

INITIATING A PILOT STUDY TO EVALUATE A LONG-TERM HARLEQUIN DUCK BREEDING POPULATION MONITORING STUDY IN WYOMING'S GRAND TETON NATIONAL PARK



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HARLEQUIN DUCK POPULATION MONITORING GRAND TETON NATIONAL PARK

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Photo caption: A pair of Harlequin Ducks (*Histrionicus histrionicus*) in Grand Teton National Park.
Photo by Ken Wright.

1.0 Introduction

The Harlequin Duck (*Histrionicus histrionicus*) is a relatively small duck species that breeds in northern boreal regions of eastern Canada, the Pacific Northwest of the U.S. and Canada, Alaska, and the Rocky Mountain regions. The breeding habitat requirements of the Harlequin Duck consist of clear, rapidly flowing streams and rivers, supporting macro-invertebrates. Harlequin Ducks forage by diving for invertebrates and insect larvae attached to streambed rocks in turbulent waters (Robertson and Goudie 1999).

The population status for North American Harlequin Ducks is regionally variable. Harlequin ducks are considered a sensitive species in Eastern Canada and the Rocky Mountain region. Populations in Alaska and the Pacific Northwest appear relatively stable (Wiggins 2005). Within the U.S., harlequins breed exclusively in Alaska, Washington, Oregon, Idaho, Montana, and Wyoming. It should be noted that harlequins formerly bred in California and Colorado, but have since disappeared from this portion of their range from unknown causes.

Harlequin Ducks in Wyoming breed exclusively in mountain streams and rivers in the northwestern portion of the state. Wyoming's harlequin duck population is unique, representing the extreme southern and eastern extent of the western North American breeding population. The Harlequin Duck is one of the rarest breeding birds in the state of Wyoming and its current breeding range appears to be limited to the Grand Teton National Park and the Bridger-Teton and Shoshone National Forests. This area is the southeastern most breeding population of this torrent habitat specialist in western North America. It is a designated "Species of Greatest Conservation Need" (Wyoming State Wildlife Action Plan 2010) and little information is available on survivorship, migration movements and winter habitat use areas. These data are needed to manage for the long-term viability of this species in Wyoming.

2.0 Objectives

The overall goal of the project was to evaluate the potential for developing a longer-term Harlequin Duck monitoring study to better understand the population status in Wyoming and risks they face outside of the nesting season including the use of satellite telemetry. The short-term objectives were to begin studying the breeding ecology of Wyoming's harlequins through the capture and attachment of uniquely color coded leg bands on breeding pairs found in Grand Teton National Park. This process would allow biologists to begin tracking individuals from year to year and potentially link their breeding areas and wintering sites. Grand Teton NP was selected due to the presence of known breeding harlequins in areas accessible by boat and foot, near Jackson Lake. Information collected from this study is intended for state and federal agencies to use in the conservation of the Harlequin Duck through the protection and management of its breeding and wintering areas.

3.0 Study Area

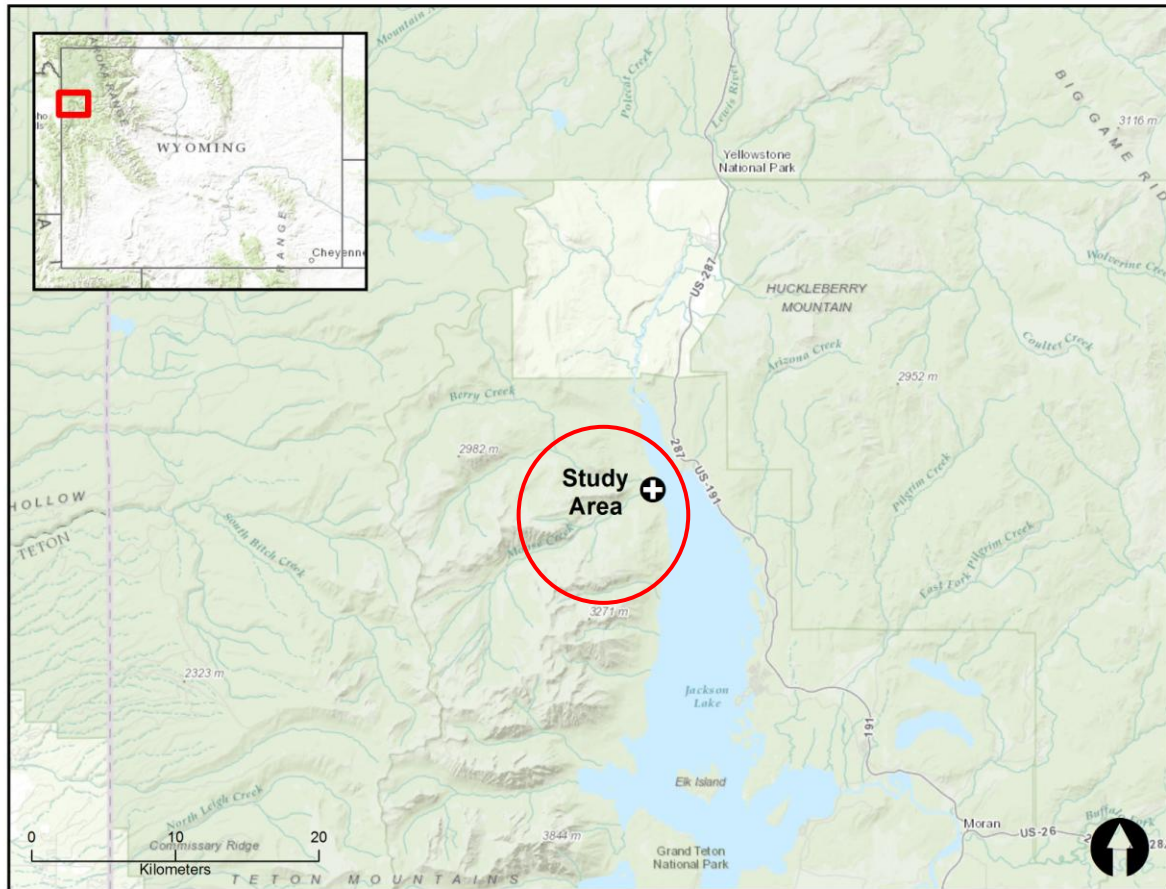
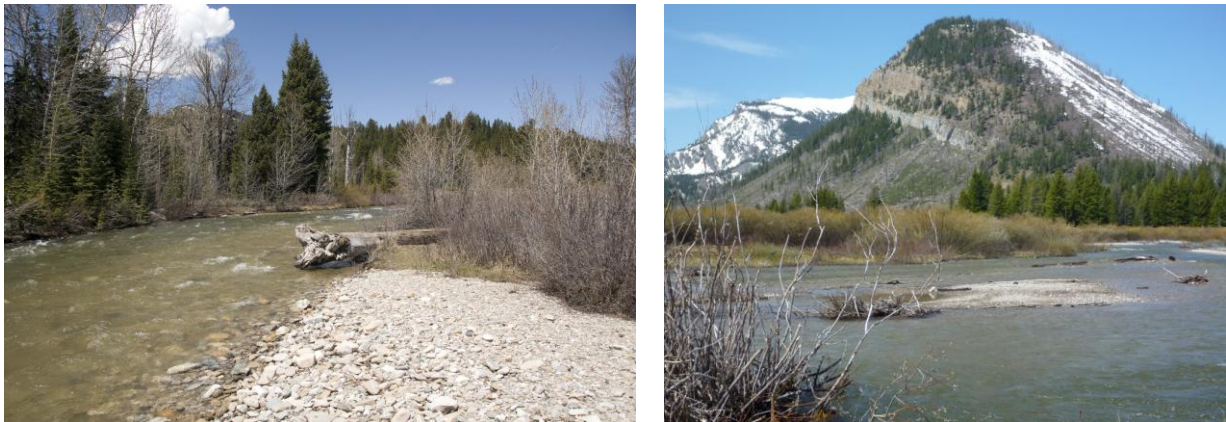


Figure 1. General study area within Grand Teton National Park.

4.0 Methods

4.1 Stream Surveys and Capture

In late May 2014, we visited known Harlequin Duck breeding streams in Grand Teton National Park. These streams are located on the northwestern shores of Jackson Lake (Figure 1). We accessed the areas initially by canoe and then walked the edges of streams to locate harlequin duck pairs and un-paired individuals (Figures 2 and 3).



Figures 2 and 3. Habitat of Harlequin Duck breeding streams in Grand Teton National Park.

When a Harlequin Duck was observed, we scouted sections of the stream above and below to look for an adequate location to trap the bird. Harlequin ducks were trapped using a 100mm mesh, 12 or 18-meter long, 4-panel mist net (Avinet Inc.). The net was stretched across the stream and secured with a pole and guy lines at opposite ends (Figures 4 and 5). Two people remained hidden at each end of the net, while 2-3 people walked the shorelines of the stream to flush the ducks into the net. Netted birds were immediately extracted from the net, banded, measured, sampled, and released unharmed near the location they were initially observed prior to capture attempts.



Figures 4 and 5. The field team stretching a mist net across a stream to capture Harlequin Ducks.

Each duck was fitted with a uniquely coded color leg band, especially designed for Harlequin Ducks. The selection of the plastic band color and coding was coordinated through a western North America Harlequin Duck banding database, in an effort to not duplicate bands already deployed in other locations. Attaching uniquely coded color leg bands to harlequins has been used extensively in other western states to document survival rates and individuals returning to the breeding areas and specific streams in following years, as well as determining their specific Pacific coast wintering locations

through the re-sighting of banded harlequins. Harlequin Ducks tend to winter in near shore coastal areas, and are frequently observed by biologists and birding groups. Re-sightings of color banded harlequins on wintering areas have provided extremely valuable information on the links between breeding and wintering sites.

4.2 Tissue Sampling

A small blood sample and feathers were collected from each captured harlequin. Laboratory analysis of blood samples can be used for screening of potentially harmful environmental contaminants, such as mercury, that harlequins may be exposed to and accumulated while on their breeding streams. Biodiversity Research Institute (BRI) operates a wildlife mercury laboratory (<http://www.briloon.org/our-science-services/bri-consulting-services/bri-laboratory>) and has vast experience analyzing and interpreting levels of mercury in wildlife, including Harlequin Ducks. Blood samples have been archived and are available to research partners interested in studying population genetics and comparing results to other Rocky Mountain harlequin breeding populations. Many of the surrounding USA states and Canadian provinces with breeding harlequins have conducted similar breeding area capture and handling efforts, and would serve as valuable comparisons in the assessment of Wyoming's harlequin population.

All handling and sampling procedures followed an approved Institutional Animal Care and Use Committee (IACUC) protocol, through the University of Southern Maine (IACUC #041114-103).

5.0 Results and Discussion

5.1 Breeding Stream Surveys

During May 22-25, biologists from Biodiversity Research Institute (BRI) and the Wyoming Game and Fish Department (WGFD), visited known Harlequin Duck breeding streams along the northwest side of Jackson Lake (Figure 1). We walked the edges of Lower Berry Creek and Moose Creek to identify Harlequin Ducks. We identified a pair of Harlequin Ducks on each of the two streams, and a single female on Lower Berry Creek (Table 1 and 2) (Figure 6).



Figure 6. Harlequin breeding stream survey extent and harlequin duck sighting locations.

We surveyed a total of 2.12 km of stream shoreline among Lower Berry Creek and Moose Creek, 0.8 km and 1.32 km, respectively. We identified a total of five Harlequin Ducks (2 pairs and 1 single female) between the two streams. A breeding pair and a single female were observed on Lower Berry Creek and a pair on Moose Creek (Tables 1 and 2).

Table 1. Harlequin duck daily sightings, May 2014.

Site	Date	Pair	Single	Latitude	Longitude
Lower Berry	May 23	1	0	43.998288	-110.713421
Lower Berry	May 24	1	0	43.997998	-110.711802
Lower Berry	May 24	0	1 (F)	43.995045	-110.709637
Lower Berry	May 25	1	1	43.997712	-110.711521
Moose Creek	May 23	1	0	43.99301	-110.714641
Moose Creek	May 24	0	0	~	~

Table 2. Total number of individual harlequin ducks observed, May 2014.

Site	Paired adults	Unpaired (F)	Unpaired (M)	Totals
Lower Berry	2	1	0	3
Moose Creek	2	0	0	2
Totals	4	1	0	5



Figure 7. A pair of Harlequin Ducks on Lower Berry Stream. Photo Ken Wright.

Historic Harlequin Duck breeding pair surveys on GTNP streams by park biologists have been sporadic, due to funding. Ground surveys were conducted in 1985 and 1986 (Wallen 1987) and again in 1993 (Wallen 1993), as part of a harlequin population and breeding stream habitat study. In more recent years, the WGFD have conducted aerial surveys of historic harlequin breeding streams via helicopter every 5 years to fulfill objectives in the State Wildlife Action Plan for this species (WGFD 2010). Helicopter surveys were conducted in 2002, 2007, and 2012 (Oakleaf and Patla 2012). WGFD intends to continue helicopter surveys every five years. These surveys provide the only consistent harlequin breeding pair monitoring effort for the park. Additional surveys are occasionally conducted, when funding is available for such efforts.

The numbers of breeding pairs annually occupying GTNP streams appear variable, and likely linked to survey method detection rates or current water conditions. Often times, ground and aerial surveys must be conducted several times to detect the total number of pairs and broods of harlequins utilizing a breeding stream (Oakleaf et al. 2003). Spring water levels are highly influenced from the winter’s snowpack. In years of low spring water level conditions, harlequins may delay utilizing upstream areas

and remain on larger open waters near outlets of breeding streams, such as the Snake River and Jackson Lake (Oakleaf and Patla 2012).

For our survey efforts in 2014, we walked the shoreline of Lower Berry Creek and Moose Creek multiple times, and only over the duration of three days (May 23-25). Our harlequin observations were lower than stream counts conducted in previous years. Stream crossings were challenging, due to warm weather rapidly melting the winter’s heavy snowpack, causing rapid stream flows.

5.2 Capture and Banding

Of the five total harlequins identified during stream surveys, three (60%) were successfully captured (a pair and single female), all on Lower Berry Creek. A Harlequin Duck pair was located on Moose Creek and an effort was made to capture them the following day, but could not locate the pair.

Each Harlequin Duck was weighed, measured, banded with a metal U.S. Fish and Wildlife Service band, color banded with a plastic orange band with black lettering, and blood and feather samples collected.

Table 3. Summary of captured and banded harlequin ducks, 2014.

Date	Age	Sex	Location	Band #	Color band (left leg)	Status
5/24/14	AHY	F	Lower Berry	02401	J5	single
5/24/14	AHY	M	Lower Berry	02402	JE	paired
5/24/14	AHY	F	Lower Berry	02403	JP	paired

Each captured harlequin was released in the same location it was captured. All three banded harlequins were observed together on Lower Berry Creek the day following handling. As expected, all three birds appeared in good health and showed no ill effects from capture and handling.

5.3 Contaminants Screening

We analyzed a blood sample from each captured bird to determine and evaluate total Hg concentrations accumulated by Harlequin Ducks breeding among Grand Teton NP streams. Concentrations ranged from 0.166 -0.228 (ppm, wet weight) (Table 4). The overall mean was 0.198 (ppm,ww).

Table 4. Mercury concentrations in blood of harlequin ducks, 2014.

Date	Age	Sex	Location	Band #	Hg (ppm, wet weight)
5/24/14	AHY	F	Lower Berry	02401	0.1997
5/24/14	AHY	M	Lower Berry	02402	0.2283
5/24/14	AHY	F	Lower Berry	02403	0.1661

To the best of my knowledge, literature does not exist which documents blood Hg concentrations in harlequins from their North American breeding streams. Only a few studies have documented blood Hg concentrations in Harlequins Ducks, and have been exclusively sampled on their wintering and molting areas in Alaska (Heard et al. 2008; BRI unpubl. data). The three Harlequin Ducks sampled from Grand

Teton NP, contained lower concentrations than harlequins sampled from two different wintering areas in Alaska (Heard et al., 2008; BRI unpubl. Data) and higher concentrations than molting harlequins sampled from Alaska (BRI unpubl. data). Wintering harlequins sampled in Prince William Sound, Alaska contained a mean blood Hg concentration of 0.82 ± 0.32 (0.27 – 1.26) (ppm, wet weight) (Heard et al., 2008). Harlequins wintering at Unalaska Island, Alaska, contained a mean blood Hg concentration of 0.31 ± 0.19 (0.10 – 0.92) (ppm, wet weight) (BRI unpubl. data). Harlequins sampled during their molting period at Kodiak Island, Alaska, contained a mean blood Hg concentration of 0.04 ± 0.02 (0.01 – 0.09) (ppm, wet weight) (BRI unpubl. data).

A more robust sample size is needed to properly assess the concentrations of Hg accumulated by Harlequin Ducks breeding in GTNP streams. A comparison of Hg concentrations of harlequins sampled from freshwater breeding streams from other North American populations would be valuable in interpreting our GTNP results.

5.4 Recommendations

- **Expand upon WFGD’s harlequin breeding stream survey efforts in GTNP:** Currently, aerial surveys are conducted by WFGD every 5 years. Aerial surveys provide a valuable snapshot of the GTNP harlequin breeding population, but could be underestimating the current population by inadvertently missing pairs and does not detect broods present later in the season. The continuation of the aerial surveys, coupled with multiple on the ground stream surveys during the breeding season would provide the best resolution for properly assessing the current population of GTNP Harlequin Ducks.
- **Continue color-marking breeding pairs:** Harlequin Ducks are a long-lived species, and are typically breeding and wintering site faithful. The continuation of marking individual harlequins on GTNP streams is needed to monitor and evaluate annual survivorship and provides an opportunity to connect breeding populations to wintering locations through color band re-observations.
- **Compare current breeding stream habitat to historic data:** A previous GTNP harlequin breeding study was conducted in the 1980s (Wallen 1987) and breeding stream habitat characteristics were collected. Collecting current breeding stream habitat information (i.e., stream dimensions, invertebrate sampling, water quality) and comparing to historic data can help evaluate GTNP harlequin breeding stream integrity.
- **Identify post-breeding requirements:** The post-breeding movements, timing, and habitat requirements of Harlequin Ducks breeding on GTNP streams is unknown. Satellite telemetry is a commonly used and effective technique utilized to track annual movements of birds, including Harlequin Ducks. Data can be used to identify the specific locations and timing of important molting, migration, and wintering sites. These data are necessary in conserving GTNP’s Harlequin Duck population.

5.5 Acknowledgements

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Field Team: (left to right) Ken Wright, Carl Brown, Lucas Savoy, Kathleen Savoy, Vince Spagnuolo, Susan Patla. Photo by Ken Wright.

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Appendix 1. Morphometric measurements of harlequin ducks handled in Grand Teton National Park, 2014.

Date	Site	Band #	Age	Sex	Wing chord (mm)	Tail (mm)	Weight (g)	Tarsus Length (mm)	Head Length (mm)	Bill Length (mm)	Bill Width (mm)	Culmen Length (mm)
5/24/2014	Lower Berry Creek	1125-02401	AHY	F	188	85	461	36.8	73.1	29.7	15.9	26.1
5/24/2014	Lower Berry Creek	1125-02402	AHY	M	200	77	615	38.5	79.9	32.7	15.8	26.1
5/24/2014	Lower Berry Creek	1125-02403	AHY	F	187	84	565	36.3	74.3	29.3	15.1	24.7