



Observations on the life history and movement of the goldeye, *Hiodon alosoides* in Montana
by William J Hill

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of
MASTER GF SCIENCE in Fish and Wildlife Management
Montana State University
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Abstract:

The life history and movement of goldeye in Montana was studied in the summers of 1963 and 1964. Specimens were secured from Fort Peck Reservoir, the Missouri River, Marias River, Teton River, and Belt Creek by gill nets, angling, electro-fishing, and toxicants. Specimens collected for an age and growth study ranged in age from 0 through VIII. Scales of 747 goldeye were examined. These showed that fish grew 4.0 inches during each of the first 2 years and 1.3 inches for each year thereafter. There was little difference in growth rate between areas. Females were larger than males after the fourth year. The ratio of male to female goldeye for all Montana areas- combined was 1:1.1. Slightly more males than females were found in the rivers while more than twice as many females as males were found in Fort Peck Reservoir. Most of the fish were ripe between April 17 and June 8 and presumably spawned at this time. The number of eggs per female ranged from 4,288 to 10,164 (average, 6,913).

Of 2,221 goldeye tagged, only 37 were recaptured. Three of these moved between 30 and 75 miles while the other 34 moved less than 2 miles.

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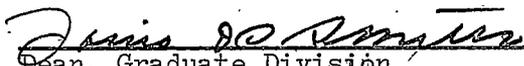
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MONTANA STATE UNIVERSITY
Bozeman, Montana

August, 1965

ACKNOWLEDGEMENTS

The writer wishes to extend gratitude to all who helped in the course of this study. Dr. C. J. D. Brown directed the study and assisted in preparing the thesis. Nels A. Thoreson of the Montana Fish and Game Department suggested the problem. He also gave valuable field assistance along with Dr. R. J. Graham, Edward Nevala, James Posewitz, Melvin Kraft, Jack Robinson, and Steve Swedeberg. The Montana Fish and Game Department financed the study under Federal Aid to Fisheries Restoration Projects F-5-R-13 and F-5-R-14.

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ABSTRACT

The life history and movement of goldye in Montana was studied in the summers of 1963 and 1964. Specimens were secured from Fort Peck Reservoir, the Missouri River, Marias River, Teton River, and Belt Creek by gill nets, angling, electro-fishing, and toxicants. Specimens collected for an age and growth study ranged in age from 0 through VIII. Scales of 747 goldeye were examined. These showed that fish grew 4.0 inches during each of the first 2 years and 1.3 inches for each year thereafter. There was little difference in growth rate between areas. Females were larger than males after the fourth year. The ratio of male to female goldeye for all Montana areas combined was 1:1.1. Slightly more males than females were found in the rivers while more than twice as many females as males were found in Fort Peck Reservoir. Most of the fish were ripe between April 17 and June 8 and presumably spawned at this time. The number of eggs per female ranged from 4,288 to 10,164 (average, 6,913). Of 2,221 goldéye tagged, only 37 were recaptured. Three of these moved between 30 and 75 miles while the other 34 moved less than 2 miles.

INTRODUCTION

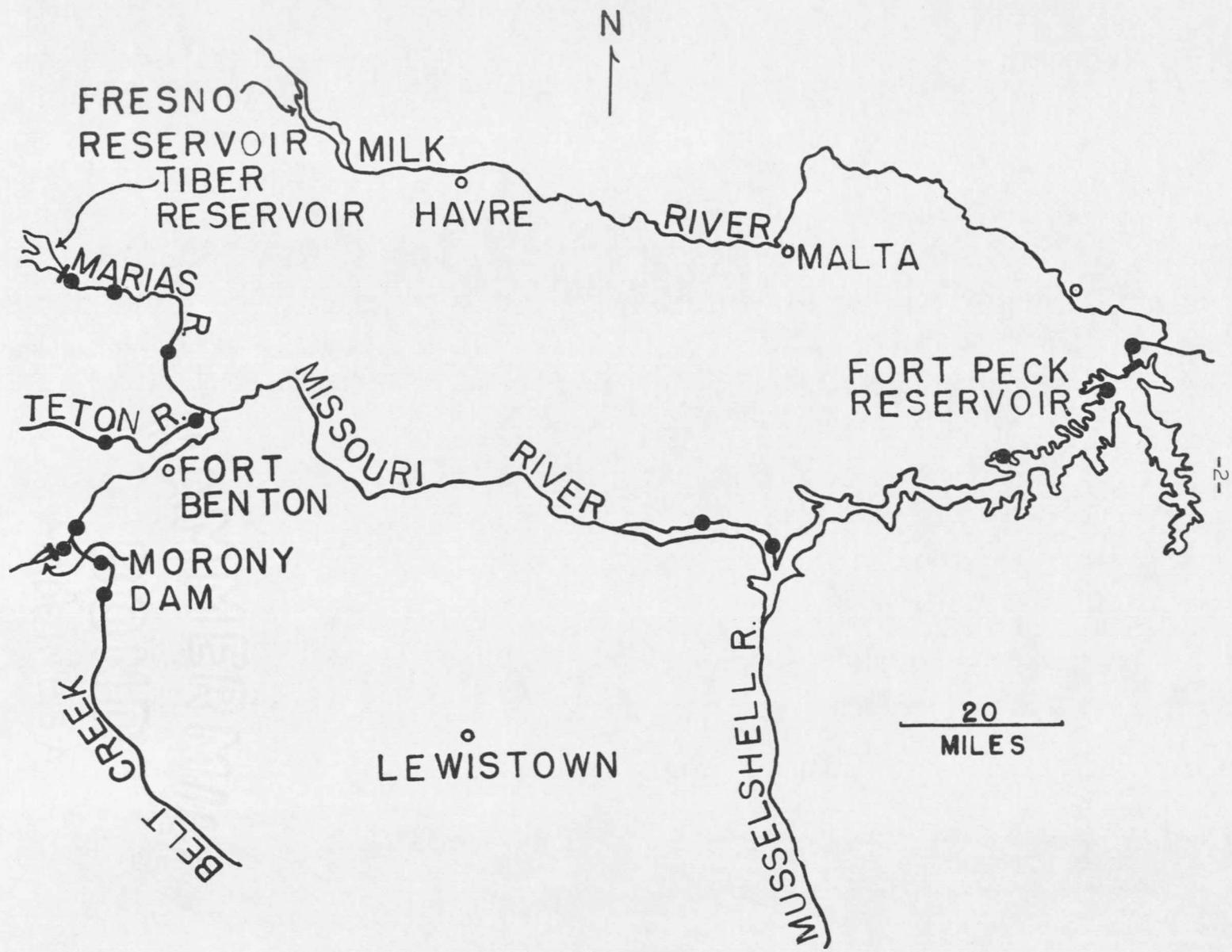
The goldeye in Montana is very abundant in the Missouri River and its tributaries below Morony Dam and in the Yellowstone River and its tributaries below the mouth of the Big Horn River. This species is not exploited for sport or commercial purposes in Montana and is considered detrimental to more desirable fishes. For this reason, it has been controlled by toxicants in some areas. A study was undertaken to gain basic knowledge about goldeye which might be useful in the management of this species.

The life history and movement of goldeye (Hiodon alosoides) in Montana was investigated from June 12, 1963, to September 27, 1963, and from March 20, 1964, to September 28, 1964. Previous work on this species in Montana was limited mainly to Fort Peck Reservoir. Peters (1964) reported on the age and growth of goldeye. Phenicie (1950) compared the relative abundance of goldeye to yellow perch. Studies on the age and growth of this species outside of Montana include those of Martin (1954) in Lake Texoma, Oklahoma, and Grosslein and Smith (1959) in the Red Lakes, Minnesota. Battle and Sprules (1960) made observations on the development of goldeye in Lake Claire, Alberta. The present study in Montana covered four collection areas on Fort Peck Reservoir, three on the Missouri River, three on the Marias River, two on the Teton River, and two on Belt Creek (Figure 1).

Methods

Goldeye were collected by experimental gill nets in Fort Peck Reser-

Figure 1. Study area. Black dots represent sampling sites.



voir and the Missouri River below Fort Peck Dam. These proved to be most effective when floated on the surface overnight. Specimens were secured by angling in the Marias River, Belt Creek, and the Missouri River above Fort Peck Reservoir, and by electro-fishing in the Teton River. Small individuals were collected by toxicants (rotenone) on the upper end of Fort Peck Reservoir.

Total lengths to the nearest 0.1 inch and weights to the nearest 0.01 pound were taken on all fish collected. Scale samples for age and growth studies were secured from the left side of the fish in the area between the dorsal fin and lateral line. Annuli were identified with the aid of a scale projection machine.

LIFE HISTORY

Age and Growth

Total calculated lengths were secured for each year-class with the aid of a nomograph. A straight-line relationship between scale and body length was assumed. The average calculated total lengths of goldeye from each area are given in Table 1.

Fort Peck Reservoir

Goldeye from Fort Peck Reservoir ranged in age from 0 through VII. A total of 249 young-of-the-year was secured in the upstream-end of the reservoir on August 21, 1964. They ranged from 1.4 to 3.3 inches in total length (average 2.3). Battle and Sprules reported about the same growth rates for young-of-the-year goldeye from Lake Claire, Alberta.

Age determinations were made on 239 additional goldeye which ranged

Table 1. Average calculated total lengths of goldeye from different areas in Montana (Number of fish in parentheses).

Location	Age group							
	I	II	III	IV	V	VI	VII	VIII
Fort Peck Reservoir	3.9 (239)	8.1 (169)	10.4 (102)	11.5 (74)	12.2 (41)	12.7 (9)	15.7 (1)	
Missouri River Above Fort Peck Reservoir	3.9 (95)	7.9 (95)	10.2 (94)	11.2 (81)	12.0 (29)	12.6 (4)		
Below Fort Peck Dam	4.3 (66)	7.8 (57)	10.0 (41)	11.3 (16)	11.9 (2)			
Marias River	3.9 (142)	7.9 (142)	10.1 (140)	11.2 (112)	11.9 (49)	12.2 (4)		
Teton River	4.1 (205)	8.2 (205)	10.3 (199)	11.5 (172)	12.1 (62)	13.7 (8)	15.4 (2)	16.0 (1)

from 4.7 to 16.8 inches in total length (average 10.2) and from 0.03 to 2.08 pounds (average 0.37) taken at various places in the reservoir. The annual average growth increments (inches) for all age groups were as follows: I-3.9; II-4.2; III-2.3; IV-1.1; V-0.7; VI-0.5; VII-3.0. Age group VII was represented by only one fish so it probably is not representative. The oldest fish from this area was 7 years, 16.8 inches long and weighed 2.08 pounds. This was also the largest specimen collected during the study.

Missouri River

Above Fort Peck Reservoir: Ninety-five goldeye from this area were in age groups II through VI and ranged from 10.9 to 13.1 inches in total length (average 11.9) and from 0.32 to 0.55 pounds (average 0.43). The annual

average growth increments (inches) for all age groups were as follows: I-3.9; II-4.0; III-2.3; IV-1.0; V-0.8; VI-0.6. The oldest fish was 6 years, 13.1 inches long, and weighed 0.51 pounds. This was also the largest specimen taken from this area.

Below Fort Peck Dam: Sixty-six goldeye taken from this area were in age groups I through V and ranged from 7.5 to 13.2 inches in total length (average 10.3) and from 0.12 to 0.60 pounds (average 0.31). The annual average growth increments (inches) for all age groups were as follows: I-4.3; II-3.5; III-2.2; IV-1.3; V-0.6. The oldest fish was 5 years, 12.5 inches long, and weighed 0.50 pounds. The largest specimen was 4 years old, 13.2 inches long, and weighed 0.60 pounds.

Marias River

A total of 142 goldeye from the Marias River were in age groups II through VI and ranged from 9.9 to 13.2 inches in total length (average 11.8) and from 0.22 to 0.65 pounds (average 0.44). The annual average growth increments (inches) for all age groups were as follows: I-3.9; II-4.0; III-2.2; IV-1.1; V-0.7; VI-0.3. The oldest specimen was 6 years, 13.0 inches long, and weighed 0.53 pounds while the largest was 5 years old, 13.2 inches long, and weighed 0.55 pounds.

Teton River

The Teton River sample consisted of 205 goldeye in age groups II through VIII. They ranged from 10.4 to 16.3 inches in total length (average 12.0) and from 0.29 to 1.34 pounds (average 0.49). The annual average growth increments (inches) for all age groups were as follows: I-4.1;

II-4.1; III-2.1; IV-1.2; V-0.6; VI-1.6; VII-1.7; VIII-0.6. The small sample in age groups VI (6), VII (1), and VIII (1) may not be representative. The oldest fish from this area was 8 years, 16.3 inches long, and weighed 1.34 pounds. This specimen was also the largest taken from this area and the oldest collected from all areas.

Combined Areas

The areas have been combined since little difference was noted in calculated total lengths. The maximum difference in calculated total lengths from all areas was 0.4 inch for the first 3 years involving 747, 668, and 576 fish, respectively, and 0.3 inch for the fourth, fifth, and seventh years involving 455, 183, and 3 fish, respectively. The sixth year had a difference of 1.5 inches and was represented by 25 fish. The small sample size in older age groups may account for the irregular variations in calculated total lengths.

No difference was found in the calculated total lengths between sexes for the first 3 year groups. However, in the fourth year, females (54 specimens) average 0.4 inch longer than males (58) and in the fifth year, females (62) averaged 0.7 inch longer than males (9). None of the males and only 18 females were older than 5 years. This suggests a greater longevity for females. Martin (1954) reported that female goldeyes in Lake Texoma, Oklahoma, were larger than males after their third year of life. In spite of the differences found in the present study, the sexes were combined. This facilitated the comparison of growth rate of Montana goldeye with those studied elsewhere.

The combined sample of goldeye in Montana included 747 specimens in age groups I through VIII (Figure 2, Table 2). They ranged from 4.7 to

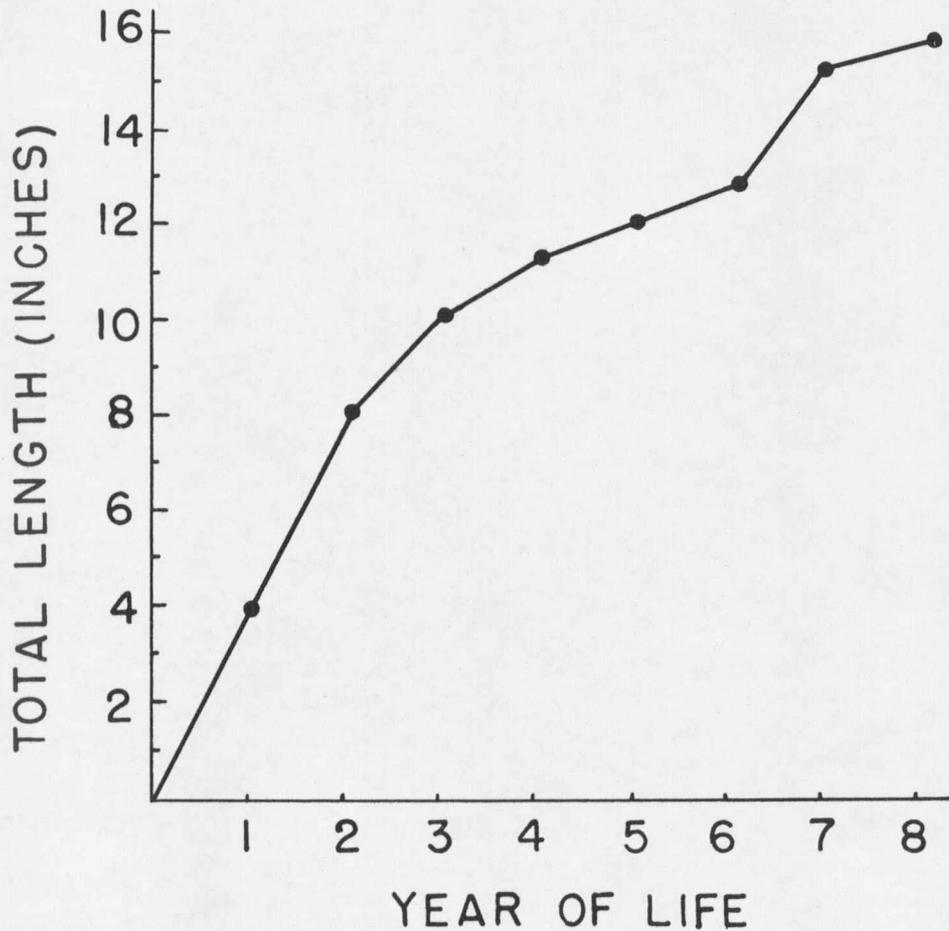


Figure 2. Average calculated total lengths of Montana goldeye for each year of life.

16.8 inches in total length (average 11.3) and from 0.03 to 2.08 pounds (average 0.42). They showed the greatest growth in their first 2 years of life. Compared to this, Lake Texoma goldeye showed the greatest growth in their first year of life (Martin, 1954).

Table 2. Average calculated total lengths for all Montana goldeye.

Age group	No of fish	Total length (inches)								Range in length at capture
		Year of life								
		1	2	3	4	5	6	7	8	
I	79	3.8								4.7- 9.4
II	92	4.2	8.1							7.8-11.2
III	121	4.3	8.3	10.3						9.0-12.7
IV	272	4.0	8.1	10.3	11.4					10.5-13.5
V	158	3.7	7.7	10.0	11.3	12.0				11.0-13.9
VI	22	3.7	7.9	10.1	11.3	12.2	12.7			12.3-15.3
VII	2	6.2	10.3	12.3	13.6	14.1	14.7	15.5		15.7-16.8
VIII	1	3.7	8.2	11.0	12.7	13.8	14.3	15.5	16.0	16.3
Total	747 Average	4.0	8.0	10.2	11.4	12.1	12.9	15.5	16.0	

Calculated total lengths of Montana goldeye are compared with other studies on this species (Table 3). Reports by Peters (1964) for goldeye

Table 3. Comparison of calculated total lengths of Montana goldeye with those from other areas.

Location	Number of fish	Average calculated total length (inches)							
		1	2	3	4	5	6	7	8
Lake Texoma, Okla. (Martin)	817	7.5	8.8	11.2	12.6	13.2	14.2		
Red Lake, Minn. (Eddy & Carlander)	625	2.8	6.4	9.4	11.0	12.5	13.6		
Red Lake, Minn. (Grosslein & Smith)	1165	4.1	8.3	11.3	12.9	14.1	15.0	15.8	16.6
Fort Peck Reservoir (Peters)	312	4.6	8.8	11.2	12.3	13.3	14.1		
Present study	747	4.0	8.0	10.2	11.4	12.1	12.9	15.5	16.0

collected in 1949 in Fort Peck Reservoir, Montana, Martin (1954) in Oklahoma, and Grosslein and Smith (1959) in Minnesota, all show greater growth than those found in the present study. Goldeye in this study showed greater growth in the period of the first 4 years of life than did specimens from Minnesota (Eddy and Carlander, 1942), but the latter grew more rapidly in the fifth and sixth years of life than did Montana specimens.

The oldest female goldeye collected in Montana was 8 years, 16.3 inches long and weighed 1.34 pounds. The oldest male was 5 years, 12.4 inches long, and weighed 0.54 pounds. The largest fish was a 7-year-old female, 16.8 inches long, and weighed 2.08 pounds. The largest goldeye collected by Martin (1954) in Oklahoma was a 6-year-old female, 14.7 inches long, and weighed 1.24 pounds, while the largest reported in the literature was from Ohio (Trautman, 1957). This had a total length of 20.0 inches and a weight of 3.13 pounds.

Sex Ratios

The goldeye shows sexual dimorphism in that the lower edge of the anal fin is straight or slightly concave in the female, while this fin has a large convex lobe in the male (Martin, 1954). This difference facilitated obtaining sex ratios without internal examination of the gonads. The sex ratio of males to females from all Montana areas combined was 1:1.1 (Table 4). Slightly more males than females were found in the rivers, except the Marias where the ratio of males to females was 1:1.5. Females were more than twice as abundant as males in the Fort Peck Reser-

