Habitat utilization by harlequin ducks in Grand Teton National Park
by Richard L Wallen

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management
Montana State University

Abstract:
A study of the Pacific harlequin duck (Histrionicus histrionicus) was conducted during 1985 and 1986 to gather baseline data on its relative abundance and distribution in Grand Teton National Park. Population and habitat data were largely gathered on four streams. Ninety-one birds were banded during the two summers; 38 adults were marked with nylon nasal discs. Twelve adults (52%) and one young of the year banded in 1985 returned in 1986. Fifteen broods were located and a chronology of plummage development was determined. Most birds hatched between 20 July and 6 August, with brood sizes ranging from three to seven (mean 5.4). Age at first flight was approximately 42 days. Six hens were fitted with poncho mount radio transmitters but no nest sites were located. Sixty-two percent of all hens identified did not hatch a brood. Stream sections most suitable for harlequin breeding had gradients less than one degree and contained dense perennial shrubs lining the banks. Conflicts between harlequin breeding activities and human use of the park were identified and management recommendations were made to reduce human disturbances to harlequin ducks.

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Richard Lee Wallen

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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June 10, 1987
Date

Graduate Dean

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Date 22 MAY 87

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ABSTRACT

A study of the Pacific harlequin duck (Histrionicus histrionicus) was conducted during 1985 and 1986 to gather baseline data on its relative abundance and distribution in Grand Teton National Park. Population and habitat data were largely gathered on four streams. Ninety-one birds were banded during the two summers; 38 adults were marked with nylon nasal discs. Twelve adults (52%) and one young of the year banded in 1985 returned in 1986. Fifteen broods were located and a chronology of plummage development was determined. Most birds hatched between 20 July and 6 August, with brood sizes ranging from three to seven (mean 5.4). Age at first flight was approximately 42 days. Six hens were fitted with poncho mount radio transmitters but no nest sites were located. Sixty-two percent of all hens identified did not hatch a brood. Stream sections most suitable for harlequin breeding had gradients less than one degree and contained dense perennial shrubs lining the banks. Conflicts between harlequin breeding activities and human use of the park were identified and management recommendations were made to reduce human disturbances to harlequin ducks.

INTRODUCTION

The harlequin duck (Histrionicus histrionicus) is classified in the tribe Mergini with Histrionicus being a monotypic genus. This species is considered to be intermediate morphologically between the eiders (Somateria sp. and Polysticta stelleri) and the oldsquaw (Clangula hyemalis) and the scoters (Melanitta sp.) (Delacour and Mayr 1945, Johnsgard 1960, 1978, Bellrose 1980). The harlequin was probably involved in the speciation of the Mergini tribe and it's adaptive radiation to fresh-water niches.

Harlequins on their breeding range have been likened to the South American torrent duck (Merganetta armata) and the New Zealand blue duck (Hymenolaimus malacorhynchos) (Bengtson 1966, Kuchel 1977). All three show affinities to turbulent streams in remote mountain areas, striking color patterns of the plumage and an insectivorous diet. However, the harlequin is not closely related to either species taxonomically (Todd 1979) and their ecological similarities are probably a result of convergence (Kuchel 1977).

The harlequin duck was named for the nuptial plumage of the drake. The latin word "histrio" means stage player (Kortwright 1943). The term "harlequin" came from a poor Italian character who wore a costume made from patches

donated by his friends. These birds have a variety of other common names as well, the lord and lady, mountain duck, rock duck and sea mouse.

The species is easily identified. The drake with its' contrasting color patterns of rust, gray, blue, black and white, is considered by some to have the most bizarre plumage of all waterfowl. The hen, with it's cryptic coloration, is similar in plumage to the scoters and bufflehead hens, although the beak, the speculum, and the white patches on the head differentiate harlequins from others.

The species is currently grouped into two populations based on the ocean in which they winter (Pacific or Atlantic). Their winter range closely corresponds to the most nutrient rich coastal areas of the northern hemisphere. The Pacific population is by far the largest (Todd 1979, Bellrose 1980, Palmer 1976), possibly because the Labrador Duck (Camptorhynchus labradorius) once occupied the north Atlantic Ocean and may have competed with the harlequin for a portion of its range.

The breeding habitat of harlequins has been studied at few locations within its range (Bengtson 1972, Kuchel 1977, Dzinbal 1982). Pair bonds are generally formed on the winter range prior to their migration to remote mountain streams where nesting occurs. The nesting habitat is largely confined to backcountry streams where dense overhead cover is

found. The drake will defend a small area around the hen, referred to as their individual distance (Kuchel 1977). This allows for an overlap of home ranges along streams which harbor numerous pairs.

Like many species of the waterfowl family, harlequins possess the ability to return to the same breeding areas in successive years (Bengtson 1972, Kuchel 1977). In order to find their remote breeding streams, harlequins may have evolved an atypical means of migration. Bengtson (1966) surmised that harlequins navigate up the rivers and streams to their breeding grounds swimming much of the way. This concept has been accepted by other authors due to a lack of direct research results (Kuchel 1977, Thompson 1985).

Bellrose (1980) noted that some subpopulations of waterfowl will make non-stop flights of 3,000 to 4,500 kilometers (km) during migration. The possibility that harlequins exhibit this behavior has not previously been postulated. This alternative to Bengtson's hypothesis appears likely in the wake of massive hydroelectric and irrigation development projects throughout the greater Columbia River basin. If the harlequins breeding in the Rocky Mountains exhibit this type of migratory behavior, they could winter anywhere throughout the known range of the Pacific population.

These small ducks have developed great proficiency at swimming and diving in swift water in search of food. While

on inland streams they feed on aquatic insects and algae using several techniques: diving into plunge pools, walking around riffles probing under and on submerged stones and swimming along the slower currents near the banks collecting benthic, drifting and surface invertebrates (Michael and Michael 1922, Cottam 1939, Bengtson 1966, Kuchel 1977). The single specimen preserved for the Montana State University Museum was found to have an esophagus full of aquatic insect larvae (J. Sparks pers. comm.).

Waterfowl conservation has recently been a topic of much concern. Habitat loss in the 20th century has been targeted as the primary cause of declining waterfowl populations (Bellrose 1980). The harlequin, because of their remote habitat preferences, has probably suffered the least from human destruction of habitat. Nevertheless, reports from Montana and Colorado show that these mountain ducks have vacated portions of their former range (Parkes and Nelson 1976, Thompson 1985).

Harlequin duck sightings in the Jackson Hole area date back to the Hayden expedition of 1860 (McCreary 1937). The species has been reported as a permanent resident in northwestern Wyoming, including Park and Teton counties and Yellowstone National Park (McCreary op. cit.). The first record of harlequins within the present day boundaries of Grand Teton National Park (GTNP) was from two birds shot below the outlet to Jackson Lake in 1907 (Palmer 1913).

Wildlife observation files in the park show 13 sightings between 1913 and 1983.

An initial survey of several streams in the park during 1984 produced 24 sightings (Wallen unpub. field notes). This early effort identified a minimum of 27 individual birds along six streams and the Snake River. This evidence contradicted the impression among biologists, naturalists and tourist literature (Follet 1976) that harlequins were rare in GTNP.

This study was conducted during the summers of 1985 and 1986. The goal was to gather sufficient information about this little known segment of the population to formulate proper management considerations in GTNP. The specific project objectives are as follows:

-Identify and characterize breeding and nesting habitat within GTNP

-Quantify the breeding chronology

-Identify feeding opportunities (benthic insects)

-Identify Park population sizes (birds/summer)

-Identify any human/harlequin conflicts

-Identify possible migration patterns to and from the study area

DESCRIPTION OF THE STUDY AREA

Location

Grand Teton National Park is located in northwestern Wyoming in Teton County and includes much of the valley referred to as Jackson Hole. The valley floor ranges from 1980 to 2135 meters (m) above sea level from south to north with the Teton range rising to an elevation of 4200 m along the western boundary. The park is bordered by John D. Rockefeller, Jr. (JDR) Memorial Parkway on the north, Targhee National Forest on the west, the Absaroka and Gros Ventre Mountain ranges on the east and the urbanization of Jackson, Wyoming along the south. Originally established in 1929 the park now encompasses 1325 km^2.

Breeding Areas

The breeding habitat of the harlequin is found along backcountry tributaries of the Snake River. Most streams in the park drain from the high peaks of the Teton Range (Figure 1). The highcountry valleys from which they drain are classic U-shaped hanging canyons cut by the glaciers of the Pleistocene period (Fryxell 1984). About a dozen small alpine glaciers remain. Avalanches and rockslides have occurred producing stairstep creeks in many of the canyons.

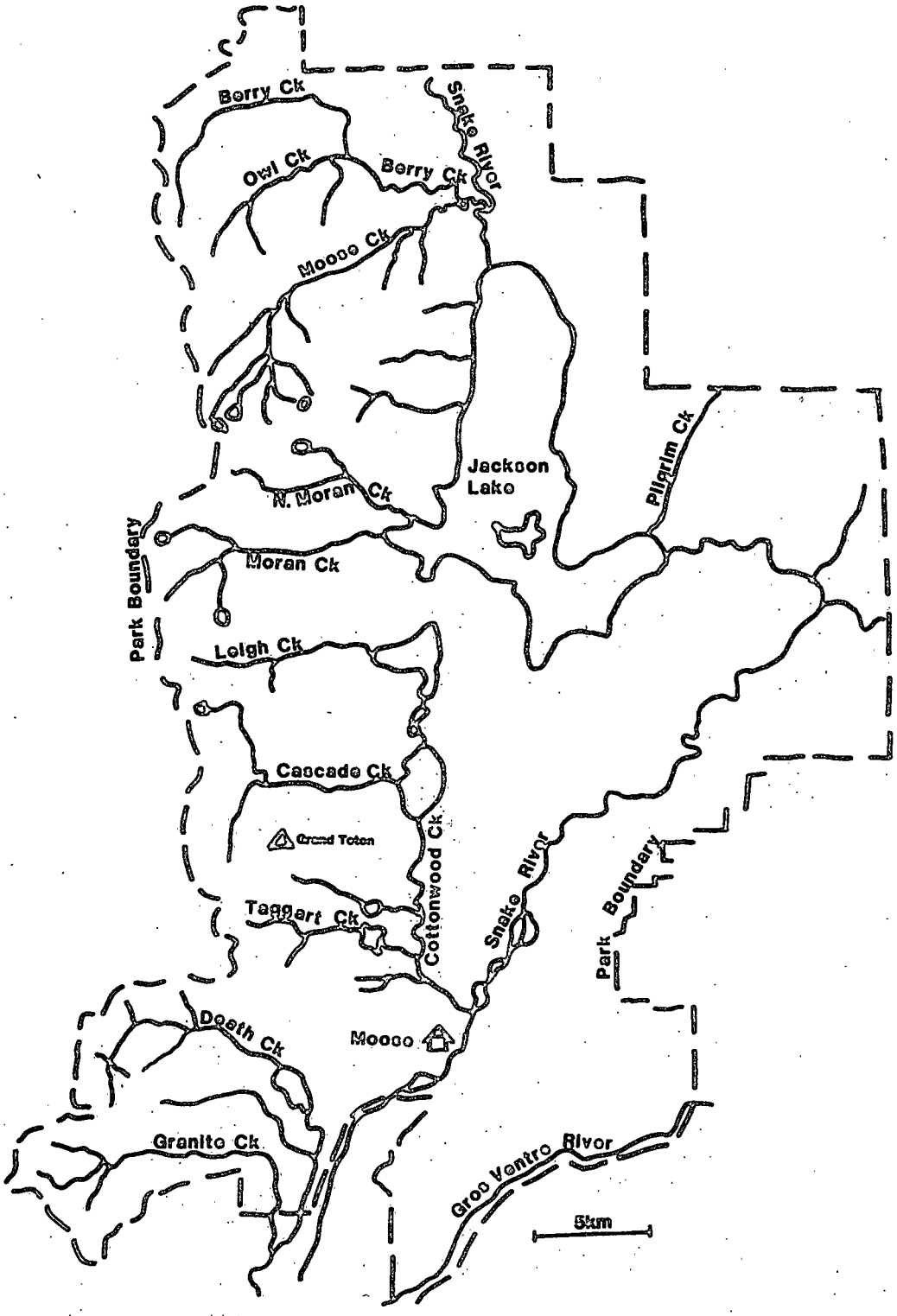

Figure 1. Major streams in Grand Teton National Park

Hynes (1970) points out that glacial streams are consistently turbid and low in temperature and oxygen. Stream sections which harbor harlequins are adequately removed from the glaciers to avoid these biological deficiencies. The primary streams of this study showed only a small increase in turbidity at high water and were clear sooner than the Snake River. Numerous openings in the forest canopy exist, allowing the water to warm sufficiently for filamentous algae to accumulate along several streams. These streams are fed primarily from snowmelt with about 30 percent (%) of the water coming from summer rains (Clark 1981). Willow (Salix spp.) and dogwood (Cornus sp.) are the dominant shrubs lining the banks while Engelmann spruce (Picea engelmannii) and subalpine fir (Abies lasiocarpa) dominate the overstory.

Purpose of the Park

Grand Teton National Park was established to protect the areas scenic values characterized by the Teton Range and Jackson Hole, and to preserve the native plant and animal life (Annon. 1985). This area is managed as a public park for the benefit and enjoyment of the people of the United States (Annon. 1986). Primary management objectives are:

-To manage all resources under the ecosystem concept, aimed to perpetuate natural systems and to establish ecologically sound thresholds of use.

-To manage all activities and uses to ensure compatibility with the preservation of park resources and the "high quality" visitor experience.

-To manage wildlife under conditions that are as natural and unrestrained as possible.

Eighty seven percent of the park land is managed as a natural zone with 45% of these lands being recommended for wilderness designation. This park is unique in that it contains eight grazing allottments, a water storage facility, an airport and a management oriented elk hunt.

Human Use

Human use of the park occurs year around, while the majority of the use occurs during the summer season (June through August). Recreational use encompasses all types of outdoor activities popular to the American public. Backpacking, horseback riding, fishing, boating and mountain climbing are activities that occur in and around the streams used by harlequins. Mean annual visitation for the two years of this study was 2.15 million people (range 2.13-2.18). This figure is down from a high of 4.1 million visitors in 1978, however visitation to the park appears to have stabilized during the past decade (GTNP unpub. files).

METHODS

Field Strategy

Based on information collected during a 1984 survey (Wallen unpub. field notes), searches for harlequins arriving on the study area were initiated along the Snake River beginning on 3 May 1985. On 24 May the search effort was shifted to backcountry tributaries of the Snake River. The remainder of the season was spent along these small streams in the Teton Range. Three to four days per week were spent in the field during May and June. After 17 June evenings and weekends were spent pursuing harlequins until 30 August. The 1986 field season lasted from 5 May until 20 September.

During 1985, the primary emphasis was on trapping and marking birds, evaluating telemetry techniques and identifying duck use and nesting areas. The 1986 season was used to concentrate on determining patterns of habitat use, a more intensive search for nests, feeding site examinations and collection of quantitative data pertaining to habitat use and availability.

In 1986, searches were made weekly along four primary streams: Granite Creek, Cascade Creek, Moose Creek and Berry Creek. When time allowed, surveys were periodically conducted along other streams to detect harlequin

occurrence. Death canyon was surveyed seven times while many of the other canyons received less than five visits throughout the study.

Observations

Birds were observed by hiking along streambanks and using binoculars and a spotting scope to collect information on the behavior and the identity of ducks. Snake River canoe trips were taken during May of each year to search for birds arriving on the study area.

Trapping

Adult birds were captured using a mist net with 10 centimeter (cm) mesh stretched across the stream with the bottom of the net at or just above the water surface. The ducks were driven towards the net and flushed from the water surface at 5 m from the net. Broods were captured by setting large rocks on the bottom of the net to secure it to the streambed and placing a second mist net of 5 cm mesh downstream. The hen and chicks 3 weeks of age or older would be caught in the larger mesh while the younger chicks would normally get through and tangle in the smaller mesh.

An unsuccessful attempt was made to catch birds along the Snake River with a decoy trap constructed of welded wire wrapped around a frame of 128 millimeter (mm) angle iron (Anderson, Sayler and Afton 1980). Wooden decoys were used

to lure the birds. These decoys were also used during netting operations to maneuver birds.

Marking

Adult birds were marked using nylon nasal discs of four shapes and eight colors (Lokemoen and Sharp 1985). Six adult hens were fitted with poncho mount transmitters weighing 13 grams (g) (Amstrup 1980, J. Montgomery and J. Toepfer pers. comm.). Birds captured in 1986 were measured using dial calipers and a Pesola scale (1000 g). The six measurements taken were: weight (g), total length (mm), culmen (mm), middle toe (mm), tarsus (mm) and wing (mm).

Habitat

Eight habitat parameters (Table 1) were recorded at each observation point. To assess habitat availability, these parameters were recorded at approximately 200 m intervals along the primary study streams. These data were statistically analyzed for utilization-availability at the 95% confidence level (Byers et al. 1984). Habitat and observation data from throughout the season have been combined.

Table 1. Habitat parameters used in evaluating each observation site and for availability of habitat along each stream (modified from Kuchel 1977)

Stream bank type
- vertical- > 45 degrees from horizontal
- horizontal- < 45 degrees from horizontal

Stream bottom- Dominant type
- bedrock
- mud
- sand
- pebbles 16-64 mm diameter
- cobbles 65-256 mm diameter
- boulders > 256 mm diameter

Streamside vegetation- Dominant type
- annual plants
- perennial shrubs
- trees

Streambank composition- Dominant type
- vegetation
- downed snags
- rip-rap
- bedrock
- cobbles

Channel type
- meander
- braided
- bedrock canyon

Availability of mid-stream loafing sites
- 0/ 10m
- 1-3/ 10m
- > 3/ 10m

Proximity of birds to human activities
- adjacent - maintained hiking trail within 10m of creek
- near - maintained hiking trail within 50m of creek
- away, accessible- unmaintained trail used by humans for access to the creek
- away, inaccessible- stream is inaccessible to humans via any kind of trail

Amount of human use of the area (numbers of people viewing the stream area per unit of time)
- heavy - > 10 people per day
- moderate - > 5 people per week
- little - 2-5 people per week
- none - < 5 people per month

Other observations of harlequins which were reported to Park biologists were investigated. If a positive identity was determined, via markers, the observation was used to keep track of movements. The habitat around these observations was measured if the observer was able to pinpoint the location.

Morphometry of Streams

Topographic maps (7.5 minute series) were used to estimate three morphometric features along all streams in the Teton Range; stream distance, elevation difference and drainage basin area. Distance was measured with a cartometer and used with the elevation differences to calculate the mean slope. Drainage basin areas were measured with a polar planimeter. Streams longer than 4.5 km were divided into smaller units based on elevation differences.

Stream Discharge

To monitor stream flow, a water bottle tied to a string was used to estimate water velocity (Robins and Crawford 1954). Discharge was calculated using surface width (m), mean depth (m), mean water velocity (m/second) and a coefficient of roughness (eight) (Hynes 1970). In 1986, mensurations were performed on the four primary study streams and one stream where harlequins were not found.

These measurements were tabulated in cubic meters per second (cms). Discharge measurements from two nonregulated streams in the valley were supplied by the Bureau of Reclamation, Minidoka Project office.

Invertebrate Sampling

Benthic invertebrates were collected with a kick sampler at riffle feeding sites along the four primary study streams. Samples were taken on a monthly basis from May until September 1986. An Ekman dredge was used on three occasions in the pond in lower Cascade Canyon. One stream, on which harlequins were not found, was sampled on three occasions during the summer. Notes were taken on relative abundance during collections. Invertebrates were preserved in the field in Kahle's solution and keyed to family or genus in the lab (Pennak 1978, Merritt and Cummins 1984).

Fecal material was collected while handling birds and preserved in 90% alcohol. This material was sorted under a dissecting microscope to try and identify remains. One trapping mortality occurred, allowing for a single esophageal examination.

RESULTS

Observations

This study produced 224 observations of harlequin ducks, 94% of which were along four backcountry streams. The number of birds individually identified on the study area are presented in Table 2. Several birds were known to frequent more than one location, but were included in the area in which they were most often observed.

Small groups of pairs and bachelor drakes arrived on the study area throughout May and early June. The only sighting below Moose along the Snake River occurred while attending the decoy trap on the night of 17 May 1985. When birds began arriving on the breeding streams the snowpack still covered the willow vegetation and human recreational use was at a minimum. The earliest sighting for each year occurred on 17 May 1985 and 5 May 1986.

Twenty-four observations of identifiable broods were recorded in 1986. From these observations, the chronology of plummage growth for juvenile harlequin ducks was determined (Table 3). Brood classifications followed those outlined by Gollop and Marshall (1954). When juveniles began flying they had grown to 95% of the weight of adult hens (540-560 g.). Forty percent of all broods which were

observed as class III birds were not accompanied by an adult. Backdating, by use of plummage development, shows that most birds on this study area hatched between 20 July and 6 August (Figure 2).

Table 2 Number and location of harlequin ducks identified in Grand Teton National Park in 1985 and 1986.

Streams	Adult males	Adult females	Juveniles	Broods	Total
Granite Ck.					
1985	2	2	6	1	10
1986	1	1	7	1	9
Cascade Ck.					
1985	5	6	0	0	11
1986	5	4	5	1	14
Moose Ck.					
1985	5	6	17	3	28
1986	5	7	21	4	33
Berry Ck.					
1985	4	7	15	3	26
1986	10	7	10	2	27
String Lk.					
1985	0	0	0	0	0
1986	2	0	0	0	2
Snake R.					
1985	1	0	0	0	1
1986	2	2	0	0	4
Total					
1985	17	21	38	7	76
1986	25	21	43	8	89