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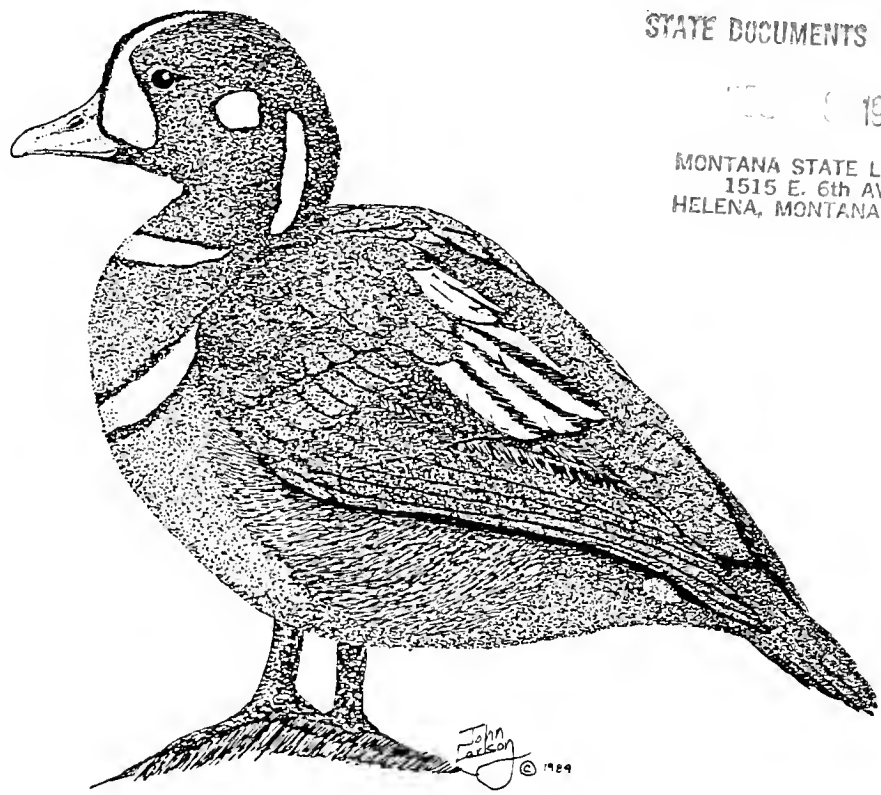
RESULTS OF HARLEQUIN DUCK (Histrionicus histrionicus)  
SURVEYS IN 1990 ON THE FLATHEAD NATIONAL FOREST, MONTANA

by

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TABLE OF CONTENTS

	<u>PAGE</u>
SUMMARY.....	2
OBJECTIVES.....	3
INTRODUCTION.....	4
SURVEY AREA.....	7
METHODS.....	9
RESULTS AND DISCUSSION.....	11
Breeding Biology.....	12
Habitat.....	19
SUMMARY OF HARLEQUIN DUCK STATUS BY RANGER DISTRICT	
Tally Lake Ranger District.....	20
Glacier View Ranger District.....	21
Hungry Horse Ranger District.....	22
Spotted Bear Ranger District.....	22
Swan Lake Ranger District.....	23
CONCLUSION AND RECOMMENDATIONS.....	23
ACKNOWLEDGEMENTS.....	26
REFERENCES.....	27
APPENDICES	
Appendix A.....	30

LIST OF TABLES

<u>NUMBER</u>		<u>PAGE</u>
1 -	STREAM SURVEY DATA.....	13
2 -	LOCATION, AGE, AND CLASSIFICATION OF HARLEQUIN DUCK BROODS OBSERVED ON THE FLATHEAD NATIONAL FOREST, 1990.....	12
3 -	HARLEQUIN DUCK OBSERVATIONS ON THE FLATHEAD NATIONAL FOREST, 1990.....	16

LIST OF FIGURES

1 -	DISTRIBUTION OF THE HARLEQUIN DUCK FROM PALMER (1976).....	6
2 -	MAJOR STREAMS IN THE STUDY AREA.....	8
3 -	LOCATIONS OF HARLEQUIN DUCK SIGHTINGS ON THE FLATHEAD NATIONAL FOREST, 1990.....	18

## SUMMARY

A survey for harlequin ducks was conducted on streams in the drainages of the North, South, and Middle Forks of the Flathead River and streams in the Swan River drainage on the Flathead National Forest from May through August, 1990. Initial stream surveys were conducted from early May through late June and were repeated from mid-July through mid-August. Stream flow rates were measured and stream physical characteristics were recorded for all streams surveyed during the second survey period. Harlequin ducks were found on 2 streams surveyed during the first period and on 4 streams surveyed during the second period. Occupied streams were predominantly braided and canyon type channels. Occupied stream gradients ranged from .013 on Big Creek to .020 on Wounded Buck Creek and stream flow rates ranged from 76 cfs on Sullivan Creek to 124 cfs on Swift Creek. Seven pairs of harlequin ducks were located during the first surveys. Three single females: 1 female with 4 young, 1 female with 2 young and an unattended brood of 4 young harlequin ducks were located during the later surveys. Harlequin ducks were observed by other individuals on two of the same streams I had previously observed harlequin ducks on. One report of a female harlequin and 4 young on the Middle Fork of the Flathead River was also received.

## OBJECTIVES

The objectives of these surveys were to determine distribution and specific streams used by harlequin ducks on the Flathead National Forest, document breeding activity and success, and describe some stream characteristics of each stream in the survey. This information is required for population viability monitoring, and to assist in habitat management for the species.

## INTRODUCTION

Male harlequin ducks are slate-blue with white patches on the head, neck, and scapulars; the flanks and sides are chestnut. Females and immatures are dusky brown with three white spots on their head.

Compared to other North American waterfowl, relatively little is known of harlequin duck breeding biology, winter ecology, or migrational habits and patterns. Kuchel (1977) conducted the only intensive study of Harlequin ducks in Montana. Two other investigations of harlequin duck breeding biology have been conducted on the North Pacific population; Dzinbal (1982) in Alaska and Wallen (1987) in Grand Teton National Park, Wyoming. The Atlantic coast population in Iceland is probably the best studied (Bengston 1966, Bengston and Ulfstrand 1971, Bengston 1972).

The distribution of harlequin ducks in North America is divided into 2 distinct populations; the North Atlantic coast and the North Pacific coast (Belrose 1980) (Figure 1). The North Pacific coast population breeds inland from northern California northward through Oregon, Washington, British Columbia, and Alaska. They also occur in areas of the northern Rocky Mountains from northwest Wyoming, through northern Canada. Harlequin ducks are most common in the Aleutian Islands of Alaska (Bellrose 1976, Palmer 1976). Montana is on the western limit of the harlequin breeding range with breeding populations uncommon and localized (Kuchel 1977).

Harlequin ducks have a unique migratory pattern. They migrate inland to breed and nest in mountainous streams, and return to the ocean upon completion of the breeding cycle.

Breeding habitat for harlequin ducks in Idaho has been found to be fast running low gradient mountain streams with banks covered by dense shrubs (Wallen & Groves 1989). Kuchel (1977) found that adult harlequin ducks on McDonald Creek in Glacier National Park, Montana confined almost all their activity to swiftly running waters, but also used stretches of abandoned stream channel.

Harlequin ducks spend 2 to 5 months on breeding streams in Montana. Pairs arrive in late April or early May. Pair formation is apparently completed by the time they leave the coast, and males appear to defend a moving territory around the female (Bellrose 1976). Nesting begins in late May (Kuchel 1977). Eggs are laid at an interval of 2 to 4 days with an average clutch size of 5.5; females incubate for 28 days (Bengston 1966 and 1972). Males depart mid- to late June for the coast with females and broods joining males in late August and early September (Kuchel 1977, Miller 1989). Harlequin ducks do not breed until they are 2 years old (Bellrose 1976, Palmer 1976).

Studies of harlequin duck food habits indicate harlequins feed almost entirely on animal matter. Cottam (1939) found animals represented 98% of the food consumed. Benthic insects are the main food consumed while the ducks are on the breeding



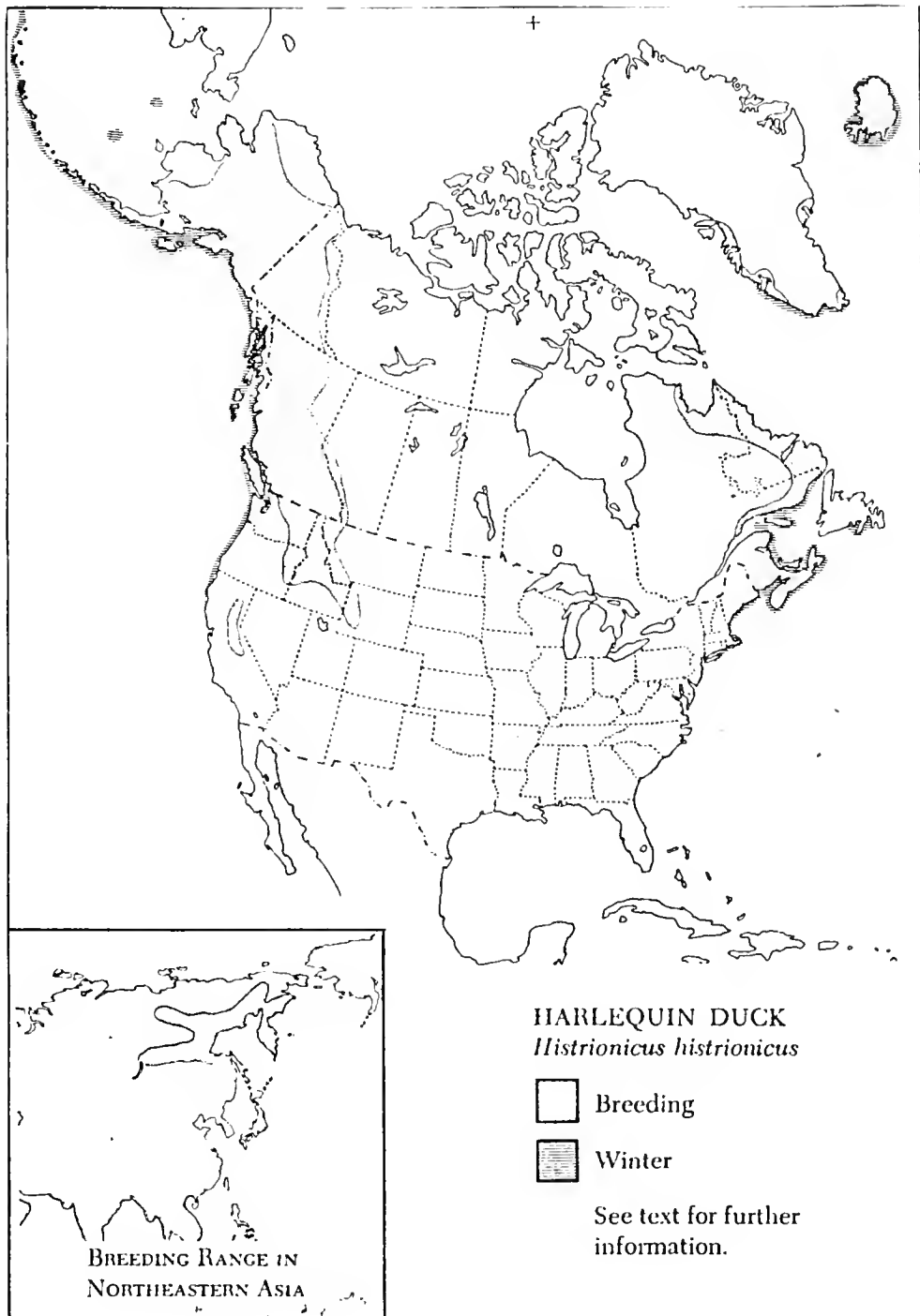


Figure 1. Distribution of the harlequin duck from Palmer (1976).

streams (Bengston and Ulfstrand 1971, Palmer 1976, Wallen 1987). Dzinbal found harlequin ducks in Alaska feed extensively on salmon roe (Dzinbal 1982). The harlequin duck is a designated sensitive species by the U.S. Forest Service in Region 1. It is a species of special concern in Montana and Idaho as designated by the Montana and Idaho Natural Heritage Programs. Wallen and Groves (1988 and 1989) and Cassirer (1989) conducted distributional and habitat surveys in Idaho and have significantly increased the knowledge of harlequin duck distribution in Idaho. Distribution and habitat data has been collected on the Kootenai National Forest in Montana for the last 2 years (Miller 1988 and 1989).

#### SURVEY AREA

The Flathead National Forest is located on the western slope of the continental divide in northwestern Montana. Most of the major vegetative habitat types of western Montana can be found within it's 2,347,299 acres, ranging from the warm dry ponderosa pine/bunchgrass type to the cool moist whitebark pine types. The elevation of the forest ranges from 3500 feet to over 10,000 feet. Precipitation ranges from 15 inches in the lower valleys to 120 inches on the mountain tops. Most of the forest is drained by the three forks of the Flathead River and the Swan and Stillwater Rivers. Surveys for harlequin ducks were conducted on streams in non-wilderness areas of the forest (figure 2).

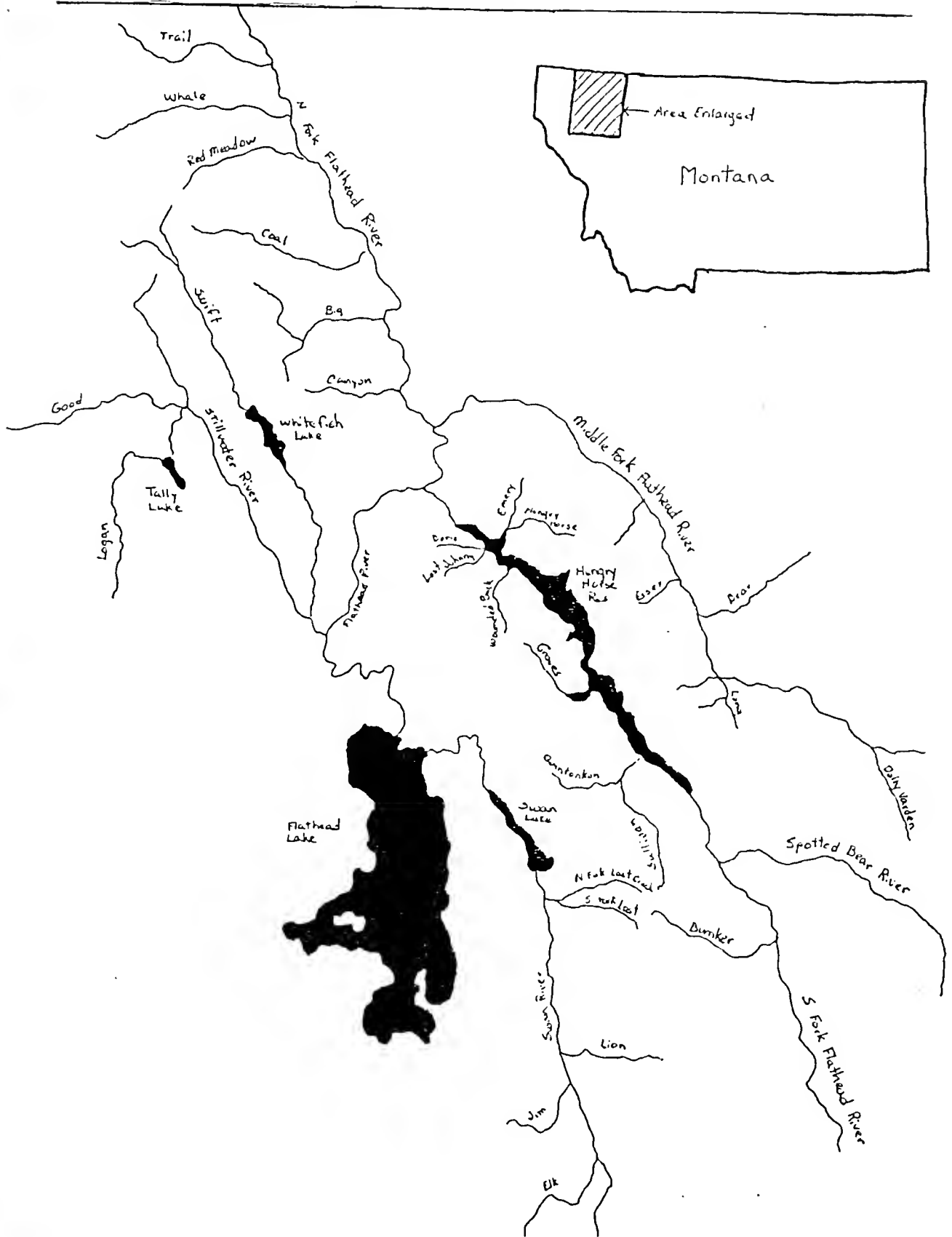


Figure 2. Major streams in the study area.

## METHODS

Harlequin duck breeding habitat in Idaho has been identified by Wallen and Groves (1989) as low gradient mountain streams greater than 10 meters wide with dense riparian vegetation and adequate water quality to support a healthy invertebrate population. Streams to be surveyed for harlequin ducks on the Flathead National Forest were selected following field evaluations during this survey based on these criteria. Conversations with Montana Natural Heritage Program staff and Flathead National Forest district biologists concerning past harlequin duck observations and streams thought to be potential harlequin duck habitat also contributed to stream selection. Surveys were limited to non wilderness areas on the Flathead National Forest.

Initial surveys to locate pairs of harlequin ducks were conducted from 6 May through 27 June by walking upstream alongside the stream banks. I was unable to walk in the streams due to high water levels caused by spring runoff. Surveys to locate harlequin hens and broods were run from mid-July through mid-August. I was able to walk up the stream bed during the later surveys due to lower water levels. This greatly increased my chances of seeing harlequins because visibility was not impaired by stream bank vegetation.

Stream flow data on all streams was collected at the starting point of the survey using methods described by Robins and Crawford (1954). Estimates of vegetation density were made at various points during the survey. A composite vegetation

density was formulated for the reach of stream surveyed.

Vegetation measurements were based on the following scale.

1. Low = 0% - 30% ground cover
2. medium = 31% - 70% ground cover
3. high = 71% - 100% ground cover

Habitat information was collected based on guidelines from Idaho surveys (Wallen and Groves 1989) as follows:

1. Dominant stream bank vegetation,

herbaceous  
shrub  
tree

2. availability of mid-stream loafing sites,

low - 0 sites / 10 m stream  
medium - 1-3 sites / 10 m stream  
high - > 3 sites / 10 m stream

3. channel type,

meander

Stream channel is located in a flat bottomed valley with deep pools separated by shallow riffles. the channel appears to shift slightly during each peak flow period.

braided

Stream channel is located in a flat bottomed valley with shallow channels and islands. The channel may shift slightly during each peak flow period.

canyon

Stream channel is structurally controlled by a "v" shaped valley. Rapids and runs characterize the stream flow. Virtually no movement of the channel occurs during peak flow periods.

channelized

Stream channel is artificially straightened by human activities.

The stream was also described with reference to stream bed composition, logjams, slow backwater areas, temperature, and associated species. Montana Natural Heritage Program field forms were completed for each stream surveyed.

When broods were observed, I estimated the age of the chicks from plumage development (Gallop and Marshall 1954). Hatching dates were estimated by backdating from the date of the observation.

#### RESULTS AND DISCUSSION

From May through August 1990, I concentrated surveys on 20 streams on the Flathead National Forest in northwest Montana with at least 2 visits to each stream (Table 1). Numerous other streams throughout the study area were examined to evaluate their potential for harlequin duck habitat. These streams were not surveyed further. I determined they did not meet harlequin duck habitat criteria, usually because they were either too small or the gradient was too high.

Four of the creeks surveyed were located on the Tally Lake Ranger District, six on the Glacier View Ranger District, six on the Hungry Horse Ranger District, and four on the Spotted Bear Ranger District. Fifteen observations of harlequin ducks were made by myself and USFS personnel (Table 2.).

The low number of harlequin observations precludes any meaningful statistical analysis of the data. The information delineating harlequin duck distribution on the Flathead National

Forest adds to current information of harlequin duck habitat and breeding biology in Montana.

First observations of harlequin ducks were on 6 May 1990, the first day of surveys. Kuchel (1977) found harlequins on McDonald Creek in nearby Glacier National Park in late April and Wallen & Groves (1989) determined that most harlequins arrived in Idaho by the first week of May. They speculated that harlequins may arrive in late April in Idaho and remain unnoticed due to the isolated nature of the habitat. My observation should not be construed as an arrival date.

#### Breeding Biology

Estimated hatching dates of broods observed, (table 3), are consistent with the range of hatching dates for harlequins in Glacier National Park (Kuchel 1977). These dates are later than the average hatching date of 6 June found in Idaho (Wallen & Groves 1989).

DATE	LOCATION	BROOD SIZE	AGE CLASSIFICATION	HATCHING DATE (+/- 3 days)
7/30/90	Sullivan Creek	4	IIa	7/12/90
8/7/90	Trail Creek	4	Fledged	6/26/90
8/7/90	Trail Creek	2	III	6/29/90
7/12/90	Middle Fork Flathead River	4	?	?

Table 3. Location, age, and classification of harlequin duck broods observed on the Flathead National Forest, 1990.

The average size of broods was 3.5 (n=4) with a range of 2 to 4. This is the same average brood size Wallen & Groves (1989)

CREEK	DATES		MILES SURVEYED	DUCKS PRESENT ?	STARTING POINT
	SURVEYED				
TRAIL	5/6/90	2.00	Y	T37N,R22W,SECT35,SE1/4,SE1/4	
	5/14/90	6.00	Y		
	8/7/90	6.00	Y		
WHALE	5/15/90	6.00	N	T36N,R21W,SECT30,NE1/4,SW1/4	
	8/8/90	6.00	N		
RED MEADOW	5/30/90	3.00	N	T36NR21W,SECT7,SE1/4,SE1/4	
	8/8/90	3.00	N		
COAL	5/16/90	2.00	N	T34N,R20W,SECT20,SW1/4,SE1/4	
	8/11/90	3.00	N		
BIG	5/17/90	3.00	Y	T33N,R20W,SECT22,SW1/4,SW1/4	
	8/9/90	3.00	N		
CANYON	5/17/90	3.00	N	T32N,R20W,SECT29,NE1/4,SW1/4	
	8/9/90	3.00	N		
DORIS	6/20/90	1.00	N	T29N,R19W,SECT2,SE1/4,NE1/4	
	8/3/90	1.00	N		
WOUNDED BUCK	5/22/90	3.00	N	T29N,R19W,SECT17,SW1/4,NW1/4	
	6/6/90	3.00	N		
	7/31/90	3.00	Y		
LOST JOHNNY	5/22/90	1.00	N	T29N,R19W,SECT1,SW1/4,NE1/4	
	6/20/90	2.00	N		
	8/10/90	2.00	N		
EMERY	6/6/90	3.00	N	T30N,R18W,SECT17,SE1/4,SW1/4	
	8/10/90	3.00	N		
HUNGRY HORSE	6/6/90	2.00	N	T30N,R18W,SECT21,NE1/4,SW1/4	
	8/10/90	2.00	N		
SULLIVAN	6/20/90	3.50	N	T26N,R17W,SECT23,NE1/4NE1/4	
	7/30/90	4.00	Y		
QUINTONKEN	7/30/90	0.50	N	T26N,R17W,SECT11,SW1/4,SW1/4	

Table 1. Stream Survey Data.



Table 1. Stream Survey Data (continued).

CREEK	DATES SURVEYED	MILES SURVEYED	DUCKS PRESENT ?	STARTING POINT
BUNKER	6/5/90	3.00	N	T24N,R14W,SECT20,SW1/4,NE1/4
	8/2/90	5.00	N	
SPOTTED BEAR	6/4/90	4.00	N	T25N,R15W,SECT17,NE1/4,SW1/4
	8/1/90	8.00	N	
SWIFT	6/15/90	4.00	N	T33N,R23W,SECT24,NW1/4,SW1/4
	7/28/90	5.00	Y	
UPPER STILLWATER	6/4/90	4.00	N	T34N,R24W,SECT20,SW1/4,SW1/4
	7/27/90	4.00	N	
LOGAN	5/21/90	3.00	N	T31N,R23W,SECT30,SW1/4,SW1/4
	6/21/90	6.00	N	
	7/24/90	6.00	N	
GOOD	5/21/90	3.00	N	T32N,R24W,SECT27,SW1/4,SE1/4
	7/23/90	3.00	N	

found in Idaho. The average brood size found Glacier National Park was 4.18 (from Kuchel 1977). Fourteen young harlequins were located during this survey. Kuchel (1977) found that most mortality of young occurred during the first 2 weeks after hatching, thus a minimum of 14 harlequin ducks were produced on the study area in 1990.

I found harlequins with broods on 2 streams on the study area. Another brood was reported by USFS on the Middle Fork of the Flathead River. The brood on Trail Creek was in the same area I observed a brood in 1989. A single female was observed on Wounded Buck Creek near where Miller (1989) had observed a brood of 4 in 1989. These observations suggest a high degree of site tenacity as reported in other studies of harlequin ducks (Bengston 1966, Kuchel 1977, Wallen 1987, Dzinbal 1982).

Three of the seven observations made during the second set of surveys were single females. No distinction could be made between nonbreeding, (i.e. sexually mature birds that refrain from breeding), and unsuccessful breeding females. This is similar to the 47-50% nonbreeders found in Alaska by Dzinbal (1982). Wallen (1987) found that 62% of the harlequins in his study area were nonbreeders. He also did not differentiate between nonbreeders and failed breeders. Bengston (1971) surmised that all females remaining on the breeding grounds without broods were nonbreeders not unsuccessful nesters. He felt that most nonbreeding female harlequins were first year birds that do not even enter the breeding areas in Iceland.

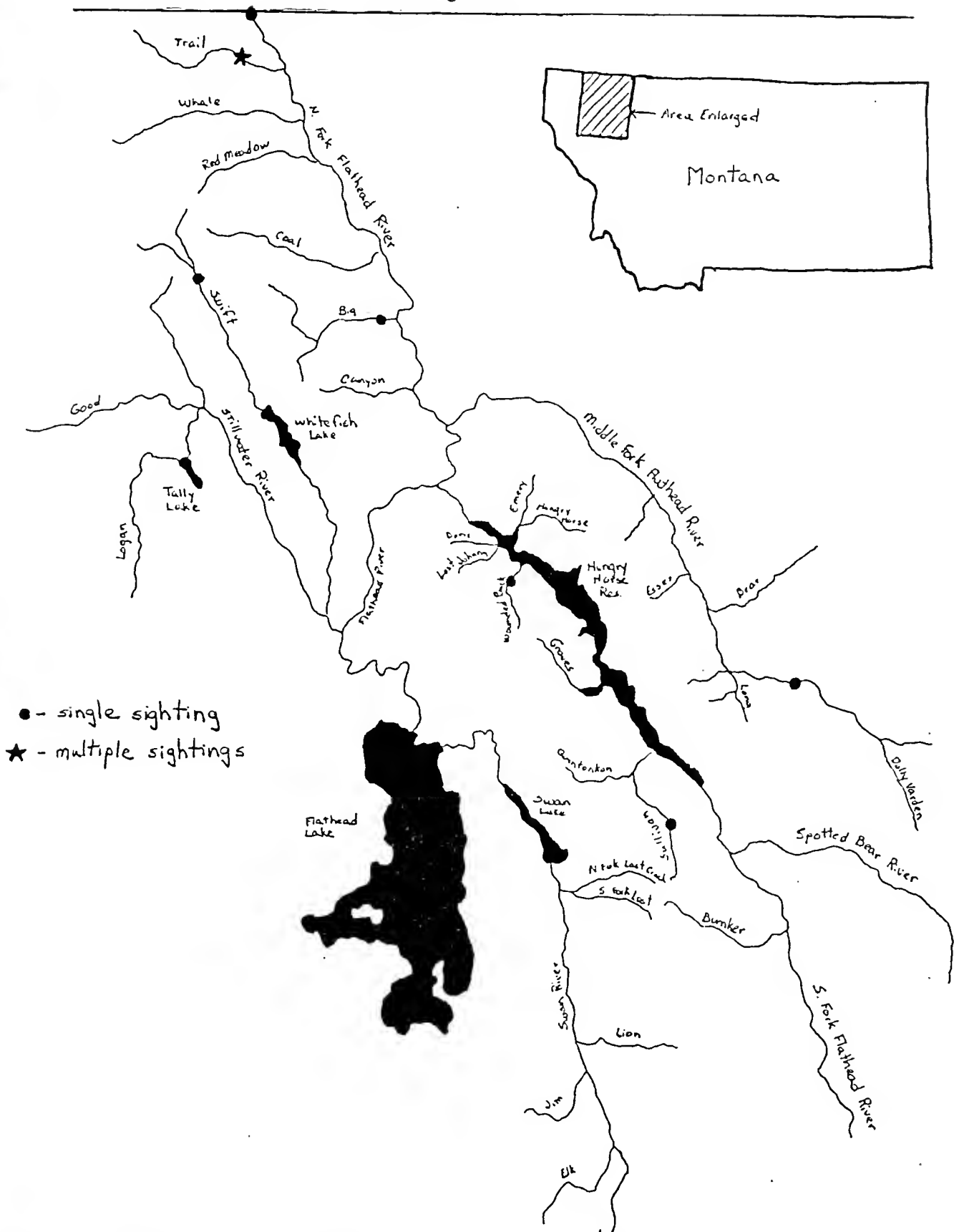
#	DATE	CREEK	OBSERVATION
1	5/6/90	TRAIL	OBSERVED 4 PAIR FEEDING AND LOAFING IN ONE SPOT NEAR BACKWATER AREA I HAD OBSERVED A BROOD LAST YEAR. T37N,R22W,SECT30, SE1/4, NE1/4.
2 *	5/10/90	WOUNDED BUCK	1 MALE OBSERVED FEEDING IN STREAM T29N,R18W,SECT 19, SW1/4
3	5/14/90	TRAIL	OBSERVED 1 PAIR ALONG CREEK FEEDING AND LOAFING . T37N,R22W,SECT 33, SW1/4,NE1/4
4	5/14/90	TRAIL	OBSERVED 1 PAIR LOAFING ON CREEK T37N,R22W,SECT 28,SE1/4,SW1/4
5	5/14/90	TRAIL	OBSERVED 2 PAIR LOAFING ON ISLAND IN CREEK. T37N,R22W,SECT 29,NE1/4,SW1/4.
6	5/14/90	TRAIL	OBSERVED 1 PAIR LOAFING ON CREEK BANK. T37N,R22W,SECT 30,S1/2,NE1/4
7	5/17/90	BIG	OBSERVED 1 PAIR FEEDING UPSTREAM T33N,R20W,SECT 21,SE1/4,SW1/4
8 *	5/31/90	NORTH FORK FLATHEAD RIVER	2 MALES OBSERVED FEEDING ON BANK AND 1 FEMALE OBSERVED FLYING UPSTREAM. T37N,R22W,SECT 5,NE1/4
9 *	7/13/90	MIDDLE FORK FLATHEAD RIVER	1 FEMALE AND 4 YOUNG OBSERVED IN RIVER. T28W,R15N,SECT 19.
10	7/28/90	SWIFT	OBSERVED 1 FEMALE LOAFING ON CREEK T33N,R23W,SECT 3,NW1/4,SE1/4
11	7/30/90	SULLIVAN	OBSERVED 1 FEMALE AND 4 YOUNG LOAFING ON GRAVEL BAR. T26N,R16W,SECT 31,NE1/4NW1/4
12	7/31/90	WOUNDED BUCK	OBSERVED 1 ADULT FEMALE LOAFING & FEEDING ON CREEK. T29N,R18W,SECT 19,S1/2,NW1/4
13	8/7/90	TRAIL	OBSERVED 1 ADULT FEMALE FLY PAST ME UPSTREAM. T37N,R22W,SECT 29,NW1/4,SW1/4
14	8/7/90	TRAIL	OBSERVED 1 FEMALE AND 2 YOUNG FEEDING UPSTREAM. T37N,R22W, SECT. 29 NW1/4,SW1/4

Table 2. Harlequin duck observations on the Flathead National Forest, 1990.

Table 2. (continued).

#	DATE	CREEK	OBSERVATION
15	8/7/90	TRAIL	OBSERVED 4 FLEDGED YOUNG FEEDING IN CREEK T37N,R22W,SECT 30,SE1/4,NE1/4

\*OBSERVATIONS BY USFS PERSONEL



● - single sighting  
★ - multiple sightings

Figure 3. Locations of harlequin duck sightings on the Flathead National Forest, 1990.

Nesting success has not been determined in any studies of the Pacific coast population because no nests have ever been found in any of the studies. Dzinbal did determine that the percentage of failed-breeding females was 33% during 1979 and 43% in 1980 thus nesting success could be interpreted to be 67% and 57% in those respective study years.

Wallen & Groves (1989) suggest that harlequin ducks are, at best uncommon nesters in northern Idaho. Results of this survey and surveys conducted on the Kootenai National Forest (Miller 1988 and 1989) suggest the same is true for western Montana.

#### Habitat

Harlequin duck habitat has been identified as low gradient, mountain streams with dense shrubs along the streambank (Kuchel 1977, Wallen & Groves 1989). Observations of harlequin ducks during this survey were within that habitat type. Stream data gathered during this survey describe the stretch of stream surveyed. Separate measurements of streams at observation locations were not conducted.

Harlequin ducks nested on only 2 streams surveyed in this study, Trail Creek, where I located 2 broods and Sullivan Creek, where I located 1 brood. The brood located on the Middle Fork of the Flathead probably came from one of the creeks flowing into the river in that area. Single females were located on Swift and Wounded Buck creeks.

Flow rates of these four creeks ranged from 77 cfs on

Wounded Buck to 125 on Swift Creek. Temperatures ranged from 9 degrees C on Swift Creek to 17 degrees C on Sullivan Creek. Gradients were all under .02 feet rise/feet run. Vegetation was all medium to high shrub or trees except Sullivan Creek which had low density shrub and trees because the creek flowed mostly through a wide, barren, gravel streambed. Channel types were braided or canyon type channels. All creeks had medium to high numbers of loafing sites. Harlequin duck distribution on the Flathead Forest is probably limited by factors other than these stream characteristics. Bengston (1971) and Kuchel (1977) both suggest that breeding success may be limited by invertebrate numbers. I believe that factors beyond those measured on this survey, such as stream productivity and stability, may determine which streams harlequins occupy since streams in this survey found to have harlequins possessed the same characteristics measured as many streams that harlequins were not found on.

#### SUMMARY OF HARLEQUIN DUCK STATUS BY RANGER DISTRICT

##### Tally Lake Ranger District

Most of the streams evaluated on the Tally Lake Ranger District were small, low gradient streams that were slow and swampy compared to the habitat criteria I used. Good Creek and Logan Creek contained areas that appeared to offer potentially suitable habitat, but no ducks were found. The upper Stillwater River appeared to be quite suitable, especially the area near the

confluence with Fitzsimmons Creek but no ducks were located. Swift Creek matched habitat criteria and 1 lone female was located on 28 July 1990 near the confluence with Swede Creek. This creek was difficult to access and it may support more ducks than were located. Both surveyed portions of Swift Creek and the Stillwater River are on the Stillwater State Forest.

#### Glacier View Ranger District

Trail Creek provided the most observations of harlequins of any searched creek in the study area. Eight separate sightings were recorded some of which were probably repeat sightings of the same birds. A total of 6 young were observed in two separate broods. A brood was also located by the author in the same area in 1989. During this survey the creek was dry above the confluence with Thoma Creek. Trail Creek was the most developed creek surveyed with at least 4 cabins located along the creek and a major forest service campground upstream from the sighting areas. One pair of harlequin ducks was observed on Big Creek on 17 May and a harlequin duck feather was found during the second survey on 9 August. Harlequin ducks were also observed by USFS personnel on 31 May at the Canadian border on the North Fork of the Flathead River. The Glacier View Ranger District appears to have more extensive harlequin habitat than any other ranger district on the Flathead National Forest other than the wilderness areas.



## Hungry Horse Ranger District

A male harlequin was observed on Wounded Buck Creek on 10 May by USFS personnel. A female harlequin was observed on 31 July by myself on this creek. Most of the creeks around Hungry Horse Reservoir are small, higher gradient streams which do not appear to provide harlequin habitat. Wheeler Creek was not surveyed due to access problems but does warrant further investigation for harlequin use. Creeks along the Middle Fork of the Flathead River were also short, high gradient creeks offering little for harlequin habitat. Creeks further up the Middle Fork of the Flathead River into the Great Bear Wilderness likely have some areas of appropriate harlequin habitat. An observation on 12 July by USFS personnel of a female with four young on the Middle Fork is evidence that breeding does occur somewhere in the wilderness.

## Spotted Bear Ranger District

Sullivan Creek was the only creek surveyed in the Spotted Bear Ranger District that harlequin ducks were found on. A female harlequin and 4 young were located on 30 July on Sullivan Creek near the confluence with Quintonkon. Sullivan Creek, Bunker Creek, and the Spotted Bear River all had reaches of high potential harlequin habitat and deserve additional surveys. Quintonkon Creek was in a narrow canyon that did not meet harlequin habitat criteria. No other creeks appeared large enough or were low enough gradient to warrant searches during

this survey. Streams in the Bob Marshall Wilderness should be evaluated as potential harlequin habitat and searched as deemed suitable. Pat Clancy MDFW&P (pers. comm.) observed 2 female harlequins fly past him in 1979 near the confluence of Dolly Varden and Argosy Creeks in the Bob Marshal Wilderness.

#### Swan Lake Ranger District

No harlequin ducks were observed on creeks surveyed on the Swan Lake Ranger District. There are no known historic records of harlequin ducks on any creeks in the Swan River Drainage despite extensive fisheries research done on the creeks in the district and no observations were reported to me during this survey. No extensive surveys were conducted although stream measurements were taken on 5 creeks in the drainage and small reaches of stream were surveyed. Most of the creeks in this district appeared to be small and have extensive swampy areas. This district should be surveyed further especially stretches of the Swan River near Condon.

#### CONCLUSIONS AND RECOMMENDATIONS

This survey suggests that harlequin ducks are uncommon and localized breeders on the Flathead National Forest. Wallen and Groves (1989) found harlequins in northern Idaho to be localized and uncommon breeders, and both breeding and wintering numbers

have probably declined in Washington and Oregon since the mid-70's (K. Dzinbal in Wallen and Groves 1989). Due to the low number of harlequin ducks found on this survey combined with the relatively low productivity of harlequin ducks and limited number of streams I found harlequins on, I recommend that the Harlequin duck remain as a Forest Service Sensitive Species.

I found harlequins in the Flathead National Forest occupy the same nesting habitat found in Glacier and Grand Teton National Parks - relatively undisturbed, low gradient, mountain streams with a healthy riparian component. I feel that these components are not the limiting factor in harlequin duck distribution as I did not find harlequins on many streams I surveyed that fit these parameters. Stream productivity and stability are other components that need to be investigated further. Habitat measurements should follow the guidelines in Wallen and Groves (1989) to provide measurement consistency and more thorough measurements of specific observation sites. Marking and banding are recommended to expand knowledge of harlequin duck breeding biology and confirm what extent mate fidelity and nest site philopatry hold true for western Montana outside of Kuchel's (1977) study area in Glacier National Park.

I recommend that surveys be continued on the Flathead National Forest to document streams that harlequins use during the breeding season although I feel that more emphasis should be placed on documenting habitat use by harlequins on streams where they are already known to breed. Additional people should also

be used to conduct surveys. I found that one person could survey a large area, but morale and effectiveness suffered. To determine nesting and brood rearing habitat, breeding season chronology, and productivity of harlequins on the Flathead National Forest, more people need to be involved in the field. As suggested by Wallen and Groves (1989), an intensive study at one locale would provide specific information needed for management of harlequin ducks on their breeding grounds. A review of the literature suggests that much is to be learned of the wintering biology and habitats of harlequin ducks also.

## ACKNOWLEDGEMENTS

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APPENDICES



APPENDIX A  
HABITAT COMPONENTS OF STREAMS SURVEYED ON  
THE FLATHEAD NATIONAL FOREST 1990.

STREAM	DATE	FLOW RATE** CFS	TEMPERATURE (deg. C)	GRADIENT	VEGETATION***	% CHANNEL TYPE	LOAFING SITES
TRAIL*	8/7/90	98.27	16	0.014	MED/HIGH SHRUB	70% BRAIDED 30% CANYON	MEDIUM
WHALE	8/8/90	152.72	15	0.015	MED/HIGH SHRUB	70% BRAIDED 30% CANYON	MEDIUM
RED MEADOW	8/8/90	39.78	17	0.023	HIGH TREE	50% BRAIDED 50% CANYON	
COAL	8/11/90	145.23	15	0.015	MED/HIGH SHRUB	70% CANYON 30% BRAIDED	HIGH
BIG*	8/9/90	105.86	13	0.013	MED/HIGH TREE	90% BRAIDED 10% CANYON	HIGH
CANYON	8/9/90	119.13	12	0.035	LOW SHRUB	100% CANYON	HIGH
DORIS	8/3/90	43.69	13	0.023	MED SHRUB	100% CANYON	HIGH
WOUNDED BUCK*	7/31/90	87.09	10	0.02	MED SHRUB	100% CANYON	HIGH
LOST JOHNNY	8/10/90	29.4	12	0.057	HIGH SHRUB	100% CANYON	
EVERY	8/10/90	27.72	12	0.023	HIGH SHRUB	100% CANYON	

STREAM	DATE	FLOW RATE** CFS	TEMPERATURE (deg. C)	GRADIENT	VEGETATION***	% CHANNEL TYPE	LOADING SITES
HUNGRY HORSE	8/10/90	17.11	12	0.023	HIGH SHRUB	100% CANYON	
SULLIVAN*	7/30/90	76.95	17	0.015	LOW TREE	70% CANYON 30% BRAIDED	LOW
QUINTONKON	7/30/90	51.75	15	0.051	LOW SHRUB	100% CANYON	LOW
BUNKER	8/2/90	140.27	13	0.006	MED TREE	80% BRAIDED 20% CANYON	MEDIUM
SPOTTED BEAR	8/1/90	185.29	13	0.098	LOW SHRUB	60% BRAIDED 40% CANYON	MEDIUM
SWIFT*	7/28/90	124.74	9	0.014	MED TREE	90% BRAIDED 10% CANYON	MEDIUM
UPPER STILLWATER	7/27/90	124.39	10	0.023	MED SHRUB	80% CANYON 20% BRAIDED	HIGH
LOGAN	7/24/90	98.82	17	0.02	MED SHRUB	100% CANYON	HIGH
GOOD	7/23/90	56.77	18	0.02	MED SHRUB	100% CANYON	HIGH

\* STREAMS HARLEQUIN DUCKS WERE LOCATED ON

\*\* BASED ON ROBBINS & CRAWFORD (1954)

\*\*\* SEE METHODS SECTION FOR EXPLANATION

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