

FDJ
08/01/92



IMPACT OF THE GIANT LIVER FLUKE (*Fascioloides magna*) ON ELK
AND OTHER UNGULATES IN BANFF AND KOOTENAY NATIONAL PARKS

A Progress Report submitted to
Canadian Parks Service

Prepared by
Dr. E Butterworth
9866-77 th Avenue
Edmonton, Alberta
T6E 1M4
(403)-431-1987

in cooperation with
Dr. M. J. Pybus
Alberta Fish and Wildlife Division
O.S. Longman Building
Edmonton, Alberta
T6H 4P2

June 30, 1992

DRAFT #2

Table of Contents

A. Objectives	3
B. Results of Completed Tasks	4
C. Tables and Figures	8

A. Objectives

The objectives of this study are to evaluate the large body of data collected by Canadian Parks Service (CPS) staff and the Alberta Fish and Wildlife Division (AFW) between 1984 and 1991 (continuing through to summer of 1992) on the giant liver fluke (*F. magna*) and its host ungulates. The evaluation of the data will provide understanding of the complex interplay among a suite of ungulate hosts and one particular parasite, the giant liver fluke, within park ecosystems of Banff and Kootenay National Parks.

Two sources of information exist on the presence of giant liver fluke in elk in Banff and Kootenay parks. Flook (1967) reported on the incidence of giant liver fluke from elk in Banff National Park during the early 1960's. A more recent cooperative project between Alberta Fish and Wildlife and Canadian Parks Service has examined 386 elk found dead either of natural causes or road killed in Banff and Kootenay National Parks. Information on the numbers of giant liver fluke, location, age, sex and health condition of the dead elk was collected for most animals examined from 1984 to 1991. This is the second progress report in the examination of the relationship of *F. magna* and elk (*Cervus elaphus*) from Banff National Park (BNP) and Kootenay National Park (KNP).

B. Results of Completed Tasks

Task 1: Collect and Inventory Existing Information

See progress report dated March 31, 1992.

Task 2: Differences between the Prevalence and Intensity of *F. magna* in Elk in 1960's and 1980's.

See progress report dated March 31, 1992.

Task 3. Correlation between the Intensity and Prevalence of *F. magna* and the Age, Sex and Health of Elk.

Information on host age, sex and condition (Kidney Fat index) were collected for ca. 125 elk examined since 1984. Previous analysis indicated that the prevalence of *F. magna* varied with year. When prevalence was adjusted for year effect from 1985 to 1988 - years where sample sizes are large enough - there was a significant difference in prevalence of the parasite between parks (Mantel - Haenszel Chi-Square = 4.35, P=0.039). Therefore, all subsequent analyses were conducted on data from each park separately.

Host Sex

There was no significant difference in the prevalence of *F. magna* between male and female elk in BNP when adjusted for the effects of year (Table 1). In KNP, sample sizes were too small to control for year and previous analysis had noted no year effect and the data was combined. There was no

significant difference in the prevalence of *F. magna* between sexes of elk in KNP (Table 2)(Chi-Square = .01, P=.92). A similar analyses (all years combined) was conducted on the elk from BNP for comparative purposes (Table 2). Again, as in the analysis where prevalence was adjusted for the effect of year there was no significant difference in the prevalence of *F. magna* between male and female elk from BNP (Chi-square = .18 ,P = .675).

A different pattern was seen with intensity (no. of parasites/infected host). Analysis of covariance was performed on log transformed data that approximated normality (Lillefore's test). Intensity of the parasite was adjusted for year effects and there was a significant difference in intensity of *F. magna* between male and female elk (F ratio=8.3, P=.005) in BNP and KNP (F ratio=8.8, P=.005) (Table 3 and 4). Both populations of male elk from the two parks had significantly higher intensity of *F. magna* than female elk.

Host Age

Because of the nature of the data, the relationship between host age, prevalence and intensity of *F. magna* were examined from two perspectives. The first uses three age classes, young of the year, yearling and adult. The second examines the relationship from the perspective of cohort. The latter

data set is smaller than the previous because accurate ages are not available for all animals over 1 year of age. Prevalence in three age classes - young of year, yearling, adult - could not be adjusted for the effect of year as sample sizes were too small. Analysis was conducted on all years combined for each park. There was a significant increase in prevalence of *F. magna* from the young of the year age class to the adult age class in elk from both BNP and KNP (Table 5).

Evaluation of cohort classes and prevalence indicated that greater than 20% of the samples had too few cases for statistical assessment. However, the pattern of the youngest cohorts (exception of 1991 with only n=6) having fewer infected individuals compared to older cohorts was apparent in both BNP and KNP (Tables 7 and 8).

The relationship between age and intensity was examined in the three age classes only because of the small sample sizes of some cohorts. In elk from BNP, the young of the year age class had a significantly higher intensity of *F. magna* than the yearling and adult age classes when adjusted for year effect ($F = 3.33$, $P = .038$). There was no significant difference in intensity of *F. magna* between the yearling and adult age classes (Table 8).

It was not possible to perform an analysis that adjusted for the effect of year on elk from KNP as the young of the year age class had zero variance. A t-test was performed to compare the intensity of the parasite in the yearling and adult age class. There was no significant difference in intensity of *F. magna* between yearlings and adult elk in KNP (Table 8).

HOST CONDITION

Host condition was assessed using kidney fat index (kidney fat/kidney wt.). Data was available for BNP and individuals in yearling and adult age classes only. There was a significant effect by month (Figure 1) and subsequent analysis was adjusted to account for this effect. There was a significant ($p=.90$) negative relationship between the KFI and intensity of *F. magna* in yearling elk ($F=8.53$, $P=.100$, $N=10$) but not in adult elk ($F=.065$, $P=.800$, $N=59$). There was no significant relationship between sex of elk and KFI in either age class.

Table 1. Percent of Male and Female Elk (*Cervus elaphus*) infected with *F. magna* from 1984 to 1991 in Banff National Park.

YEAR = 1984		Uninfected	Infected	TOTAL	N
Female		50.00	50.00	100.00	10.00
Male		42.86	57.14	100.00	7.00
TOTAL		47.06	52.94	100.00	
N		8	9	17	
YEAR = 1985					
Female		51.72	48.28	100.00	29.00
Male		60.87	39.13	100.00	23.00
TOTAL		55.77	44.23	100.00	
N		29	23	52	
YEAR = 1986					
Female		45.65	54.35	100.00	46.00
Male		69.57	30.43	100.00	23.00
TOTAL		53.62	46.38	100.00	
N		37	32	69	
YEAR = 1987					
Female		23.81	76.19	100.00	21.00
Male		55.00	45.00	100.00	20.00
TOTAL		39.02	60.98	100.00	
N		16	25	41	
YEAR = 1988					
Female		36.36	63.64	100.00	22.00
Male		12.50	87.50	100.00	16.00
TOTAL		26.32	73.68	100.00	
N		10	28	38	

Table 1. contd.

YEAR	= 1989			
Female	14.29	85.71	100.00	21.00
Male	10.53	89.47	100.00	19.00
TOTAL	12.50	87.50	100.00	
N	5	35	40	

YEAR	= 1990			
Female	25.00	75.00	100.00	8.00
Male	8.33	91.67	100.00	12.00
TOTAL	15.00	85.00	100.00	
N	3	17	20	

YEAR	= 1991			
F	27.27	72.73	100.00	11.00
M	26.67	73.33	100.00	15.00
TOTAL	26.92	73.08	100.00	
N	7	19	26	

MANTEL-HAENSZEL CHI-SQUARE = 1.195 PROBABILITY = 0.274

Table 2. Percent of Male and Female Elk (*Cervus elaphus*) infected with *F. magna* from 1984 to 1991 in Banff National Park(BNP) and Kootenay National Park(KNP).

PARK = BNP

	Uninfected	Infected	TOTAL	N
F	36.90	63.10	100.00	168.00
M	39.26	60.74	100.00	135.00
TOTAL	37.95	62.05	100.00	
N	115	188	303	

PARK = KNP

	Uninfected	Infected	TOTAL	N
F	29.79	70.21	100.00	47.00
M	28.57	71.43	100.00	21.00
TOTAL	29.41	70.59	100.00	
N	20	48	68	

Table 3. Intensity of *F. magna* in male and female elk (*Cervus elaphus*) from Banff National Park.

SEX =Female

	FM	LOGFM	ADJUSTED
N OF CASES	106	106	106
MEAN	26.670	2.553	2.586
STANDARD DEV	60.141	1.132	1.132

SEX =Male

	FM	LOGFM	ADJUSTED
N OF CASES	82	82	82
MEAN	41.429	3.124	3.082
STANDARD DEV	49.065	1.211	1.211

Table 4. Intensity of *F. magna* in male and female elk (*Cervus elaphus*) from Kootenay National Park.

SEX =Female

	FM	LOGFM	ADJUSTED
N OF CASES	33	33	33
MEAN	21.067	2.426	2.420
STANDARD DEV	22.220	1.317	1.317

SEX =Male

	FM	LOGFM	ADJUSTED
N OF CASES	15	15	15
MEAN	46.533	3.520	3.534
STANDARD DEV	47.024	0.844	0.844

Table 5. Prevalence of *F.magna* in three age classes (1-young of year, 2 - yearling, 3- adult) of elk (*Cervus elaphus*) from Banff (BNP) and Kootenay (KNP) National Parks.

PARK = BNP

	PERCENT		TOTAL	N
	UNINFECTED	INFECTED		
1	91.95	8.05	100.00	87.00
2	43.18	56.82	100.00	44.00
3	10.67	89.33	100.00	178.00
TOTAL	38.19	61.81	100.00	
N	118	191	309	

TEST STATISTIC	VALUE	DF	PROB
LIKELIHOOD RATIO CHI-SQUARE	181.163	2	0.000

PARK = KNP

	PERCENT		TOTAL	N
	UNINFECTED	INFECTED		
1	92.86	7.14	100.00	14.00
2	36.36	63.64	100.00	11.00
3	9.09	90.91	100.00	44.00
TOTAL	30.43	69.57	100.00	
N	21	48	69	

TEST STATISTIC	VALUE	DF	PROB
LIKELIHOOD RATIO CHI-SQUARE	36.368	2	0.000

Table 6. Prevalence of *F. magna* in elk (*Cervus elaphus*) of different age cohorts from Banff National Park.

COHORT	PERCENT		TOTAL	N
	UNINFECTED	INFECTED		
64.000	.00	100.00	100.00	1.00
70.000	33.33	66.67	100.00	3.00
71.000	.00	100.00	100.00	1.00
73.000	.00	100.00	100.00	1.00
75.000	33.33	66.67	100.00	3.00
77.000	.00	100.00	100.00	3.00
78.000	16.67	83.33	100.00	6.00
79.000	25.00	75.00	100.00	4.00
80.000	11.11	88.89	100.00	9.00
81.000	.00	100.00	100.00	16.00
82.000	11.11	88.89	100.00	9.00
83.000	31.25	68.75	100.00	16.00
84.000	52.38	47.62	100.00	21.00
85.000	75.00	25.00	100.00	40.00
86.000	69.44	30.56	100.00	36.00
87.000	64.00	36.00	100.00	25.00
88.000	81.82	18.18	100.00	11.00
89.000	50.00	50.00	100.00	4.00
90.000	63.64	36.36	100.00	11.00
91.000	16.67	83.33	100.00	6.00
TOTAL	49.56	50.44	100.00	
N	112	114	226	

Table 7. Prevalence of *F. magna* in elk (*Cervus elaphus*) of different age cohorts from Kootenay National Park.

COHORT	PERCENTS		TOTAL	N
	UNINFECTED	INFECTED		
74.000	.00	100.00	100.00	1.00
85.000	100.00	.00	100.00	4.00
86.000	66.67	33.33	100.00	9.00
87.000	50.00	50.00	100.00	8.00
88.000	75.00	25.00	100.00	4.00
TOTAL	65.38	34.62	100.00	
N	17	9	26	

Table 8. Intensity of *F. magna* in elk (*Cervus elaphus*) from Banff(BNP) and Kootenay (KNP) National Parks.

PARK	AGECLASS	MEAN	SD	N
BNP	1	133.5	100.9	7
	2	36.2	53.5	25
	3	30.5	53.0	159
KNP	1	3.0		1
	2	20.0	19.3	7
	3	31.2	35.7	40

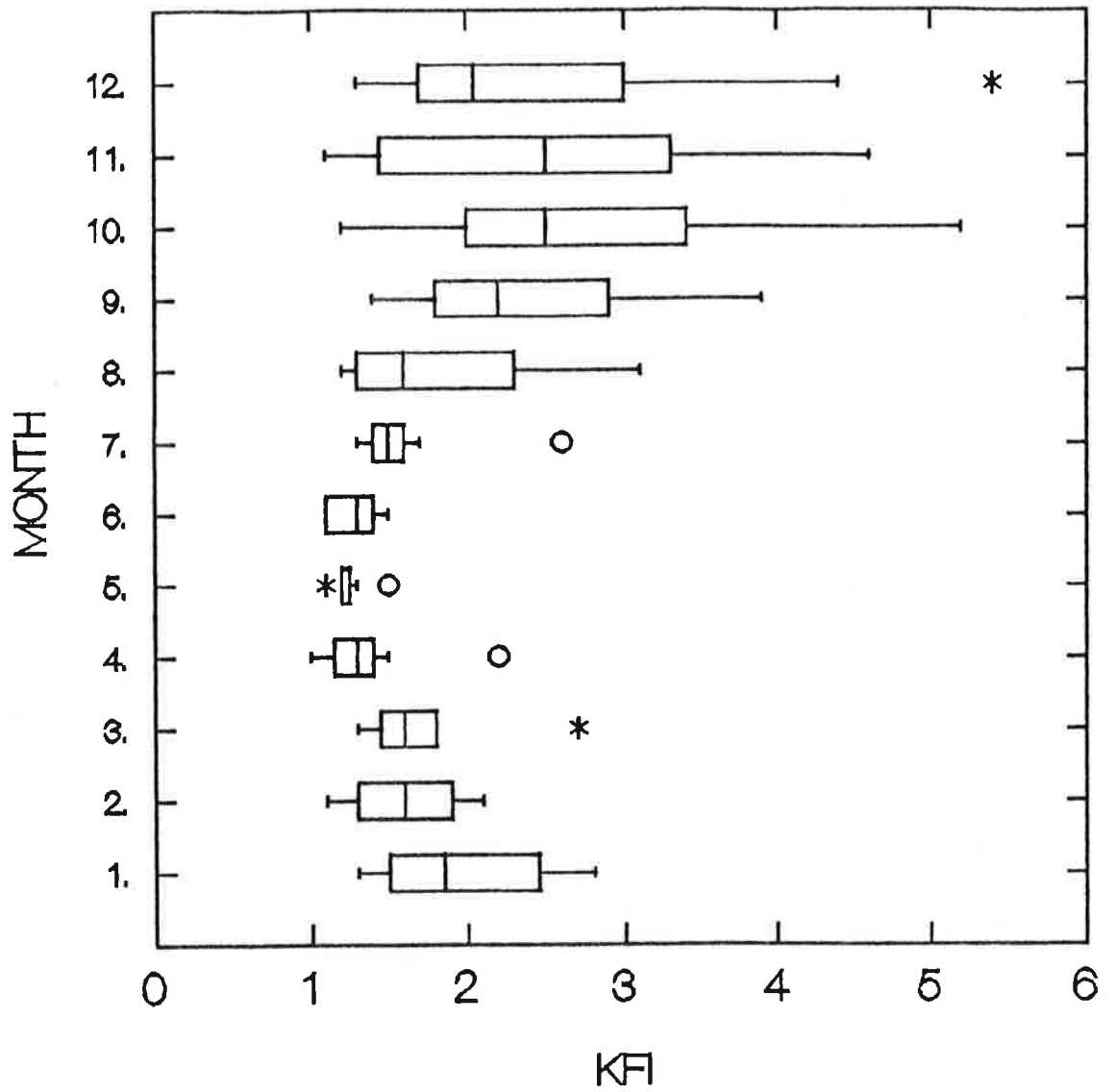


FIG.1 Seasonal changes in Kidney fat index (KFI) in elk from Banff National Park from 1985 - 1989). Box Plots- vertical line in box=median, ends of box=2nd and 3rd quartiles, outside lines=1st and 4th quartiles, points=outliers.

