movements of seals between shorefast and drifting ice. In our future work we hope to delineate these movement patterns more clearly.

3. Pathology and Parasitology

A considerable amount of material for pathological and parasitological examinations has been collected by this project. The bulk of this material has been provided to Drs. F. H. Fay and R. A. Dieterich and Mr. L. M. Shults (RU#194 - Morbidity and Mortality of Marine Mammals) for examinations and analyses. Within the limits of available time and funding, some material has been examined by personnel of this Research Unit. Mr. L. Shults has identified some of the parasites of ringed seals and provided verification of others tentatively identified by us. Results of our examinations will be combined with those of RU#194. A paper on the helminth parasites is in the early stages of preparation.

A total of 29 ringed seals were examined this quarter for helminth parasites, and 28 seals (96%) were found to harbor at least one species of helminth parasite (Table 4). Seven species of parasites were recovered. The acanthocephalas Corynosoma semerme and C. strumosum were the most prevalent, followed by the cestode Diplogoniporus tetrapterus and the stomach nematode, Phocanema decipiens. The acanthacephalan Corynosoma validum, the cestode Anophryocephalus ochotensis, and the heart nematode Dipetalonema spirocauda were rare.

Marine mammal hearts, either obtained from specimens collected by personnel working on RU#230 and 232 or those provided by RU#194, 229 and 243, are examined for marine mammal heartworms, Dipetalonema (Acanthocheilonema) spirocauda (Lidey 1858) Anderson 1959. Examinations are still underway but findings thus far are presented in Table 5. The pathological and resultant physiological, behavioral and ecological effects of marine mammal heartworms is presently under investigation.

C. Bearded Seal

Ovarian analyses were completed on all female bearded seals from which reproductive tracts were obtained in 1977, up to 31 July. This sample consisted of 95 animals. Of these, 42 (44%) were sexually immature and 53 (56%) had ovulated at least once.

Analysis of the age-specific productivity is currently in progress, as is examination of uteri for comparison with ovarian analysis.

Table 4. Helminth parasites recovered from ringed seals.*

	Sex	Diplogoniporus tetrapterus	Anophyyocephalus ochotensis	Dipetalonema spirocauda	Phocanema decipiens	Corynosoma semerme	Corynosoma strumosum	Corynos validu
NP-09-77	F	X	-	-	-	X	X	-
NP-10-77	F	X	-	-	X	X	X	-
NP-11-77	M	-	-	-	-	X	-	X
NP-12-77	M	X	-	-	-	X	X	-
NP-13-77	F	X	-	-	X	X	X	-
NP-14-77	F	-	-	-	unk	X	X	-
NP-15-77	F	X	-	-	unk	X	X	-
NP-16-77	M	-	-	-	-	X	-	-
NP-17-77	F	-	-	-	-	X	X	X
NP-18-77	F	X	-	-	-	X	X	-
NP-19-77	F	-	-	-	X	X	X	-
NP-20-77	M	-	-	-	X	X	X	-
NP-21-77	F	X	-	-	X	-	X	-
NP-22-77	M	X	-	-	-	X	X	-
NP-23-77	F	-	-	-	X	X	-	-
NP-28-77	F	X	-	-	-	X	X	-
NP-29-77	F	X	X	X	X	X	X	-
NP-30-77	F	X	-	-	-	X	X	-
NP-31-77	F	X	-	-	-	X	-	-
NP-32-77	M	-	-	-	X	X	X	-
BP-1-77	M	-	-	-	-	X	-	-
BP-2-77	M	-	-	-	-	X	-	-
BP-7-77	M	X	-	-	-	X	X	-
BP-8-77	M	-	-	-	-	X	X	-
BP-9-77	F	X	-	-	X	X	X	-
BP-10-77	M	X	-	-	X	X	X	-
SUVP-22-77	F	-	X	-	X	-	X	-
DISP-12-77	M	-	-	-	X	-	X	-
DISP-13-77	M	-	-	-	-	-	-	-
Number infected		15	1	1	12	24	22	2
Percent infected		52	3	3	41	83	76	7

*Many of the identifications were made or confirmed by Mr. L. Shults, OCS RU#194.

Table 5. Examinations for marine mammal heartworms (Dipetalonema (Acanthocheilonema) spirocanda).

Species	Location	Number examined	Number positive	Percent Positive
Phoca hispida	Beaufort Sea	16	0	0
Phoca hispida	Barrow	4	1	25.0
Phoca hispida	Point Hope	9	0	0
Phoca hispida	Shishmaref	275	3	1.1
Phoca hispida	Nome	31	3	9.6
Phoca hispida	Bering Sea	3	0	0
Phoca vitulina largha	Shishmaref	20	2	10.0
Phoca vitulina largha	Wales	2	0	0
Phoca vitulina largha	Bering Sea	18	1	5.6
Phoca vitulina richardii	Kodiak	87	15	17.2
Phoca fasciata	Bering Sea	15	0	0
Erignathus barbatus	Beaufort Sea	5	0	0
Erignathus barbatus	Barrow	5	1	20.0
Erignathus barbatus	Wainwright	4	0	0
Erignathus barbatus	Shishmaref	16	0	0
Erignathus barbatus	Nome	6	0	0
Erignathus barbatus	Bering Sea	10	0	0
Odobenus rosmarus	Bering Sea	1	0	0
Eumetopias jubatus	Bering Sea	1	0	0
Eumetopias jubatus	Gulf of Alaska	31	0	0
Delphinapterus leucas	Point Hope	23	0	0

Based solely on examination of ovaries, 1 of the 53 animals (1.9%) which had ovulated at one time or another was barren when collected (had not ovulated during the current year). All of the remaining 52 (98.1%) showed an active corpus luteum. This compares with presence of a corpus luteum in 96 percent of 54 females obtained in 1975 and 1976.

The age distribution of nine females, obtained in 1977, which had ovulated for the first time was: age 2, 2 animals; age 3, 1 animal; age 4, 3 animals; age 5, 1 animal; and age 6, 2 animals. Some of these ovulations would not have resulted in pregnancy and examination of uteri will be necessary before age at initial pregnancy can be determined. However, it appears to be between ages 2 and 6. Two females had hard, large follicles, larger than 12 mm, but had not ovulated. Both of these were two year olds.

During 1976 most bearded seals taken at Shishmaref were killed between 30 June and 12 July and exhibited a high proportion of newly implanted fetuses. In 1977, most bearded were taken earlier, between 24 June and 2 July. The incidence of implanted fetuses in uteri obtained at Shishmaref and examined to date is very low. It appears that implantation begins in early July.

The heavy field schedule of project personnel during this quarter did not permit extensive analysis of data or specimens other than ovaries. Laboratory work and data analysis will be our major involvement during the ocming two quarters.

V. Problems Encountered and Recommended Changes

None, with the exception of the anticipated difficulty of obtaining seal specimens from the Beaufort Sea during summer and fall. We are directing more effort toward collection of specimens from the Beaufort Sea.

VI. Estimates of Funds Expended

As of August 31 we have expended the following approximate amounts during FY77.

Salaries and benefits	-	$52,387.65
Travel and per diem	-	3,262.93
Contractual services	-	5,636.21
Commodities	-	2,153.95
Equipment	-	15.65
Total Expenditures	-	$63,456.39

VII. Literature Cited

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