

DISTRIBUTION, HABITAT USE AND STATUS OF HARLEQUIN DUCKS
(Histrionicus histrionicus) IN NORTHERN IDAHO, 1990

by

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October 1990

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SUMMARY

Surveys for harlequin ducks were conducted on streams in northern Idaho from the Selway River to the Canadian border. Harlequin ducks were observed on 12 streams. Unconfirmed reports were received from 10 additional streams. Minimum estimated population size was 30 pairs and 11 broods. This likely represented the majority of the population in northern Idaho during 1990. Approximately 1/3 of pairs observed in the spring produced ducklings to 3 weeks of age or older. Average brood size at class II and older was 3, and average estimated hatching date was July 3, although estimated hatching dates spanned a 34-day period from June 18-July 21. Annual variation in pair numbers and productivity was documented.

Harlequins were generally observed in streams 10 m wide or greater, away from roads, in riffles, runs or rapids with a cobble or boulder substrate, and a mature to old-growth cedar/hemlock overstory.

Recommendations for inventory and monitoring are included.

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INTRODUCTION

The ecology of harlequin ducks in Idaho has been studied since 1987. Initial work concentrated on describing distribution, general habitat use and determining breeding chronology (Wallen and Groves 1988, 1989, Cassirer 1989, Cassirer and Groves 1989). Subsequently, habitat use and breeding ecology were studied more intensively on streams near Upper Priest Lake, one of the most productive areas for harlequins in Idaho (Cassirer and Groves 1989).

During 1990, our objectives were to estimate population size and reproductive success by repeatedly surveying stream reaches known to be used by harlequin ducks throughout northern Idaho. Habitat data were also collected in areas used by harlequins. Additionally, some streams were surveyed for the first time in 1990 to clarify distribution.

STUDY AREA

Surveys were conducted on streams from the Selway River north to the Canadian border (Figure 1). This included the West Fork Ranger District (R.D.) on the Bitterroot National Forest, Moose Creek R.D. on the Nez Perce National Forest, Powell and North Fork R.D.'s of the Clearwater National Forest, Avery R.D. on the St. Joe National Forest, Wallace R. D. on the Coeur d'Alene National Forest, and the Sandpoint, Bonners Ferry and Priest Lake R.D.'s on the Kaniksu National Forest.

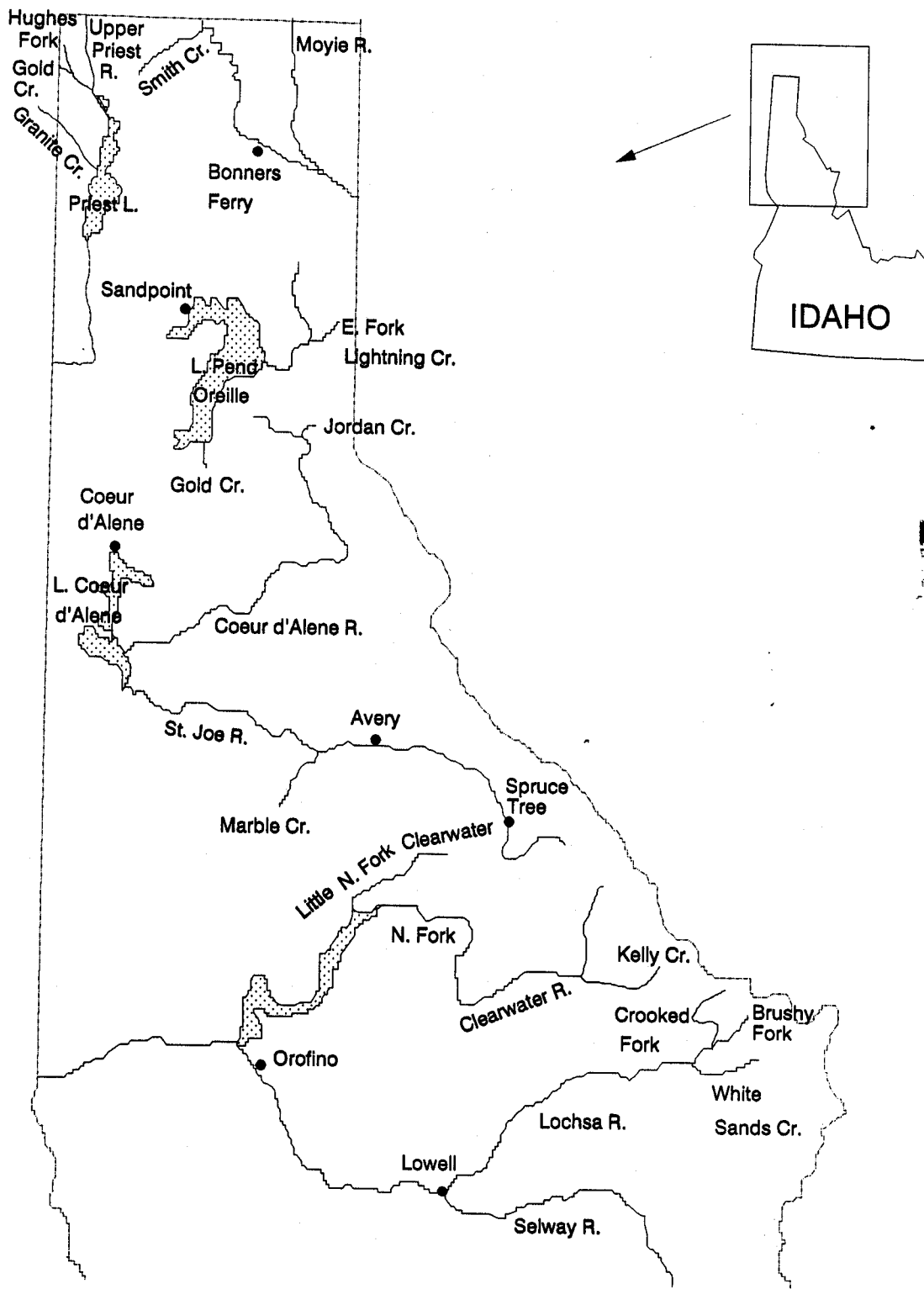


Figure 1. Study area, 1990.

METHODS

Stream reaches known to be used by harlequin ducks were surveyed two to four times during the summer. Surveys during April and May were used to estimate pair densities. We returned to these streams in late June, July and August to document reproductive success. Surveys were also conducted one or more times during the summer on some streams that had never been surveyed.

Surveys were primarily conducted by walking in or along streams, and also by rafting, tubing and driving on roads adjacent to streams (Appendix A). Habitat data (Appendix B) were collected at all harlequin observation sites. During August, the same habitat data were collected systematically along stream reaches used by harlequins in 1990 at 1-km (Gold Cr. Lake PDO, Gold Cr. Priest L., Hughes Fork, N. Fork Granite Cr., E. Fork Lightning Cr., Crooked Fork and the Coeur d'Alene River), 3-km (Upper Priest River, Moyie River), or 5-km (Lochsa, St. Joe, N. Fork Clearwater) intervals. Sixty adult and 13 brood observations were compared and all harlequin observations were compared to systematic observations with a chi-square test and a Bonferroni Z statistic at $\alpha = 0.05$ (Neu et al. 1974).

Ducklings were classified by plumage development according to Gollop and Marshall (1954). Hatching dates were estimated by backdating using harlequin duck development calculated by Wallen (1987) for Grand Teton National Park.

A poster soliciting reports of harlequin duck observations

(Cassirer and Groves 1989, Appendix A) was circulated to the Clearwater, Idaho Panhandle and Nez Perce National Forests, and put up at trailheads and along stream access points. Reports of harlequin ducks were usually followed up by a survey of the area.

One male was trapped and marked with nylon nasal markers (Cassirer and Groves 1989, p. 6) in 1990 (Appendix C).

Macroinvertebrates were collected with a Hess sampler on four streams used by harlequins in Idaho and streams used by harlequins in Glacier and Grand Teton National Parks. Samples are being analyzed by the Forest Service Intermountain Region Aquatic Ecosystem Analysis Laboratory in Provo, Utah.

RESULTS

Population estimates and distribution

Surveys were conducted on 38 streams (Appendix A). Harlequin ducks were observed 73 times on 12 of these streams: the Coeur d'Alene River, Crooked Fork, E. Fork Lightning Creek, Gold Creek on Lake Pend Oreille, Gold Creek at Priest Lake, Granite Creek, Hughes Fork, Lochsa River, Moyie River, N. Fork Clearwater River, St. Joe River, and Upper Priest River (Figure 1, Appendix D). Reports were received from 10 additional streams: Marble Creek, N. Fork St. Joe River, Selway River, White Sands Creek, N. Fork Spruce Cr., Bargamin Cr., Crooked River, Bear Paw Cr., and N. Fork Gold Cr. at Lake Pend Oreille. Harlequin ducks were observed throughout the field season, April

24-August 23. Males were observed until June 22. Prior to June 23, all but one female observed were accompanied by males.

Harlequins were not observed on any streams where they had not been observed or reported in previous years, and they were not observed or reported on three streams where broods have been reported in the past (Kelly Creek, Little N. Fork Clearwater and Smith Creek).

A minimum of 22 pairs were observed and a minimum of eight more were estimated, based on observations of single adults and broods (Table 1). Average pair densities were 1 pair per 6.7 km of stream, although one small stream had more than 1 pair/km, whereas other longer rivers had densities as low as 1 pair/16 km (Table 1). An average of 29% of the pairs observed in the spring raised ducklings to at least 3 weeks of age (class IIb).

Brood Ecology

A total of 33 ducklings were observed or reported in 11 broods. Average hatching date was estimated to be July 3, however hatching spanned a 34-day period from June 18 to July 21 (Table 2). Nine of 11 broods were estimated to have hatched between June 18 and July 6. Average brood size at class IIb and older was 3. No mortality was observed in two broods observed as class Ic and IIb and observed again 5-6 weeks later as class III. Three class III and one class IIc broods were observed without a hen.

Table 1. Pair numbers, densities and productivity of harlequin ducks on streams in northern Idaho, 1990.

Stream	Minimum no. pairs	km ¹	km/pair	Percent of pairs reproducing ²
Lochsa	5	80	16	20
St. Joe	4	56	14	25
N. Fork Granite Cr.	2	12	6	50
E. Fork Lightning Cr.	1	5	5	0
Upper Priest River ³	4	19	5	25
Gold Cr. (Priest Lake)	2	7	3.5	0
Hughes Fork	5	13	3	60
Gold Cr. (L. Pend Oreille)	2	1.5	0.8	50
Moyie River	1	-	-	-
Coeur d'Alene River ³	1	-	-	-
N. Fork Clearwater River ³	3	-	-	-
Total	30	-	-	-
Average	-	-	6.7	29

¹ length of stream reach where pairs have been observed

² ducklings survived to at least class II

³ minimum pair numbers estimated from single adult and/or brood observations

Table 2. Summary of harlequin duck brood observations and estimated hatching dates, northern Idaho 1990.

Stream	Date	Brood size	Class	Estimated age (days) ¹	mid-point estimated hatching dates
N. Fork Granite Cr.	6/30	3	Ic	10-14	June 18
Gold Cr. (L. PDO)	7/13	3	IIb	22-27	June 19
St. Joe	7/23	6	IIb-IIc	22-35	June 24
Lochsa	8/3	3	III	36-42	June 25
N. Fork Clearwater	8/6	4	III	36-42	June 28
N. Fork Clearwater	8/6	3	III	36-42	June 28
Upper Priest River	8/13	3	III	36-42	July 5
N. Fork Clearwater	8/7	2	IIc	28-35	July 6
Hughes Fork	8/14	1	III	36-42	July 6
Hughes Fork	8/14	2	IIc	28-35	July 13
Hughes Fork	8/14	3	IIb	22-27	July 21
Average		3			July 3

¹ Wallen 1987, p. 18

Returns of marked ducks

Eight of 16 harlequins (6 of 10 females and 2 of 6 males) marked in 1988 and 1989 were observed in 1990 (Appendix D). Both males were paired when marked and returned with the same mate. No marked single males were observed and all marked ducks were observed on the same stream reach where they were originally marked. One female marked on the Upper Priest River was also observed on Hughes Fork. One paired female marked in 1988 was not observed in 1989 but was seen with a brood in 1990. Three marked females reproduced successfully in 1990.

Habitat use

Harlequin duck habitat (n=73 observations) was generally characterized by streams 10 m wide or greater; over 50 m from roads; with a cobble or boulder substrate; trees, a tree/shrub mosaic, or shrubs on the streambank; and a mature to old-growth overstory, although some harlequins were observed in other habitats (Figure 2). Harlequins were usually observed in riffles, runs and rapids with one or more loafing sites in cedar/hemlock forest. The stream channel was usually cut into a "v" shaped valley and was structurally restricted by the streambank (Appendix F). Elevations ranged from 635 to 1231 m (2080 to 4040 ft). Gradient on stream reaches used by harlequin ducks averaged 1.7%.

Available habitat on these reaches was similar to that

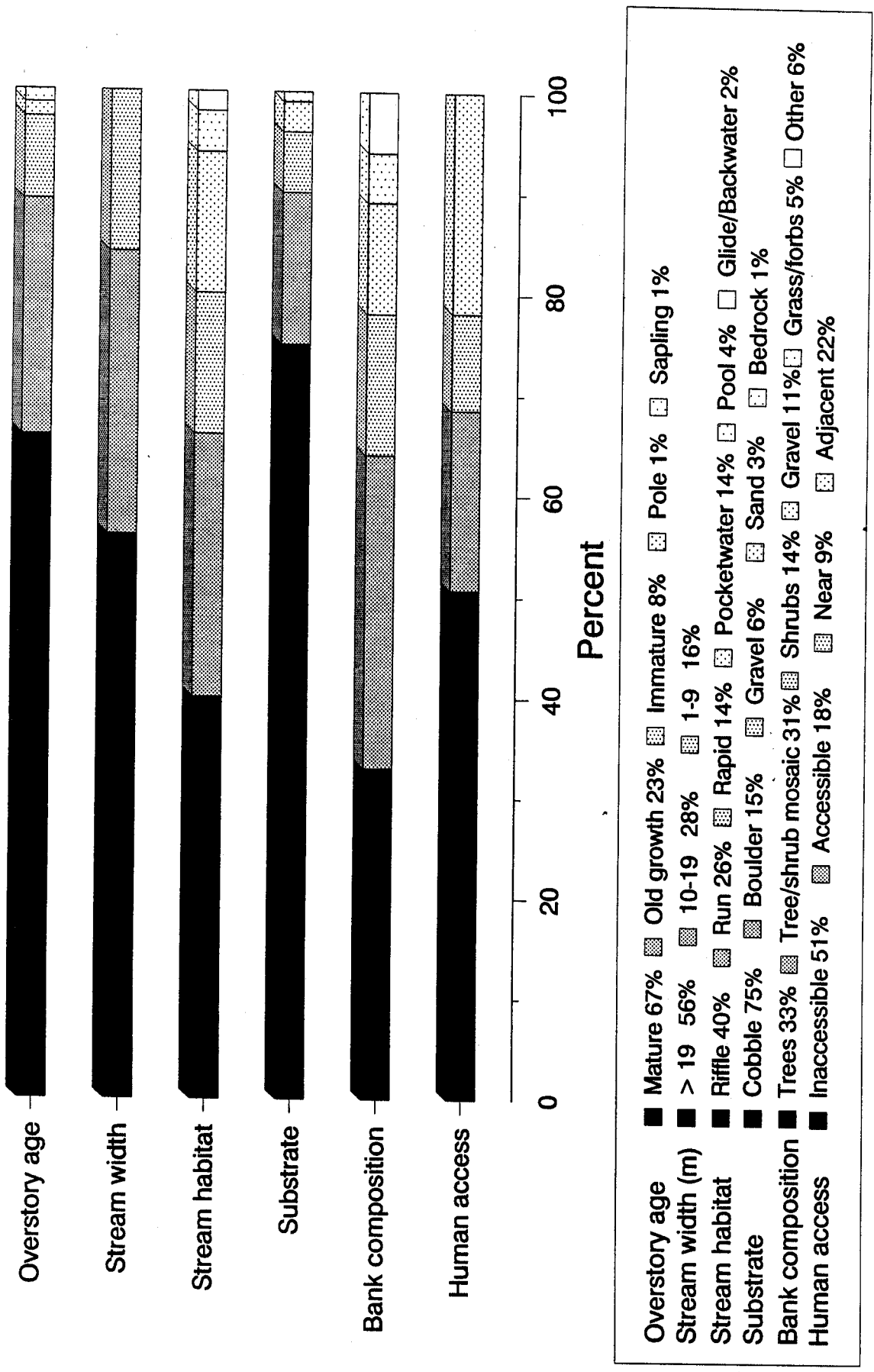


Figure 2. Habitat characteristics of areas used by harlequin ducks in Northern Idaho, 1990.

described for areas used by harlequins. Harlequins did tend to be observed less frequently in immature overstory, and in shrub or grass/forb habitats and more often in cedar/hemlock stands than would be expected if they were using these areas randomly (Appendix F).

Significant use of areas with fewer loafing sites and faster water (Appendix F) may be a result of measuring availability during low flows in August. Apparent selection for wider streams (Appendix F) may be due to the fact that systematic transects describing availability were taken less frequently along larger streams.

Of the 12 streams where harlequin ducks were observed in 1990, four were closed to fishing, three opened May 26 for catch-and-keep and five opened July 1, one for catch-and-keep and four for catch-and-release. The Lochsa, St. Joe, N. Fork Clearwater and Moyie rivers were also used by boaters. Most boating on these streams occurs from May to early July. Nesting and early brood rearing occurred above those stretches usually used by boaters.

Brood habitat was generally similar to that used by adults (Appendix F), however broods used narrower stream reaches, with more woody debris and more loafing sites. Broods were more commonly observed in pocketwater and pool habitats and were never observed in runs or rapids. Brood observations were also associated more with gravel substrates, meandering stream channels and vegetative overhang, although these differences were

not significant ($0.08 < p < 0.13$).

SUMMARY OF DISTRIBUTION BY NATIONAL FOREST

Clearwater National Forest

Harlequins were observed on the Lochsa River above Boulder Creek, on Crooked Fork and on the North Fork Clearwater River above Coyote Creek. Harlequins were reported on White Sands Creek and North Fork Spruce Creek. No harlequins were observed in surveys of Kelly Creek and Vanderbilt Creek although some reaches of these streams did appear to have suitable habitat.

Nesting occurred on the North Fork Clearwater River and may have also occurred on North Fork Spruce Creek (Lochsa drainage) although this could not be confirmed. No successful nesting occurred on the Lochsa River itself in 1990, although the Lochsa was used by a brood moving downstream during July and August from a nesting area on either White Sands Creek, Crooked Fork or Brushy Fork. A minimum of eight pairs produced at least four broods on the Clearwater National Forest.

St. Joe National Forest

Harlequins were observed on the St. Joe River above Marble Creek. No harlequins were observed on surveys of Beaver Creek, Loop Creek, Marble Creek, N. Fork St. Joe River, Simmons Creek, Slate Creek and the Little North Fork of the Clearwater. Marble Creek, N. Fork St. Joe River, Simmons Creek, Slate Creek and the Little North Fork of the Clearwater did appear to have potential

habitat. Harlequins were reported on Marble Creek and N. Fork St. Joe River.

Nesting occurred on the St. Joe River above Bacon Creek. A minimum of five pairs (four on the St. Joe, one on Marble Creek) produced at least one brood on the St. Joe National Forest.

Coeur d'Alene National Forest

A harlequin female was observed on the Coeur d'Alene River near Wren Creek. No broods were observed. No harlequins were observed in surveys of Jordan Creek.

Kaniksu National Forest

Harlequins were observed on E. Fork Lightning Creek, Gold Creek on Lake Pend Oreille, Gold Creek at Priest Lake, Granite Creek and N. Fork Granite Creek at Priest Lake, Hughes Fork, Moyie River and the Upper Priest River. No harlequins were observed in surveys of the Pack River, Grouse Creek, N. Fork Gold Creek on Lake Pend Oreille, Ball Creek, Boulder Creek, Boundary Creek, Cow Creek, Grass Creek, Smith Creek, or Trout Creek. The Pack River, Grouse Creek, N. Fork Gold Creek, Boulder Creek, Boundary Creek and Smith Creek did appear to have potential habitat in some reaches.

Nesting occurred on Gold Creek Lake Pend Oreille, Hughes Fork, N. Fork Granite Creek and Upper Priest River. A minimum of 17 pairs produced at least six broods on the Kaniksu.

Five of six females and two of four males marked on the

Priest Lake Ranger District in 1988 and 1989 returned in 1990. Movements of two marked females in 1989 and 1990 indicated that some of the same females use Upper Priest River and Hughes Fork.

Nez Perce and Bitterroot National Forests

Harlequin ducks were reported on the Selway River, Bargamin Cr. and Crooked River. No harlequins were observed in surveys of Bear Cr. and Whitecap Cr. on the Selway.

DISCUSSION

Population estimates and distribution

Although the accuracy of our survey methods is unknown, we feel that our minimum estimate of 30 pairs and 11 broods on 12 of the most productive streams in the state is close to the actual number on these streams, and comprised the majority of the population in northern Idaho during 1990. Surveying in or along streams appears to be fairly successful because of the fidelity of harlequins to streams (lack of movement between streams during surveys) and because of their reluctance to fly or leave the stream channel when disturbed.

Harlequin ducks were observed on a limited number of streams and data from marked birds indicates strong fidelity to these streams. Kuchel (1977) and Wallen (1987) observed similar philopatry and reported average return rates for adults of 50 - 52%. Average pair density in northern Idaho was less than 16% of average densities reported on streams in Glacier National Park,

Grand Teton National Park and Iceland (Bengston 1972, Kuchel 1977, Wallen 1987).

Productivity

Most pairs (71%) did not successfully raise a brood in 1990. Wallen (1987) reported an average of 62% of pairs in Grand Teton National Park were unsuccessful or nonbreeders. Dzinbal estimated 47-50% of pairs did not produce a brood in Prince William Sound, Alaska, and Bengston (1972) estimated 30% nonbreeding pairs in Iceland. Wallen (1987) felt that the percent of pairs breeding was related to the level of human disturbance, because streams with little access had higher productivity than an accessible stream with high human use.

Average brood size of 3 is somewhat less than that observed in 1988 (3.5) and 1989 (4.67), and less than that observed in Grand Teton (5.4) and Glacier National Parks (3.88) (Kuchel 1977, Wallen 1987). Estimated average hatching dates were 1 week later than 1989, and 2 weeks later than 1988 (Cassirer and Groves 1989, Wallen and Groves 1989), although there was considerable variability among streams and among individuals.

Annual variation in both adult numbers and productivity was observed. Three pairs were observed on N. Fork Granite Cr. in 1989 and two in 1990, and two pairs were observed on the Hughes Fork in 1989 and five in 1990. Broods occurred on three streams in 1990 that did not produce broods in 1989, and one stream that had a brood in 1989 did not produce a brood in 1990. Likewise,

no harlequins were observed on several streams that have had confirmed breeding in the past. Whether these streams are no longer used by harlequins cannot be determined without several years of surveys.

Habitat use

Harlequin ducks, particularly broods, were usually observed in relatively undisturbed habitat on stream reaches away from roads in northern Idaho. Within these stream reaches there was little evidence for selection for any of the characteristics measured. Adults did not make extensive use of meanders and shrubby habitats as reported by Kuchel (1977) and Wallen (1987). This may be because abundant low gradient habitat occurs in straight and curved forested sections of streams in northern Idaho. Broods were observed more commonly in meanders with immature overstory and vegetative overhang than adults, and were observed to use both vegetative overhang and woody debris for cover. Shrubby vegetation appeared to be important for broods, but was often associated with forest in a tree/shrub mosaic or as a minor component of a predominantly forested area. Riparian shrub cover may be more prevalent at nesting areas; only one brood observed was less than 2 weeks old. Older broods move downstream from nesting areas during the summer (Kuchel 1977, Wallen 1987, Cassirer and Groves 1989)

MANAGEMENT RECOMMENDATIONS

Since 90% of harlequin observations were in mature or old-growth areas on National Forests, it is likely that some of the drainages used by harlequins will be scheduled for timber harvest in the near future. To minimize impacts of timber harvest, riparian and adjacent areas on stream reaches used by harlequin ducks should be preserved, and roads and trails should be over 50 m from and out of sight of the stream. Human activity on and adjacent to the stream between April and September should be avoided.

Baseline data and monitoring are essential to evaluate the effects of timber harvest. This includes monitoring streams in protected areas as a control. We recommend systematically surveying all stream reaches used by harlequin ducks twice annually. Surveys should be conducted by floating or walking in the stream or by walking along the streambank. A pair survey should be conducted May 1-15 and a brood survey August 1-15 to monitor population levels and productivity. Additional surveys on streams that appear to contain suitable habitat or where harlequins have been reported should be conducted to clarify distribution.

ACKNOWLEDGEMENTS

Thanks to field assistant Kitty Russell, and to Kris and Bob Anderson, Tony Wright, Julie Hilty, Greg Kaltenecker and Chris Warren for help in the field. Cooperation of Forest Service biologists and personnel Tim Layser, Sandy Mack, Kurt Becker, Chris Lee, Sandy Jacobsen, Floyd Bleeker and Harry Jageman, and Fish and Game personnel Bill Carter, John Scott and Dwain Lowry is appreciated. Dan Davis, Paul Harrington and Sandy Jacobsen directed funding to the project. Vehicles were supplied by Bert Bowler (raft) and Paul Hanna (truck).

Many thanks to all the people who looked for and reported harlequin ducks.

This project was funded by the Clearwater and Idaho Panhandle National Forests under the U.S. Forest Service Challenge Cost Share Program, the Bonners Ferry Ranger District on the Idaho Panhandle National Forest and the Idaho Department of Fish and Game Nongame and Endangered Wildlife Program.

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APPENDIX A

Harlequin duck survey routes in northern Idaho, 1990

Harlequin duck survey routes and dates, 1990.

Stream	Date	Area	Surveyed from	Surveyed to	Type ¹
CLEARWATER NATIONAL FOREST					
<u>Powell Ranger District</u>					
Brushy Fork	6/13-15	Spruce Cr.- Crooked Fork	T38N,R16E,S21	T37N,R15E,S5	W
	7/4-6	"	T38N,R16E,S21	T37N,R15E,S5	W
Crooked Fork	4/25	Roaded area	T37N,R15E,S6	T37N,R14E,S27	R
	5/15	"	T37N,R15E,S6	T37N,R14E,S27	R
	6/13-15	Shotgun Cr.- Lochsa R.	T38N,R14E,S35	T37N,R14E,S34	W
	8/2	"	T38N,R14E,S35	T37N,R14E,S34	W
Lochsa	4/25	Crooked Fork- Lowell	T37N,R14E,S34	T32N,R7E,S4	R
	5/14-15	Crooked Fork- Boulder Cr.	T37N,R14E,S34	T35N,R9E,S27	F/R
	6/12-14	Crooked Fork- Lowell	T37N,R14E,S34	T32N,R7E,S4	F/R
	7/3-7/5	Crooked Fork- Boulder Cr.	T37N,R14E,S34	T35N,R9E,S27	F/R
	8/1-3	Crooked Fork- Boulder Cr.	T37N,R14E,S34	T35N,R9E,S27	W/R
Spruce Cr.	6/13	1 mile above Brushy Fork	T38N,R16E,S27	T38N,R16E,S21	W
	7/4	Road 373- Brushy Fork	T38N,R17E,S19	T38N,R16E,S21	W
White Sands	4/25	above Cabin Cr.- Lochsa	T37N,R14E,S25	T37N,R14E,S34	W
	5/13	1 mi. below Colt Cr.- Lochsa	T36N,R15E,S23	T37N,R14E,S34	W
	6/13	Cabin Cr.- Lochsa	T37N,R14E,S25	T37N,R14E,S34	W
	7/4	Below Heather Cr.- Colt Cr.	T36N,R16E,S27	T36N,R15E,S26	W
	8/2	5 mi.- Lochsa	T36N,R15E,S9	T37N,R14E,S34	W

¹ W=Walked in or along stream, R=Surveyed from vehicle on road, F=Floted in raft or inner tube

Harlequin duck survey routes and dates, 1990, cont'd.

Stream	Date	Area	Surveyed from	Surveyed to	Type
<u>North Fork Ranger District</u>					
Cayuse Cr.	8/4	Never Again Flats- Kelly Cr.	T38N,R11E,S8	T39N,R11E,S24	W/F
Kelly Cr.	5/16-18	Middle Fork bridge- N. Fork Clearwater	T39N,R13E,S6	T39N,R10E,S18	W/R
	7/7	Moose Cr.- N. Fork Clearwater	T39N,R11E,S16	T39N,R10E,S18	R
	8/4-5	Hanson Meadows- N. Fork Clearwater	T39N,R12E,S26	T39N,R10E,S18	W/R
N. Fork Clearwater	5/16-17	Kelly Cr.- Orogrande Cr.	T39N,R10E,S18	T38N,R8E,S8	R
	7/7-8	Vanderbilt Cr.- Kelly Cr.	T41N,R11E,S7	T39N,R10E,S18	W/R
	8/6-7	Niagara Cr.- Kelly Cr.	T42N,R11E,S30	T39N,R10E,S18	W/R
Vanderbilt Cr.	7/10	Chamberlain Mdws.- N. Fork Clearwater	T42N,R10E,S32	T41N,R11E,S7	W
COEUR D'ALENE NATIONAL FOREST					
<u>Wallace Ranger District</u>					
Coeur d'Alene R.	6/3	Deer Cr.- Cathedral Rocks	T53N,R3E,S8	T53N,R3E,S20	W
	6/23	Dahlman Cr.- 3099 bridge	T54N,R2E,S29	T53N,R2E,S4	W
	7/1	3099 bridge- Big Hank	T53N,R2E,S4	T52N,R3E,S29	F
	8/22	3099 bridge- Teepee Cr.	T53N,R2E,S4	T53N,R3E,S31	W
Jordan Cr.	6/3	above 403 bridge- Coeur d'Alene R.	T53N,R3E,S16	T53N,R3E,S17	W
	7/23	Lost Fork- Coeur d'Alene R.	T53N,R3E,S15	T53N,R3E,S17	W
	8/22	403 bridge- Coeur d'Alene R.	T53N,R3E,S16	T53N,R3E,S17	W

¹ W=Walked in or along stream, R=Surveyed from vehicle on road, F=Floted in raft or inner tube

Harlequin duck survey routes and dates, 1990, cont'd.

Stream	Date	Area	Surveyed from	Surveyed to	Type
KANIKSU NATIONAL FOREST					
<u>Priest Lake Ranger District</u>					
Gold Cr.	5/22-27	Hemlock Cr.- Hughes Fork	T38N,R45E,S12	T63N,R5W,S10	W
	6/29	Helmer Cr.- Hughes Fork	T38N,R45E,S2	T63N,R5W,S10	W
	8/14	Hemlock Cr.- Hughes Fork	T38N,R45E,S12	T63N,R5W,S10	W
Granite Cr.	4/28	Huff Lake- S. Fork Granite	T37N,R45E,S2	T62N,R5W,S30	W
	5/23	Huff L.- bridge above Kerr L.	T37N,R45E,S2	T61N,R5W,S2	W
	6/30	Stagger Inn- 302 bridge	T38N,R45E,S26	T62N,R5W,S28	W
	8/15	"	T38N,R45E,S26	T62N,R5W,S28	W
Hughes Fork	4/26-27	Jackson Cr. Tr.- Upper Priest R.	T64N,R5W,S33	T63N,R5W,S13	W
	5/24	"	"	"	W
	6/29	"	"	"	W
	8/14	"	"	"	W
Upper Priest	4/27	Snow Creek- 1013 bridge	T64N,R5W,S26	T63N,R5W,S2	W
	5/25-26	Continental Cr.- 1013 bridge	T65N,R5W,S14	"	W
	6/28	Falls-1013 bridge	"	"	W
	8/13	"	"	"	W

¹ W=Walked in or along stream, R=Surveyed from vehicle on road, F=Flolated in raft or inner tube

Harlequin duck survey routes and dates, 1990, cont'd.

Stream	Date	Area	Surveyed from	Surveyed to	Type
<u>Bonnars Ferry Ranger District</u>					
Ball Cr.	6/2	Spanish Cr.- below Swede Cr.	T63N,R2W,S34	T63N,R1W,S20	W
Boulder Cr.	6/2	427 bridge- Pouch Cr.	T60N,R2E,S17	T61N,R2E,S33	W
	6/2	Clifty Cr.- McGinty Cr.	T61N,R2E,S34	T61N,R3E,S32	W
	7/18	427 bridge- Gaging sta.	T60N,R2E,S17	T61N,R3E,S32	W
Boundary Cr.	6/1	Blue Joe Cr. Rd- 2450 bridge	5428600 UTMN 620200 UTME	5427800 UTMN 513000 UTME	R
	8/17	Grass Cr.- Kootenai R.	5427500 UTMN 517800 UTME	T65N,R1W,S7	W
Cow Cr.	7/18	above 2545 bridge- Smith Cr.	T64N,R3W,S5	T64N,R3W,S1	W
Grass Cr.	6/1	above Search Cr.- Boundary Cr.	T64N,R4W,S3	5427500 UTMN 517800 UTME	W
Moyie River	5/31	Eastport- Moyie Falls	T65N,R2E,S10	T62N,R2E,S11	F
	7/16	Eastport-1 mi. above Eileen dam	T65N,R2E,S10	T63N,R2E,S25	F/W
	8/16	"	T65N,R2E,S10	T63N,R2E,S25	F/W
Smith Cr.	5/30	above W. Fork- 2443 bridge	T64N,R3W,S34	T64N,R3W,S1	W
	7/17	below Bear Cr.- West Side Rd.	T64N,R3W,S3	T65N,R2W,S26	W
Trout Cr.	5/29	S. of Trout L.- 2425 bridge	T63N,R2W,S15	T63N,R2W,S12	W

¹ W=Walked in or along stream, R=Surveyed from vehicle on road, F=Floted in raft or inner tube

Harlequin duck survey routes and dates, 1990, cont'd.

Stream	Date	Area	Surveyed from	Surveyed to	Type
<u>Sandpoint Ranger District</u>					
Gold Cr.	5/6	Substation Rd.- Lake PDO	T53N,R1W,S10	T53N,R1W,S3	W
	6/22	"	"	"	W
	7/13	"	"	"	W
	8/23	"	"	"	W
N. Gold Cr.	6/22	above power line- Lake PDO	T53N,R1W,S2	T53N,R1W,S3	W
	7/13	278 bridge- Lake PDO	T53N,R1W,S1	T53N,R1W,S3	W
Grouse Cr.	7/14	Trail 355- Wylie Cr.	T59N,R2E,S18	T59N,R1E,S15	W
E. Fork Lightning Cr.	5/7	Thunder Cr.- Lightning Cr.	T57N,R4E,S23	T57N,R3E,S32	W
	6/22	"	"	"	W
	7/14	"	"	"	W
	8/23	Char Cr.- Lightning Cr.	T57N,R3E,S27	T57N,R3E,S32	W
Pack River	5/7	Zuni Cr.- Tavern Cr.	T61N,R2W,S29	T59N,R2W,S11	R
	7/15	McCormick Cr.- Tavern Cr.	T60N,R2W,S5	T59N,R2W,S11	W
NEZ PERCE NATIONAL FOREST					
<u>Selway Ranger District</u>					
Bear Cr.	5/4-6	Wahoo Cr.- Selway River	T32N,R15E,S24	T31N,R13E,S16	W
BITTERROOT NATIONAL FOREST					
<u>West Fork District</u>					
Whitecap Cr.	5/27-29	below Cliff Cr.- Selway River	T30N,R15E,S12	T29N,R14E,S8	W

¹ W=Walked in or along stream, R=Surveyed from vehicle on road, F=Floted in raft or inner tube

Harlequin duck survey routes and dates, 1990, cont'd.

Stream	Date	Area	Surveyed from	Surveyed to	Type
ST. JOE NATIONAL FOREST					
<u>Avery Ranger District</u>					
Beaver Cr.	6/26	Bad Bear Cr.- St. Joe R.	T43N,R8E,S37	T43N,R9E,S8	W
Little N. Fork Clearwater	8/24	Montana Cr.- Foehl Cr.	T43N,R6E,S28	T42N,R6E,S23	W
Loop Cr.	5/5	above Cliff Cr.- N. Fork St. Joe	T46N,R6E,S11	T46N,R6E,S7	R
Marble Cr.	5/1	DaVeggio bridge- St. Joe	T44N,R3E,S9	T45N,R5E,S13	R
	7/12	McGuire Cr.- St. Joe R.	T43N,R3E,S2	T45N,R5E,S13	W/R
	8/21-22	below Duplex Cr. St. Joe R.	T43N,R3E,S1	T45N,R5E,S13	W
N. Fork St. Joe	5/5	Moon Cr.- St. Joe R.	T47N,R5E,S28	T45N,R5E,S14	R
Slate Cr.	8/20	Daisy Gulch- St. Joe R.	T45N,R4E,S34	T45N,R4E,S10	W
Simmons Cr.	6/25	Washout Cr.- St. Joe R.	T44N,R10E,S32	T44N,R8E,S24	W
St. Joe R.	5/1-4	Bean Cr.- Marble Cr.	T42N,R9E,S12	T45N,R5E,S17	W/R
	6/23-26	Aqua Cr.- Conrad Crossing	T43N,R10E,S30	T44N,R8E,S14	W/F
	7/9	Red Ives- Gold Cr.	T43N,R9E,S20	T44N,R8E,S14	R
	7/11	Bluebells Cr.- Aqua Cr.	T43N,R10E,S26	T43N,R10E,S30	W
	8/20	Brokenleg Cr.- Marble Cr.	T42N,R9E,S10	T45N,R5E,S17	W/R

¹ W=Walked in or along stream, R=Surveyed from vehicle on road, F=Floted in raft or inner tube

APPENDIX B

Habitat data sheet and definitions of measurements taken at harlequin observations and systematically along streams; 1990

HARLEQUIN DUCK HABITAT DATA FORM

DATE _____ STREAM _____ OBSERVER _____

HARLEQUIN
OBSERVATION? Y N TYPE _____ ACTIVITY _____

CIRCLE ONE CIRCLE ONE CIRCLE UP TO TWO

HABITAT SUBSTRATE BANK
COMPOSITION

PO POOL	CL CLAY	TR TREES
RI RIFFLE	SA SAND	SH SHRUB
RU RUN	GR GRAVEL	GF GRASS/FORB
PW POCKETWATER	CO COBBLE	MO TREE/SHRUB MOSAIC
GL GLIDE	BO BOULDER	BE BEDROCK
RA RAPID	BE BEDROCK	SA SAND
BA BACKWATER		SI SILT
		GR GRAVEL
		DE DEBRIS

OVERSTORY CHANNEL TYPE HUMAN ACCESS

SE SEEDLING	ME MEANDER	AD ADJACENT
SA SAPLING	BR BRAIDED	NE NEAR
PO POLE	ST STRAIGHT	AC ACCESSIBLE
IM IMMATURE	CU CURVED	IN INACCESSIBLE
MA MATURE		
OG OLD-GROWTH		

CIRCLE AS APPROPRIATE

TYPE OF HUMAN DEBRIS / 10 M
ACTIVITY ENTER # OF EACH TYPE

BO BOATING	BR BRIDGE _____	LOAFING SITES/10M _____
RO ROAD	CB COLLAPSED BR. _____	ISLANDS _____
FI FISHING	RA RAMP _____	STREAM WIDTH (M) _____
HI HIKING	DR DRIFT _____	OVERSTORY SPP. _____
NO NONE		

VEGETATIVE OVERHANG Y N BANK UNDERCUT Y N

UTMN _____ UTME _____

T _____ R _____ S _____ 1/4 _____

COMMENTS _____

HABITAT

28

POOL- deep slow water areas, created by obstructions such as boulders or logs.

RIFFLE- shallow water areas where the water surface is influenced by the stream bottom, (whitewater).

RUN- deeper than a riffle, no whitewater but velocity greater than .3 m / sec., too fast to be a pool.

POCKETWATER- a run or riffle with boulders (> 30 cm in diameter), which create numerous small pools.

GLIDE- run areas with velocities < .3 m / sec.

RAPID- deep water, but water surface still influenced by stream bottom and/or streambank, (whitewater).

BACKWATER- slow water area out of the main stream channel.

SUBSTRATE

GRAVEL- .2-7 cm, (.1"-3")

COBBLE- 8-30 cm, (3"-12")

BOULDER- >30 cm, (>12")

OVERSTORY

SEEDLING- 1-10 yrs old, < 4.5' tall.

SAPLING- 10-40 yrs old, > 4.5' DBH < 5".

POLE- 40-70 yrs old, DBH 5"-9".

IMMATURE- 70-100 yrs old, DBH 9"-14".

MATURE- 100-160 yrs old, DBH 14"-20"

OLD GROWTH- over 160 yrs old or DBH > 20"

CHANNEL TYPE

MEANDER- channel follows sinuous curves, deep pools separated by shallow riffles, appears to shift slightly during peak flows.

BRAIDED- channel located in flat bottomed valley, midstream bars occur and divided the stream into several intersecting and shifting channels.

STRAIGHT- stream channel linear, structurally controlled by "V" shaped valley. No movement of channel during peak flows.

CURVED- stream channel curves or zig-zags more abruptly than a meander. Channel structurally controlled by a "V" shaped valley, no movement during peak flows.

HUMAN ACCESS

ADJACENT- established area of human activity maintained within 10 m.

NEAR- established area of human activity maintained within 10-50m.

ACCESSIBLE- >50m from human activity, accessible by boat or trail.

INACCESSIBLE- >50m from human activity, inaccessible by boat or trail.

WOODY DEBRIS

BRIDGE- log across stream.

COLLAPSED BRIDGE- log across stream, submerged in the middle of the stream.

RAMP- one end of log in the stream, the other on the bank.

DRIFT- log floating in stream.

LOAFING SITE- rocks or log in the stream completely surrounded by water, suitable for resting sites.

VEGETATIVE OVERHANG- vegetation extending over stream within 12" of the water surface.

Habitat categories and definitions, 1990

STREAM HABITAT

Pool- deep slow water areas.

Riffle- shallow water areas where the water surface is influenced by the stream bottom (whitewater).

Rapid- deep water but water surface still influenced by stream bottom and/or streambank, (whitewater).

Run- deeper than a riffle, no whitewater but velocity greater than 0.3 m / sec., too fast to be a glide or pool.

Pocketwater- a run or riffle with boulders (> 30 cm in diameter) which create numerous small pools.

Glide- run areas with velocities < 0.3 m / sec.

Backwater- slow water area out of the main stream channel.

SUBSTRATE

Silt, Sand, Gravel (0.2-7 cm), **Cobble** (8-30 cm), **Boulder** (> 30 cm), **Bedrock**.

BANK COMPOSITION- Composition of both streambanks

Trees, Shrubs, Grass/forb, Tree/shrub mosaic, Bedrock, Sand, Silt, Gravel, Boulder, Woody debris.

OVERSTORY

Seedling- 1-10 yrs old, < 1.4 m tall, **Sapling-** 10-40 yrs old, > 1.4 m tall, dbh < 13 cm, **Pole-** 40-70 yrs old, dbh 13-23 cm, **Immature-** 70-100 yrs old, dbh 24-36 cm, **Mature-** 100-160 yrs old, dbh 37-51 cm, **Old Growth-** over 160 yrs old or dbh >51 cm.

CHANNEL TYPE

Straight- stream channel linear, structurally controlled by a "V" shaped valley. No movement of channel during peak flows.

Curved- stream channel curves or zig-zags more abruptly than a meander. Channel structurally controlled by a "V" shaped valley, no movement during peak flows.

Meander- channel follows sinuous curves, deep pools separated by shallow riffles, appears to shift slightly during peak flows.

Braided- channel located in flat-bottomed valley, midstream bars occur and divide the stream into several intersecting and shifting channels.

HUMAN ACCESS

Adjacent- established area of motorized human activity within 10 m.

Near- established area of motorized human activity within 50 m.

Accessible- > than 50 m from established area of human activity, accessible by boat or trail.

Inaccessible- > than 50 m from established area of human activity, not accessible by boat or trail.

Habitat categories and definitions, 1990 cont'd.

LOAFING SITE- Rocks or logs completely surrounded by water suitable for resting sites.

Debris, Loafing sites and islands counted within 10 m of harlequin observation or systematic habitat transect.

STREAM WIDTH- Estimated wetted width.

GRADIENT- Estimated off 1:24000 topographic maps.

VEGETATIVE OVERHANG- vegetation over the stream within 30 cm of the water surface.

APPENDIX C
Trapping record 1990

Trapping record, 1990.

Date	Creek	Age Sex	Band No.	Nasal Marker	Culmen length (mm)	Weight (gm)	Wing length (cm)
5/6	Gold Cr. L. Pend Oreille	AHYM paired	805-90235	L- Black R- Red ovals	27.1	635	190

APPENDIX D

Harlequin duck observations
in northern Idaho 1990.

Harlequin duck observations, northern Idaho 1990.

Date	Stream	Type	UTM N	UTM E	TRS
5/24	Gold Cr. (PriestL.)	pair	5406000	499200	T63N,R5W,S17,SE
5/24	Gold Cr. (Priest L.)	1 male	5407400	501600	T63N,R5W,S10,SW
6/29	Gold Cr. (Priest L.)	1 female	5406400	499600	T63N,R5W,S17,NE
5/24	Gold Cr. (Priest L.)	pair	5407450	501550	T63N,R5W,S10,SW
5/23	N. Fork Granite	1 male	5397500	494700	T37N,R45E,S2,SW
5/23	N. Fork Granite	pair 90213 & 90214	5395500	495800	T37N,R45E,S12,SW
6/30	N. Fork Granite	1 female 3 imm.	5400150	495350	T62N,R45E,S35,NE
8/15	Granite Creek	1 female 3 imm.	5386900	509100	T61N,R4W,S17,SE
4/26	Hughes Fork	pair 90203 & 90204	5409200	500700	T63N,R5W,S4
4/26	Hughes Fork	pair	5409250	500600	T63N,R5W,S4
4/26	Hughes Fork	pair	5407500	501400	T63N,R5W,S9
4/27	Hughes Fork	male	5405700	505500	T63N,R5W,S15
4/27	Hughes Fork	pair	5406900	502850	T63N,R5W,S15
5/24	Hughes Fork	pair 90203 & 90204	5409800	500400	T63N,R5W,S4,NW
5/24	Hughes Fork	pair	5407250	502100	T63N,R5W,S10,SW
6/29	Hughes Fork	1 female 90218	5407300	502100	T63N,R5W,S10,SW
6/29	Hughes Fork	1 female	5407400	501900	T63N,R5W,S10,SW

Harlequin duck observations N. Idaho, 1990, cont'd.

Date Stream	Type	UTM N	UTM E	TRS
8/14 Hughes Fork	1 female 3 imm. 90204	5407000	502500	T63N,R5W,S15,NE
8/14 Hughes Fork	1 imm.	5406700	504500	T63N,R5W,S14,NE
8/14 Hughes Fork	1 female 2 imm. 90202	5407500	501600	T63N,R5W,S10,SW
5/24 Boulder Cr. (Priest L.)	1 male	5406900	503750	T63N,R5W,S14,NW
4/27 Upper Priest	2 males 1 female 90219	5408800	503600	T63N,R5W,S2,SW
4/27 Upper Priest	pair 90218	5409100	503400	T63N,R5W,S2,SW
5/25 Upper Priest	1 male	5409900	502850	T63N,R5W,S3,NE
5/25 Upper Priest	1 male	5409850	502900	T63N,R5W,S2,NW
5/25 Upper Priest	1 male	5410400	502500	T64N,R5W,S34,SE
5/25 Upper Priest	1 male	5410600	502600	T64N,R5W,S34,SE
5/26 Upper Priest	1 male	5421800	501500	T65N,R5W,S27,SW
5/26 Upper Priest	1 male	5423850	502300	T65N,R5W,S22,NE
6/28 Upper Priest	1 female	5419100	501600	T64N,R5W,S10,NW
6/28 Upper Priest	1 female	5413300	502700	T64N,R5W,S27,NE
6/28 Upper Priest	1 female 90230	5414800	502800	T64N,R5W,S22,NE
6/28 Upper Priest	1 female	5415300	502800	T64N,R5W,S15,SE
8/13 Upper Priest	1 female 3 imm. 90230	5409000	503400	T63N,R5W,S2,SW
5/31 Moyie	pair	5403800	562600	T63N,R2E,S25,NW
5/31 Moyie	1 male	5407600	562300	T63N,R2E,S12,SW
4/24 Lochsa	pair	5148500	656100	T36N,R12E,S9

Harlequin duck observations N. Idaho, 1990, cont'd.

Date	Stream	Type	UTM N	UTM E	TRS
4/24	Lochsa	2 males 1 female	5145000	646750	T36N,R11,S21
4/25	Lochsa	pair	5153000	669300	T37N,R13E,S35,NW
4/25	Lochsa	pair	5135800	633300	T35N,R9E,S24,NE
4/25	Lochsa	2 males 1 female	5148500	656100	T36N,R12E,S9
5/14	Lochsa	pair	5147500	655200	T36N,R12E,S17,NE
5/14	Lochsa	3 males 1 female	5148900	662900	T36N,R12E,S7,NE
5/14	Lochsa	pair	5153300	673900	T37N,R14E,S32,NW
5/14	Lochsa	1 male	5147600	654500	T36N,R12E,S17,NW
5/15	Lochsa	1 male	5136700	634500	T35N,R10E,S18,SE
5/15	Lochsa	pair	5145200	646700	T36N,R11E,S21,SE
6/14	Lochsa	1 female	5148600	662200	T37N,R13E,S7,SE
6/14	Lochsa	pair	5148900	662900	T37N,R13E,S7,NE
7/05	Lochsa	1 female	5153200	674100	T37N,14E,S32,NW
7/05	Lochsa	1 female	5148500	656700	T37N,R12E,S9,SE
7/05	Lochsa	1 female	5146900	649800	T36N,R12E,S14
4/25	Crooked Fork	1 male	5158300	679900	T37N,R14E,S11,SE
8/06	N. Fork Clearwtr	4 imm.	5193500	645800	T41N,R11E,S21,SW
8/07	N. Fork Clearwtr	2 imm.	5192300	646200	T41N,R11E,S28,NW
8/07	N. Fork Clearwtr	3 imm.	5190600	645700	T41N,R11E,S33,NW
8/06	N. Fork Clrwtr	3 imm.	5192300	646700	T41N,R11E,S28,NE
5/01	St. Joe	1 female	5233250	586800	T45N,R5E,S17,NE

Harlequin duck observations, N. Idaho, 1990 cont'd.

Date	Stream	Type	UTM N	UTM E	TRS
5/02	St. Joe	pair	5223500	620500	T44N,R8E,S14,SE
5/03	St. Joe	Pair	5205100	626900	T42N,R9E,S16,NE
5/03	St. Joe	Pair	5204600	624700	T42N,R9E,S17,NW
6/23	St. Joe	1 female	5207600	624800	T42N,R9W,S5,SW
6/24	St. Joe	1 female	5204500	624600	T42N,R9E,S17,NW
6/26	St. Joe	1 female	5208600	623800	T43N,R9E,S31,SE
6/26	St. Joe	1 female	5216300	623600	T43N,R9E,S7,NE
7/09	St. Joe	1 female	5221300	621400	T43N,R8E,S25,NW
7/01	Coeur d'Alene	1 female	5312300	561600	T53N,R2E,S11,NW
5/07	E. Fork Lightning	pair	5346600	569000	T57N,R3E,S32,NE
5/06	Gold Cr. L. Pend Oreille	pair 90235	5312700	541200	T54N,R1W,S3,SE
6/22	Gold Cr. L. Pend Oreille	1 male	5312950	540900	T53N,R1W,S3,SE
7/13	Gold Cr. L. Pend Oreille	3 females 3 imm. 90217	5312000	541400	T53N,R1W,S3,SE
8/23	Gold Cr. L. Pend Oreille	1 female 3 imm.	5313000	540900	T53N,R1W,S3,NW

APPENDIX E

Harlequin duck reports in northern Idaho, 1990.

Harlequin duck reports on the Clearwater National Forest, 1990.

Date	River	Location	Observation	Observer	TRS
4/13	Lochsa	near Wendover	1 male	Steve Williams	T37N,R13E,S36
4/29	Lochsa	confluence of White Sands & Crooked Fork	3 males 1 female	Don & Vicki Davis	T37N,R14E,S34
4/30	Lochsa	confluence of White Sands & Crooked Fork	2 males	Don & Vicki Davis	T37N,R14E,S34
April	Lochsa	milepost 138	1 male	Peter Kitts	T35N,R11E,S21
5/6	Lochsa	milepost 129.5	pair	Steve Lanigan	T35N,R10E,S8
5/7	Lochsa	milepost 154.4	pair	Steve Nadeau	T36N,R13E,S5
5/12	Lochsa	Bald Mountain	1 male	Bob Anderson	T35N,R10E,S8
5/13	Lochsa	Badger Cr.	pair	Bob Anderson	T37N,R13E,S33
5/23	Lochsa	Cold Storage Cr.	1 male	Chuck/Suzi Campbell	T37N,R13E,S35
5/23	Lochsa	Warm Springs Creek	3 males	Chuck/Suzi Campbell	T36N,R13E,S7
5/24	Lochsa	milepost 140-141	pair	Barry Miller	T36N,R11E,S14
5/25	Lochsa	milepost 126-127	1 male	Barry Miller	T35N,R10E,S18
5/26	Lochsa	milepost 155-156	1 male	Brian Jamison	T37N,R13E,S33
6/3	Lochsa	1/4 mi. below Wendover C.G.	pair	Peter Kitts	T37N,R13E,S35

Harlequin duck reports on the Clearwater National Forest, 1990,
cont'd.

Date	River	Location	Observation	Observer	TRS
6/10	Lochsa	Boulder Cr.	1 female	Winifred Hepburn	T35N,R9E,S27
6/13	Lochsa	Wendover island	1 male	Dennis Elliot	T37N,R13E,S35
7/2	Lochsa	Warm Springs Creek	2 females	Keith Carlson	T36N,R13E,S7
7/23	Lochsa	confluence of White Sands & Crooked Fork	1 female 4 ducklings	Joe Vergemeer	T37N,R14E,S34
7/24	Lochsa	confluence of White Sands & Crooked Fork	1 female 4 ducklings	Joe & Pat Vergemeer	T37N,R14E,S34
8/4	Lochsa	Colt killed island	1 female 4 ducklings	Stu Hoyt	T37N,R14E,S33
4/14	Crooked Fork	near Devoto cedar grove	1 male	Steve Nadeau	T37N,R14E,S22
6/13	N. Fork Spruce Cr.	14 mile marker	1 female 5-6 ducklings	Shirley Nelson	T38N,R16E,S25
7/4	White Sands	2 mi. from mouth	1 female	Kim Ragotzkie	T37N,R14E,S36

Harlequin duck reports on the Nez Perce National Forest, 1990.

Date	River	Location	Observation	Observer	TRS
6/16	Selway River	1 mi. below Indian Creek	1 female	Jack Herbert	T29N,R14E,S32
6/17	Selway River	Indian Cr. Campsite	1 male	Monte Miles	T28N,R14E,S6
6/18	Selway River	between Shearer and Bear Cr.	pair	Marnie Traub	T31N,R13E,S21
6/29	Selway River	Selway Lodge	1 female	Barry Miller	T31N,R13E,S28
6/29	Selway River	Cougar Flats	1 male	Barry Miller	T31N,R13E,S28
6/30	Selway River	Rattlesnake Bar	2 females	Barry Miller	T32N,R13E,S32
4/21-23	Bargamin Creek	about 1 mile above Salmon R.	1 male	Gary Loomis	T26N,R10E,S24
7/1	Crooked River	2 miles above mouth	1 male	Fred/Lean Foreman	T29N,R7E,S36

Harlequin duck reports on the Kaniksu National Forest, 1990.

Date	River	Location	Observation	Observer	TRS
5/2	Moyie	1/4 mi. above Meadow Cr. CG	1 male	Gary Koehler	T63N,R2E,S12
5/26	Moyie	below Deer Cr.	pair	Philip Sweet	T63N,R2E,S24
April	Bear Paw Creek		pair	Jay Penniman	T33N,R46E
5/9	N. Fork Granite	just above bridge	pair	Roger Bonneau	T37N,R45E,S2
5/10	N. Fork Granite	below Tillicum Creek	pair	Riley Hawdon	T37N,R45E,S12
5/26	Upper Priest River	above 1013 bridge	1 female	Lisa Hawdon	T63N,R5W,S2
5/29	Hughes Fork	200 ft. below culvert	pair	Art Corothers	T63N,R5W,S10
5/29	Hughes Fork	50 ft. above 1013 bridge	pair	Art Corothers	T63N,R5W,S10
7/13	N. Fork Gold Cr.	mouth	2 females	Cliff Gentry	T53N,R1W,S3

Harlequin duck reports on the St. Joe National Forest, 1990.

Date	River	Location	Observation	Observer	TRS
4/9		St. Marie sewage lagoon	pair	John Myre	T46N,R2W,S15
5/2	Marble Creek	milepost 5	pair	Jack Johnston	T45N,R3E,S26
5/30	Marble Creek	milepost 12	pair	Waverly Reeves	T44N,R3E,S9
6/9	N. Fork St. Joe	Squaw creek	1 male	Rex McHail	T46N,R5E,S36
4/15	St. Joe	below Avery 4.5 milepost	pair	Kurt Becker	T45N,R4E,S17
5/16	St. Joe	Simmons creek	pair	Lynette Myre	T44N,R8E,S24
5/31	St. Joe	E. of Turner Flat	pair	Gary Reynolds	T45N,R6E,S13
6/10	St. Joe	below Avery 2.25 milepost	pair	Jay Rotella	T45N,R4E,S13
7/1	St. Joe	near Tumbledown Cr.	2 females	Mike Branigan	T44N,R8E,S9
7/23	St. Joe	below Bacon Cr. trail	1 female 6 ducklings	Mark Hill	T42N,R9E,S16

APPENDIX F

Results and analysis of habitat measurements, 1990

Table 1. Used and available habitats along stream reaches used by harlequin ducks, 1990.

Stream habitat $X^2 = 28.197$, $P < 0.001$

	Riffle	Run	Rapid	Pocketwater	Glide	Pool	Backwater
Available n=142							
Percent	52.8	9.9	2.1	20.4	8.5	6.3	0
Used n=73							
Percent	39.7	26.0	13.7	13.7	1.4	4.1	1.4
Confidence interval a = 0.05	24.5- 54.8	12.4- 39.6	3.0- 24.4	3.0- 24.4	0- 5.0	0- 10.3	0- 5.0
Selection	o	+	o	o	-	o	o

Substrate $X^2 = 2.647$, $P = 0.754$

	Cobble	Boulder	Gravel	Sand	Clay	Bedrock
Available n=142						
Percent	73.2	16.9	6.3	2.8	0.7	0
Used n=73						
Percent	75.3	15.1	5.5	2.7	0	1.4

Overstory age $X^2 = 6.880$, $P = 0.044$

	Old growth	Mature	Immature	Pole	Sapling
Available n=142					
Percent	18.3	55.6	21.1	4.9	0
Used n=73					
Percent	23.3	65.8	8.2	1.4	1.4
Confidence interval a=0.05	10.2- 36.4	51.1- 80.5	0- 16.7	0- 5.0	0- 5.0
Selection	o	o	-	o	o

¹ o = no selection, + = selection for, - = selection against

Used and available habitats along stream reaches used by harlequin ducks, 1990, cont'd.

Bank Composition $X^2 = 20.2$, $P = 0.009$

	Trees	Tree/shrub mosaic	Shrub	Grass/forb	Gravel
Available n=284 Percent	27.8	24.6	22.2	13.4	5.6
Used n=146 Percent	26.0	30.8	11.6	5.5	11.0
Confidence interval $\alpha=0.05$	12.4- 39.6	16.5- 45.1	1.7- 21.5	0- 12.6	1.3- 20.7
Selection	o	o	-	-	o

Bank Composition cont'd.

	Boulder	Bedrock	Debris	Silt
Available n=284 Percent	0.7	3.2	2.5	0
Used n=146 Percent	0	2.7	2.1	1.3
Confidence interval $\alpha=0.05$	0- 3.1	0- 7.7	0- 4.4	0- 3.5
Selection	o	o	o	o

Channel type $X^2 = 6.88$ $P = 0.076$

	Straight	Curved	Meander	Braided
Available n=142 Percent	43.7	16.2	33.1	7.04
Used n=73 Percent	50.7	26.0	19.2	4.1

¹ o = no selection, + = selection for, - = selection against

Used and available habitats along stream reaches used by harlequin ducks, 1990, cont'd.

Human access $X^2 = 3.66$, $P = 0.300$

	Inaccessible	Accessible	Near	Adjacent
Available n=142 Percent	44.4	15.5	19.7	20.4
Used n=73 Percent	50.7	17.8	9.6	21.9

Vegetative overhang $X^2 = 0.028$, $P = 0.867$

	No	Yes
Available n=142 Percent	56.3	43.7
Used n=73 Percent	57.5	42.5

Bank Undercut $X^2 = 2.337$, $P = 0.126$

	No	Yes
Available n=142 Percent	56.3	43.7
Used n=73 Percent	67.1	32.9

Woody debris within 10 m $X^2 = 0.984$, $P = 0.611$

	None	One	>One
Available n=142 Percent	56.3	15.5	28.2
Used n=73 Percent	61.6	16.4	21.9

Used and available habitats along stream reaches used by harlequin ducks, 1990, cont'd.

Loafing sites within 10 m $X^2 = 14.626$, $P = 0.001$

	None	One	>One
Available n=142 Percent	9.9	8.4	81.7
Used n=73 Percent	20.6	21.9	57.5
Confidence interval $\alpha = 0.05$	8.1- 33.1	9.1- 34.7	42.2- 72.8
Selection	o	+	-

Island within 10 m $X^2 = 0.919$, $P = 0.632$

	No	Yes
Available n=142 Percent	82.4	17.6
Used n=73 Percent	79.5	20.5

Forest type $X^2 = 8.559$, $P = 0.014$

	Cedar/hemlock	Spruce/fir	Cottonwood
Available n=142 Percent	64.1	32.4	3.5
Used n=73 Percent	82.2	17.8	0
Confidence interval $\alpha = 0.05$	70.4- 94.1	5.9- 29.7	0- 1.0
Selection	+	-	-

¹ o = no selection, + = selection for, - = selection against

Used and available habitats along stream reaches used by harlequin ducks, 1990, cont'd.

Stream width $X^2 = 12.187$, $P = 0.0002$

	1-9 m	10-19 m	> 19 m
Available n=142 Percent	32.4	35.2	32.4
Used n=73 Percent	16.4	27.4	56.2
Confidence interval $\alpha = 0.05$	4.9- 27.9	13.6- 41.2	40.8- 71.6
Selection	-	o	+

¹ o = no selection, + = selection for, - = selection against

Table 2. Comparison of brood and adult habitat use, 1990.

Stream habitat $X^2 = 30.539$, $P < 0.001$

	Riffle	Run	Rapid	Pocketwater	Glide	Pool	Backwater
Adults n=60							
Percent	41.7	31.7	16.7	5.0	1.7	1.7	1.7
Broods n=13							
Percent	30.8	0	0	53.8	0	15.4	0
Confidence interval a = 0.05	18.0- 43.6	0- 2.8	0- 2.8	40.0- 67.6	0- 2.8	5.4- 25.4	0- 2.8
Difference ¹	o	-	-	+	o	+	o

Substrate $X^2 = 8.282$, $P = 0.082$

	Cobble	Boulder	Gravel	Sand	Bedrock
Adults n=60					
Percent	78.3	15.0	3.3	3.3	0
Broods n=13					
Percent	61.5	15.4	15.4	0	7.7

Channel type $X^2 = 6.076$ $P = 0.108$

	Straight	Curved	Meander	Braided
Adults n=60				
Percent	56.7	25.0	15.0	3.3
Broods n=13				
Percent	23.1	30.8	38.5	7.7

¹ o = no difference, + = brood observed more often in habitat, - = broods observed less often in habitat

Comparison of brood and adult habitat use, 1990, cont'd.

Bank Composition $X^2 = 7.62, P > 0.10$

	Trees	Tree/shrub mosaic	Shrub	Grass/forb	Gravel
Adults n=120 Percent	32.5	30.0	13.3	4.2	13.3
Broods n=26 Percent	34.6	34.6	15.4	11.5	0

Bank composition cont'd.

	Bedrock	Debris	Silt
Adults n=120 Percent	3.3	1.7	1.7
Broods n=26 Percent	0	3.9	0

Overstory age $X^2 = 5.986, P = 0.200$

	Old growth	Mature	Immature	Pole	Sapling
Adults n=60 Percent	21.6	70.0	5.0	1.7	1.7
Broods n=13 Percent	30.8	46.2	23.1	0	0

Human access $X^2 = 3.997, P = 0.262$

	Inaccessible	Accessible	Near	Adjacent
Adults n=60 Percent	46.7	20.0	8.3	25.0
Broods n=13 Percent	69.2	7.7	15.4	7.7

Comparison of brood and adult habitat use, 1990, cont'd.

Vegetative overhang $X^2 = 2.355$, $P = 0.125$

	No	Yes
Adults n=60 Percent	61.7	38.3
Broods n=13 Percent	38.5	61.5

Bank Undercut $X^2 = 1.263$, $P = 0.261$

	No	Yes
Adults n=60 Percent	70.0	30.0
Broods n=13 Percent	53.8	46.2

Woody debris within 10 m $X^2 = 7.678$, $P = 0.022$

	None	One	>One
Adults n=60 Percent	68.3	11.7	20.0
Broods n=13 Percent	30.8	38.4	30.8
Confidence interval $\alpha = 0.05$	18.0- 43.6	24.9- 51.9	18.0- 43.6
Difference ¹	-	+	o

¹ o = no difference, + = brood observed more often in habitat, - = broods observed less often in habitat

Comparison of brood and adult habitat use, 1990, cont'd.

Loafing sites within 10 m $X^2 = 8.035$, $P = 0.018$

	None	One	>One
Adults n=60 Percent	25.0	25.0	50.0
Broods n=13 Percent	0	7.7	92.3
Confidence interval $\alpha = 0.05$	0- 2.8	0.3- 15.1	65.6- 100.0
Difference ¹	-	-	+

Island within 10 m $X^2 = 1.601$, $P = 0.206$

	No	Yes
Adults n=60 Percent	76.7	23.3
Broods n=13 Percent	92.3	7.7

Forest type $X^2 = 1.106$, $P = 0.293$

	Cedar/hemlock	Spruce/fir
Adults n=60 Percent	80.0	20.0
Broods n=13 Percent	92.3	7.7

¹ 0 = no difference, + = brood observed more often in habitat, - = broods observed less often in habitat

Comparison of brood and adult habitat use, 1990, cont'd.

Stream width $X^2 = 8.457$, $P = 0.015$

	1-9 m	10-19 m	> 19 m
Adults n=60			
Percent	11.7	25.0	63.3
Broods n=13			
Percent	38.5	38.5	23.0
Confidence interval $\alpha = 0.05$	25.0- 52.0	25.0- 52.0	11.3- 34.7
Difference	+	o	- .

¹ o = no difference, + = brood observed more often in habitat, - = broods observed less often in habitat

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