MONTANA COMMON LOON (GAVIA IMMER)
SUMMARY REPORT

2014

BIODIVERSITY RESEARCH INSTITUTE
innovative wildlife science

RICKETTS CONSERVATION FOUNDATION

MONTANACOMMON LOON (*GAVIA IMMER*) SUMMARY REPORT, 2014

SUBMITTED TO:

Chris Hammond
Montana Fish, Wildlife & Parks
490 N Meridian Road
Kalispell, MT 59901

SUBMITTED BY:

Allison Byrd, David Evers
Biodiversity Research Institute
276 Canco Road
Portland, ME 04103
(207-839-7600)

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The mission of Biodiversity Research Institute is to assess emerging threats to wildlife and ecosystems through collaborative research, and to use scientific findings to advance environmental awareness and inform decision makers.

To obtain copies of this report contact:
Allison Byrd
Biodiversity Research Institute
276 Canco Road
Portland, ME 04103
(207) 839-7600 x207
allison.byrd@briloon.org
www.briloon.org

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FRONT PHOTO: Kintla Lake, Glacier National Park, Montana. Photo by Allison Byrd.

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1.0 EXECUTIVE SUMMARY

Biodiversity Research Institute (BRI) has initiated the largest conservation study for the Common Loon (*Gavia immer*), a key indicator of aquatic integrity for lakes and near shore marine ecosystems, across North America. This initiative provides an opportunity to identify current major threats and create solutions that strengthen current populations and restore loons to their former breeding range. This study encompasses three focal regions: the West (Wyoming, Montana, Idaho, British Columbia, and Alberta); the Midwest (Minnesota); and the Northeast (Massachusetts, New Hampshire, and Maine). Partnered with Montana Fish, Wildlife and Parks (MFWP) and Montana Common Loon Working Group (MTCLWG), which includes representatives from agencies, tribes, non-profit organizations, industry, and landowners (full list of representatives in Hammond 2009), BRI is helping to assess the overall health and status of Montana's common loon population through surveys, banding efforts, and nonlethal sampling of blood, feathers, and abandoned eggs.

MFWP and MTCLWG members have been monitoring numerous lakes and managing loons in the state since the late 1980's. To support MTCLWG and MFWP, BRI oversaw banding efforts, assisted with lake monitoring, and performed limited fall surveys to check for chicks. Additionally, BRI collected data for a nationwide common loon health assessment study. Between MFWP and BRI, capture was attempted on 29 lakes, with successful capture of 6 adults (2 recaptures) and 11 chicks. Fall chick survival checks were performed on 24 lakes (16 territories) in northwestern Montana.

BRI initiated a comprehensive health study of common loons, which aims to establish normal health reference ranges for this species across North America. The health assessment will also illuminate the impacts of potential threats to loon health, such as infectious disease, fungal disease, persistent organic pollutants, and cyanotoxin analysis. Montana contributed samples from 8 chicks and 3 adults for this study.

Feathers and blood collected during the 2014 season, and eggs collected since 2009, were analyzed for mercury contamination. The mercury level of a feather collected from the remains of a deceased loon on Logging Lake in Glacier National Park exceeded lowest adverse effect levels in loons (Evers et al. 2008). Unfortunately, this high mercury feather was not the same feather commonly tested in other loons, so this result is somewhat without context.

BRI recommends the following in 2015: 1) tracking intra- and inter-seasonal movements of color-marked adults and sub-adults, 2) maintaining (or increasing) capture and monitoring efforts of adults and juveniles statewide, and 3) quantifying potential threats to loons (predators, invasive species, contaminants).

2.0 INTRODUCTION

Supported by a grant from the Ricketts Conservation Foundation (RCF), Biodiversity Research Institute (BRI) biologists, working with MTFWP and MTCLWG, will be addressing three major conservation components in the West over the next five years: (1) population assessments through surveys and habitat evaluations; (2) specialized outreach and conservation initiatives; and, (3) identification of research needs and restoration options, including the potential translocation of chicks.

Common Loons (*Gavia immer*) breed on lakes in the forested regions of Alaska, Canada, and the most northern portions of the continental United States. In the western United States, loons historically nested as far south as northern California, southern Idaho, and central Wyoming (Evers 2007). Currently, there are 105 territorial pairs in the western United States. Most of the breeding pairs are located in Montana (75 pairs, 68.2%) while Washington and Wyoming have 18 (16.4%) and 16 (14.5%) territorial pairs, respectively. Idaho had a breeding pair as recently as 2013 (a member of that breeding pair was lost to probable lead poisoning in 2014).

The Conservation Plan for the Common Loon in Montana as a species with the greatest conservation need (Hammond 2009). Common Loons are known to breed in Montana both north and west of Helena. Since surveys began in the late 1980s, Montana has maintained a stable and slightly increasing loon population. Fecundity in Montana appears to be above average (in comparison to many other states), ranging between 0.66 and 0.70 chicks fledged per territorial pair.

Potential threats to Montana's loon populations include: direct human disturbance to shoreline nests and chicks; water level fluctuations; contaminants (e.g., lead sinkers, mercury); aquatic invasive species; gill-netting; and hazards in the winter (e.g., marine oil spills, marine fisheries bycatch; Evers et al. 2010). These potential threats need to be identified and quantified.

Montana's loons breed on freshwater lakes arriving after ice-out, typically in late March or early April (Hammond 2009). Montana's high elevation lakes delay spring arrival due to later ice-out dates than lower elevation lakes in other portions of their range. Although Montana's loons have not been documented to breed successfully on lakes above 5,200 ft (Chris Hammond, personal communication), BRI has documented loons successfully breeding in Wyoming at lakes above 8,000 ft (Evers et. al. 2013, Spagnuolo et al. 2014). These lakes may not experience ice-out until June 1st, but loons are able to successfully fledge young despite a compressed breeding season.

BRI assigned a field biologist to support 2014 state agency Common Loon survey efforts in the northwest. This biologist was also intermittently working with Common Loons in British Columbia and songbirds in Wyoming, which reduced the total amount of time dedicated to work in Montana (approximately 11 weeks spent in Montana from May through September). Field research efforts emphasized broad survey coverage to assure a reasonable accounting of current state population and productivity numbers, while gathering specific information on known breeding pairs.

3.0 MAJOR OBJECTIVES AS OUTLINED IN 2014 WORK PLAN

Assist MFWP with surveys of loon territories and with identifying research in support of the Conservation Plan for the Common Loon in Montana (2009), including:

1. Survey lakes that take considerable time and effort to reach and cannot be routinely surveyed by loon interns or where assistance is needed. Data obtained through monitoring will be used to (a) identify and maintain the current number and spatial distribution of nesting territories, and (b) identify and protect potential territories with suitable habitat quality.

2. Assist MFWP with banding efforts, including coordinating capture schedule with loon interns and area coordinators. Obtain blood samples and tissue samples from captured loons to contribute data to national health assessment research.

3. Work to develop new research projects and maintenance of current projects to best guide conservation and management. Assist with database management, data entry, and reporting.

4.0 COMMON LOON HEALTH ASSESSMENT

BRI initiated a four-year study assessing the health of common loons across North America in the spring of 2014. The most comprehensive loon health study ever conducted, this project will assess numerous health parameters in loons from three key regions across the continent including the Northeast (New England and New York), the Midwest (Minnesota), and the West (Montana, Wyoming, Washington and British Columbia).

Samples were collected from over 160 adult and juvenile common loons, including 112 from the Northeast region, 31 from the Western region, and 20 from the Midwest. Samples were submitted for variety of health analyses, such as baseline health data, persistent organic pollutant and heavy metals biomonitoring, cyanotoxin detection, infectious disease surveillance, fungal disease surveillance, hemoparasite detection, and stable isotope analysis.

5.0 STUDY AREA

Loon surveys by MFWP in this region occurred west of the Continental Divide and north of Missoula. The highest concentrations of BRI loon surveys were conducted north and west of Kalispell to the Idaho and Canadian borders. A subset of lakes occurred in remote areas in northwestern Montana requiring significant travel time to access.

6.0 METHODS

6.1 GROUND SURVEYS

Survey methods were consistent with those reported in Evers (2007). All known or potential loon territories and surrounding areas were surveyed using 10X binoculars with occasional use of a 20-60x spotting scope (Fig. 1). A canoe or kayak was used on moderate- and large-sized lakes with poor road access or launching facilities. Emphasis was placed on surveying during peak loon nesting and hatching periods occurring from May through July. Every effort was made to gather information from the greatest distance possible from the loons to minimize impacts on nesting and brooding activities. If nesting evidence was obscured by vegetation, it necessitated searching for nest evidence by foot. On these occasions, searches were conducted by walking the perimeter of the available nesting habitat in loon territories while respecting land ownership and territory boundaries.

Nesting pairs were defined as those having laid at least one egg; a nesting attempt was evidenced by a constructed nest dish or scrape with at least one egg present or fresh eggshell fragments. Successful nesting pairs hatched at least one chick.

Chicks hatched were recorded as those that hatched completely out of their eggs, not necessarily departing from the nest. For this report, we define the terms *chick* and *fledgling* as follows: *chicks* refer to loon young ≤6 weeks post-hatching and fledglings or "fledged young" refer to loon young >6 weeks of age. Sub-adult loons in alternate plumage were recorded as immatures (ages 1-2). Loon chicks that survived past six weeks of age were assumed to have fledged.

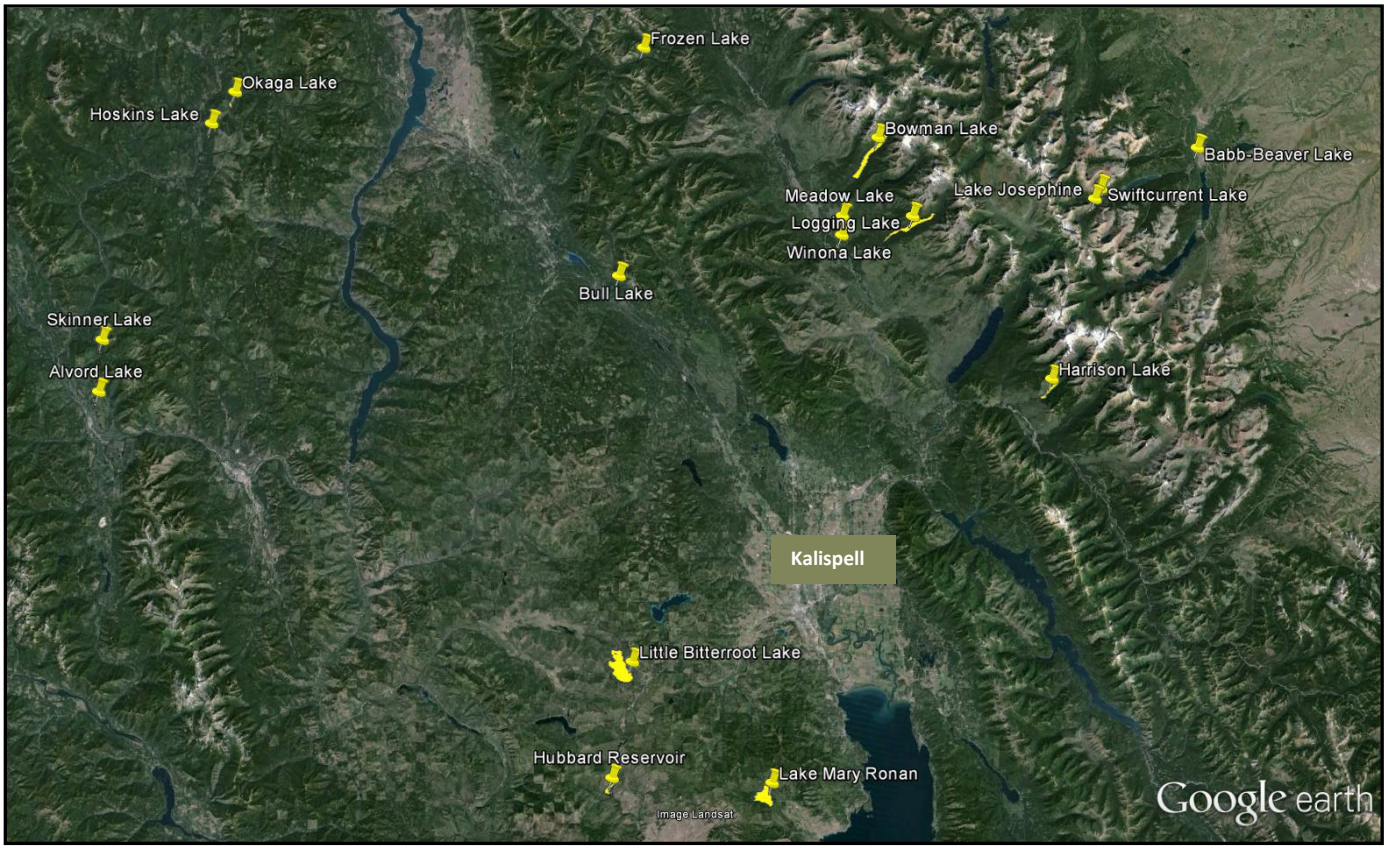

Figure 1. Lakes surveyed by BRI biologist in Northwest Montana, 2014.

6.2 LOON CAPTURE AND SAMPLE COLLECTION

Loons were captured using well-established night-lighting and playback techniques (Evers 1993). Adult birds were banded with U.S. Fish & Wildlife Service aluminum bands and a unique combination of plastic colored bands, enabling identification of individual birds to be made from a distance in future observations. Tissue samples (feathers, blood) were collected and sent to BRI and other collaborating laboratories for analysis.

6.3 RESIGHTING BANDED INDIVIDUALS

Marked individuals were tracked to gain further information on territory boundaries, between-year territory fidelity, mate-switching, estimated minimum survivorship, intra-seasonal movements, and recruitment.

All adult loons were observed for the presence or absence of leg bands. Adult loons previously banded as juveniles were recorded as "ABJs" (Adults Banded as Juveniles). ABJs were discerned by having the silver USFWS band located on the left leg; all other adults had a silver band on the right leg. Color band observations were collected visually, and then later verified against a band identification list to avoid bias.

7.0 RESULTS

During the 2014 field season, a total of 75 pairs of loons were lakes were monitored by MT CLWG. BRI biologist Allison Byrd visited a subset of lakes during the breeding season (Table 1).

7.1 BRI MONITORING RESULTS

Seventeen lakes were monitored opportunistically by BRI biologist, Allison Byrd, throughout the summer of 2014. A full table of monitoring visits is available in Appendix A of this report.

Lake	Date	Area	Survey Method	# Ad	TP (1/0)	NP (1/0)	On the nest date	Est. Hatch Date	Nest Status	Unpaired Adults	Chicks Hatched
Lake Mary Ronan	20-May	Kalispell South	shoreline	0	0	0				0	
Logging Lake	22-May	GNP	canoe	2	1	1	before 5/22			0	
Little Bitteroot Lake	23-May	Kalispell West	kayak	2	1	0				0	
Hubbard Reservoir	23-May	Kalispell West	shoreline	1	0	0					
Bowman Lake	27-May	GNP	kayak	1	?	?					
Winona Lake	27-May	GNP	shoreline	2	1	1?					
Meadow Lake	27-May	GNP	shoreline	1	?	?					
Babb-Beaver Lake	28-May	GNP	shoreline	2	1	1	before 5/28				
Swiftcurrent Lake	28-May	GNP	shoreline	2	1	1					
Josephine	28-May	GNP	shoreline	1	?	?					
Harrison Lake	29-May	GNP	shoreline	0	0	0					
Alvord Lake	19-Jun	Kootenai	kayak	2	1	1		5/22	hatch		2
Skinner Lake	19-Jun	Kootenai	shoreline	1	?					1	
Hoskins	20-Jun	Yaak	shoreline	1		?					
Okaga	20-Jun	Yaak	shoreline	1							
Frozen Lake	7-Jul	Kootenai	shoreline	0	0						
Bull Lake	10-Jul	Eureka	kayak	1				6/10	hatch		1
Totals				**20**	**6**	**4**					**3**

Table 1. BRI surveying efforts in Montana, 2014. Further information available in Appendix A.

7.2 LOON DAY RESULTS

Montana Loon Society oversees a systematic breeding survey known as "Loon Day". During a single day in both mid-May and mid-July, all loon pairs and chicks are counted.

Loon Day Results 2014	
Territorial Pairs within Glacier National Park	17
Territorial Pairs outside of Glacier National Park	58
Total Statewide Estimate of Territorial Pairs	**75**
Chicks present within Glacier National Park	11
Chicks present outside of Glacier National Park	49
Total Statewide Estimate of Chicks	**60**
Statewide Estimate of Chicks/Territorial Pair	**0.8**

These Loon Day counts have been conducted since 1999 and the number of territorial pairs has increased by 44% since 2006.

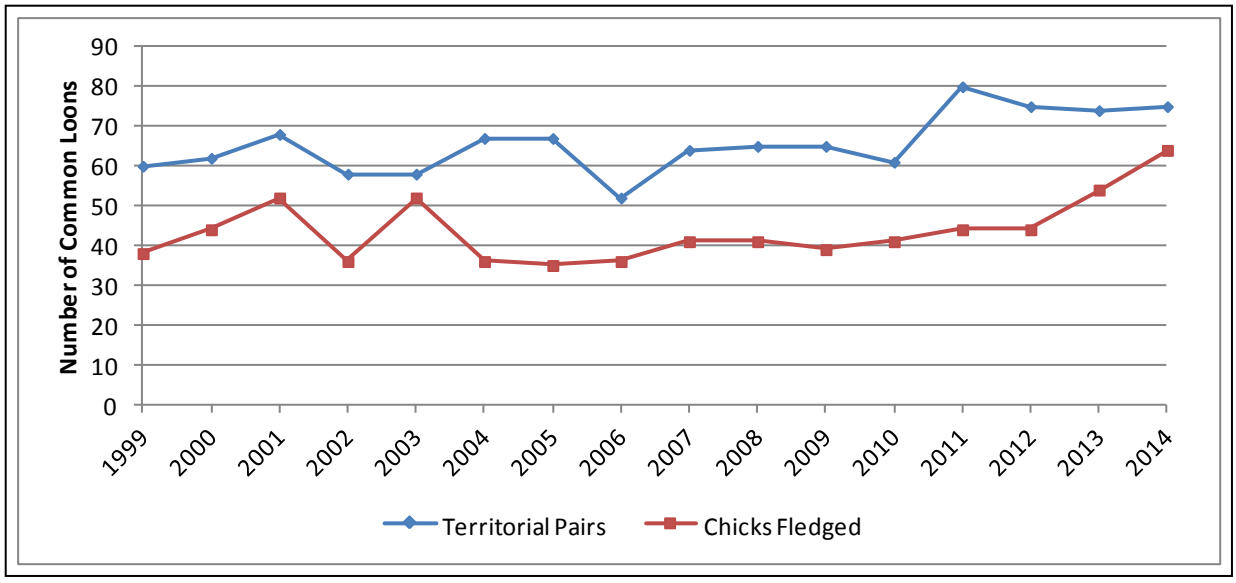

Figure 2. The number of territorial pairs and chicks fledged in Montana, 1999-2014.

Based on Montana Loons Society's past data, overall productivity increased in 2014, as well.

Figure 3. The overall productivity (chickssurviving/territorial pair) of loon pairs in Montana, 1999-2004. 0.48 is the productivity needed for a sustainable population.

7.3 BANDING RESULTS

A total of twenty loons were captured in Montana in 2014 (Table 2). Four unbanded adults and 11 chicks were captured and banded, two previously banded adults were recaptured, and three chicks were captured but too small to band. All captured birds were sampled for the health assessment study (See section 7.5 "title of section"). Information on all capture efforts and attempts is located in Appendix B of this report.

Band_#	Date	Lake_Name	Territory	Recapture?	Age	Sex
0938-447-72	6/22/2014	Carpenter Lake (Tetrault)	Carpenter Lake (Tetrault)	N	A	M
0938-447-58	6/22/2014	Carpenter Lake (Tetrault)	Carpenter Lake (Tetrault)	N	A	F
UNMT-14002	6/25/2014	Loon Lake (Kraft Creek)	Loon Lake (Kraft Creek)	N	J	U
UNMT-14001	6/25/2014	Loon Lake (Kraft Creek)	Loon Lake (Kraft Creek)	N	J	U
0938-447-52	7/13/2014	Lower Thompson Lake	Lower Thompson Lake	N	J	U
0669-205-01	7/13/2014	Lower Thompson Lake	Lower Thompson Lake	N	J	U
0938-447-99	7/14/2014	Upper Thompson	Middle	N	J	U
0938-447-70	7/14/2014	Upper Thompson	East	N	A	M
0938-447-90	7/15/2014	Placid Lake	Placid Lake	N	J	U
1058-006-16	7/15/2014	Spencer Lake	Spencer Lake	N	J	U
1058-006-18	7/15/2014	Spencer Lake	Spencer Lake	N	J	U
1058-006-17	7/15/2014	Skyles Lake	Skyles Lake	N	J	U
1058-006-19	7/16/2014	Beaver Lake	Beaver Lake	N	J	U
UNMT-14003	7/17/2014	Lower Stillwater	Lower Stillwater	N	J	U
1058-006-20	7/17/2014	Pierce Lake	Pierce Lake	N	J	U
0938-447-80	7/18/2014	Ashley Lake	East	Y	A	M
0938-446-82	7/18/2014	Ashley Lake	East	Y	A	F
0669-217-02	7/18/2014	Ashley Lake	East	N	J	U
0938-447-60	7/18/2014	Ashley Lake	East	N	J	U
0669-205-48	7/18/2014	Ashley Lake	Eagle	N	A	M

Table 2. Successful banding efforts in Montana, 2014.

7.4 FALL CHICK SURVIVAL CHECKS

In late summer and early fall, lakes with reported chicks were checked for chick presence (Table 3). A common metric for evaluating chick survival is a chick exceeding 6 weeks of age. Even if a chick is not seen fledging a lake, if they are known to have survived beyond 6 weeks of age, they are thought to have a greater probability of fledging. Unfortunately there was a period of time mid-August that lakes could not be checked by the BRI biologist, but during this time, some chicks were old enough to fledge. In cases where no chicks were seen, these chicks may have fledged the lake or may not have survived.

			Loon Presence or Absence							
Lake	**Hatch Date**	**# Chicks Hatched**	**23-Jul**	**11-Aug**	**25-Aug**	**2-Sep**	**5-Sep**	**6-Sep**	**7-Sep**	**11-Sep**
Clearwater Area										
Summit	6/8	2								0 loons
Clearwater	6/23	1								0 loons
Rainy	7/5	2								**2 c**, 1 a
Placid	6/11	2								1 c, 1 a
Upsata	6/8	1								**1 c**, 0 a
Hidden	7/5	1								**1 c**, 1 a
Swan Area										
Loon Lake- Kraft Creek	6/11	2								**2 c**, 1 a
Pierce Lake	6/18	1								**1 c**, 1 a
Kalispell West Area										
Upper Middle Thompson	5/26	2							**2 c**, 1 a	
Upper East Thompson	7/1	2							**2 c**, 1 a	
Lower Thompson	5/28	2							1 c, 2 a	
Little McGregor	6/3	2							0 loons	
Lone	6/20	1							**1 c**, 1 a	
Ashley (causeway)	6/30	1			**1 c**					
Ashley (east)	6/18	2						**2 c**		
Ashley (eagle)	13-July	1			**1 c**					
Tally-Stillwater Area										
Lower Stillwater	7/7	1					**1 c**, 0 a			
Beaver	6/12	2		**2 c**, 0 a						
Spencer	5/26	2			**chicks fledged**					
Skyles	5/31	1		**1 c**, 0 a						
Murphy Lake Area										
Murphy	5/28	2					**2 c**, 1 a			
Dickey South	5/30	1					**1 c**, 0 a			
Carpenter/Tetrault	5/29	2	**2 c**, 2 a							
Bull	6/10	1					**1 c**, 1 a			
Lick	5/28	2					0 loons			
Flathead River-Forks Area										
Mud/Garnet	Unk	2								0 loons
Teepee	Unk	Unk								0 c, 1 a
Half Moon	Unk	2								**2 c**, 2 a

*Table 3. Fall chick survival dates in Montana, 2014. **Bold** numbers (or words) represent the number of chicks present in July surviving beyond 6 weeks of age. Zeros represent unknown fates (chicks may have fledged or died prior to survey date), "c"= "chicks", "a"= "adult". All Blue Cells represent lakes/territories with chicks surviving >6 weeks.*

7.5 MERCURY ANALYSIS

7.5.1 FEATHER MERCURY ANALYSIS

Feathers from seven adults were tested for mercury in 2014. Feather mercury represents the mercury burden of the loon during feather growth. The feathers tested were flight feathers, which are grown on the wintering grounds. None of the seven secondary feather samples tested were above the lowest observed adverse effect levels (LOAELs) (40 ppm or mg/kg; Evers et al. 2008).

There was, however, a feather with mercury levels higher than the lowest observed effect level, which was from the remains of a loon carcass on Logging Lake. A deceased loon was reported to the park and when the carcass site was visited for recovery, only a few feathers remained, one of those feathers being a scapular feather. Unfortunately, LOAELs have not been established for scapular feathers and there are differences in mercury concentrations depending on molt schedule and scheme. BRI hopes to understand these differences through future studies.

Band #	Hg conc. [mg/kg]	Feather Type	Sample Weight [g]	Sample Collection Date	Lake Name	Territory	Age	Sex
0938-44682	5.939	secondary	0.0555	7/19/2014	Ashley Lake	East	ATY	F
0938-44758	7.914	secondary	0.0587	6/22/2014	Carpenter Lake	Tetrault	ATY	F
0938-44772	9.889	secondary	0.0583	6/22/2014	Carpenter Lake	Tetrault	ATY	M
0669-20548	11.965	secondary	0.0565	7/19/2014	Ashley	Eagle	ATY	M
0938-44780	12.204	secondary	0.0571	7/18/2014	Ashley Lake	East	ATY	M
0938-44770	15.155	secondary	0.0592	7/14/2014	Upper East Thompson		ATY	M
UnMT14001*	46.661	scapular*	0.0400	5/22/2014	Logging Lake		ATY	U

Table 4. Feather mercury levels for feathers collected from loons in Montana, 2014.

**The values for this analysis are from the scattered remains of a deceased loon and are believed to be scapular feathers. Therefore, this feather's mercury value is not directly comparable to the other values in the table. This scapular feather is included, however, as it is above the lowest observed effect level of 40 ppm in feathers and may be of interest in the coming years.*

7.5.2 BLOOD MERCURY ANALYSIS

Blood mercury was analyzed for sixteen samples collected in Montana in 2014. None of the results exceeded the lowest observed adverse effect level (LOAEL) for loons, which is 3.0 ug/g (Evers 2008). Blood mercury levels represent the current mercury burden for loons (at the time of sampling) and reflect the amount of mercury their diet.

Band_#	Hg conc. [mg/kg]	Sample Collection Date	Lake Name	Territory	Age	Sex
0938-44760	0.057	7/18/2014	Ashley	East	CH	UNK
1058-00617	0.102	7/15/2014	Skyles Lake		HY	UNK
0938-44799	0.124	7/14/2014	Upper Middle Thompson		HY	UNK
1058-00619	0.135	7/17/2014	BeaverLake		CH	UNK
0938-44752	0.136	7/13/2014	Lower Thompson		HY	UNK
1058-00616	0.150	7/15/2014	Spencer Lake		HY	UNK
0669-20501	0.176	7/13/2014	Lower Thompson		HY	UNK
1058-00618	0.197	7/16/2014	Spencer Lake		HY	UNK
0938-44790	0.218	7/15/2014	Placid Lake		HY	UNK
1058-00620	0.279	7/17/2014	Pierce Lake		CH	UNK
0938-44682	0.602	7/19/2014	Ashley Lake	East	ATY	F
0938-44780	0.863	7/18/2014	Ashley Lake	East	ATY	M
0938-44758	0.953	6/22/2014	Carpenter Lake		ATY	F
0669-20548	1.050	7/19/2014	Ashley Lake	Eagle	ATY	M
0938-44772	1.159	6/22/2014	Carpenter Lake		ATY	M
0938-44770	1.694	7/14/2014	Upper East Thompson		ATY	M

Table 5. Blood mercury levels for blood collected from loons in Montana, 2014.

7.5.3 EGG MERCURY ANALYSIS

Egg mercury was analyzed for 20 eggs collected from failed nests from 2009 to 2014. . None of the results exceeded the lowest observed adverse effect level (LOAEL) for loon eggs, which is 1.3 ug/g (Evers 2008). Egg mercury levels are directly correlated with female blood mercury values (Evers et al. 2002) which are related to available methylmercury in the environment and diet.

Lake	Collection Date	Wet Weight Hg Conc. [mg/kg]
Upsata Lake	6/28/2009	0.26
Upsata Lake	6/28/2009	0.21
Loon Lake (Trego)	7/6/2009	0.26
Ashley Lake (Dam Territory)	5/31/2010	0.24
Upper Thompson Lake (East Territory)	6/5/2010	0.29
Blanchard Lake	7/9/2010	0.22
Blanchard Lake	7/9/2010	0.20
Ashley Lake (Causeway Territory)	5/31/2011	0.49
Howe Lake	8/26/2011	0.52
Howe Lake	8/26/2011	0.49
Rodger Lake	6/13/2012	0.24
Clearwater Lake	6/24/2012	0.21
Blanchard Lake	6/25/2012	0.78
Lake Alva	6/16/2013	0.82
Alvord Lake	6/16/2013	0.12
Lower Thompson Lake	6/17/2013	0.32
Lower Stillwater	7/13/2013	0.39
Upsata Lake	6/10/2014	0.27
Quartz Lake	6/25/2014	0.42

Table 6. Whole egg mercury values for failed eggs collected in Montana, 2009-2014.

7.6 HEALTH ASSESSMENT

I. Common Loon Health Data

In 2014, samples were collected from over 160 adult and juvenile common loons across the United States and in Canada, which included three adults and eight chicks from Montana. The following is the health data for which BRI has obtained laboratory results. In many of the explanations of findings, Montana results are compared to Minnesota results. This is due to the high number of chicks sampled in both of these states and because Montana chick results (obtained within the field

season) were used as a baseline for comparison with Minnesota chicks which were translocated from northern to southern Minnesota in 2014.

A. Baseline Health Data

a. **Packed Cell Volume (PCV):** The fraction of whole blood volume that consists of red blood cells. Abnormally low PCV values can indicate anemia due to disease or blood loss, while abnormally elevated PCV values indicate dehydration or other health problems.

2014 Packed Cell Volume (PCV) Results

Normal mean packed cell volume range for adult loons is between 40 – 50%, but is lower in chicks. The eight chicks sampled in MT in 2014 had a mean packed cell volume (38.5%) that was comparable to the mean packed cell volume of similarly aged loon chicks sampled in MN the same year (37.8%). The packed cell volume values recorded for chicks in MT and MN were both lower than the mean packed cell volume recorded for MT adults (46.3%) and for all adults sampled in all regions in 2014 (48.1%).

b. **Total Solids (TS):** Measures the total dissolved solids (mainly proteins) in plasma. Alterations in TS values can indicate inflammation, infection, dehydration, and other disease states.

2014 Total Solids Results

Plasma total solids values followed a similar trend as packed cell volume (PCV) results, with chicks having lower mean values than adults (average.0-5.0 Chicks from MT had mean total solids values of 3.5 g/dL, while mean total solids in adults was 4.3 g/dL. Lower packed cell volume and total solids values in juveniles compared to adults has been previously reported in common loons

(Haefele *et al* , 2005), and this finding likely represents normal physiologic development.

c. **Lactate:** Measures the amount of lactic acid present in the blood, which is produced as a result of anaerobic metabolism when oxygen delivery to the tissue is inadequate to support metabolic demands. Elevated blood lactate levels can be caused by prolonged physical exertion, dehydration, poor blood circulation, anemia, or severe respiratory disease.

2014 Lactate Results

Normal blood lactate ranges have not been established in free-ranging avian species, but in most domestic mammal species, a lactate value above approximately 2.0 mmol/L is considered elevated. Blood lactate values measured in MT chicks (mean= 4.97 mmol/L) were higher than the mean lactate value in MT adults (2.37 mmol/L) and the overall mean lactate value for all adults (3.2 mmol/L). Higher post-capture lactate values in chicks are likely due to decreased exercise tolerance and incomplete muscle development and fitness compared to adults. Capture time (defined as the total time interval between first onset of chase to completion of blood collection after capture) was recorded for most MT loons sampled. Increased lactate values were not associated with increased capture time. The highest lactate value recorded in a MT chick was 8.6 mmol/L (Ashley Lake, East Territory chick). For this chick, the capture time was relatively short (20 minutes). Increased blood lactate values are more likely due to individual differences in fitness and physiologic status rather than excessive exertion from prolonged capture times.

d. **White Blood Cell Count :** Provides a count of the total number of white blood cells present in the blood, as well as the distribution of the different types of white blood cells (lymphocytes, heterophils, eosinophils, monocytes, basophils).

Changes in the number and types of white blood cells resent can indicate a variety of problems including infection, inflammation, chronic stress, bone marrow disease, and neoplasia.

2014 White Blood Cell Count Results

MT chicks had a mean estimated total white blood cell count (9,500 cells/µl) that was slightly lower than values reported for MN chicks (mean= 12,400 cells/µl) and the overall mean reported for all adults from all regions (11,800 cells/µl). The mean estimated total white blood cell count for MT adults (17,000 cells/µl) was higher than the overall mean for all adults, but this was largely influenced by a single MT adult loon (Ashley Lake, Eagle Territory male) with a moderately elevated white blood cell count of 30,000-31,000 cells/µl. This loon exhibited white blood cell changes indicative of an active immune response possibly due to an infection, though the bird appeared clinically healthy at the time of capture. It will be important to gather follow-up information this summer to determine if this individual survived and returned to Ashley Lake.

The heterophil to lymphocyte (H:L) white blood cell ratio is an index of avian stress. Chronic stressors such as human disturbance, temperature extremes, disease, and ongoing territorial disputes elevate the number of heterophils while depressing the number of lymphocytes. Therefore, and increased H:L ratio can be an indicator of stress. The H:L ratio changes much more slowly (30 min- 20 hours) in response to stress than blood corticosterone levels which can rise within a few minutes. Because of this, the H:L ratio is not usually influenced by the stress of capture and handling, and reflects more chronic stressors.

MT chicks had relatively low H:L ratios (ratio of >1 in seven out of eight chicks), with a mean H:L ratio of 0.7. This is lower than the mean H:L ratio of MN chicks (1.3). Adult loons in MT had a mean H:L ratio of 1.49, while the overall mean H:L ratio for all adults was 1.03. The lower H:L ratios found in MT loon chicks may be

evidence of lower stress levels in these chicks compared to chicks in other states and adults.

e. **Plasma Biochemistry Panel**: Measures several different substances in the blood, including electrolytes, enzymes, proteins, and other health markers. Provides basic health information including liver and kidney function, fluid and electrolyte balance, muscle damage, and lipid metabolism.

   Protein Electrophoresis: Measures the amounts of specific proteins in the blood (such as immunoglobulins) that may become altered during an inflammatory response or other disease state. The pattern of proteins measured can provide evidence of specific infection types, malnutrition, renal disease, or liver disease.

   2014 Plasma Biochemistry and Protein Electrophoresis Results

   Normal reference ranges have not yet been established for common loons for plasma biochemistry or protein electrophoresis, but comparison of these values between similarly aged chicks from MT and MN revealed comparable results with a few exceptions (described below).

   One MT chick (Pierce Lake chick) was found to have elevated levels of several enzymes associated with liver damage when compared to enzyme levels in other chicks from MT and MN. These enzymes include alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma glutamyltransferase (GGT), and lactate dehydrogenase (LDH). This finding is complicated by the fact that the blood sample became hemolyzed (ruptured red blood cells) after collection, and hemolysis has been found to falsely elevate LDH and AST levels. Therefore, it is unclear whether this chick did in fact have liver disease, or whether this was a result of sample hemolysis after blood collection. Common causes of liver disease in wild avian species include parasitism such as liver flukes, liver infection, toxicity, and hepatic lipidosis (fatty liver disease). While every effort was made

to process, freeze, and ship plasma samples as quickly as possible to the lab for analysis following capture, working in remote locations can sometimes cause delays in sample processing which increases the incidence of sample degradation and hemolysis.

Chicks from MT had lower plasma potassium values (mean= 3.7 mmol/L) than chicks from MN (mean= 6.0 mmol/L). The reason for this difference is unclear. The potassium levels in MT chicks are similar to potassium levels previously measured in adult red-throated loons (Kneeland unpublished data, 2014) and potassium levels reported for other avian species. The most likely explanation for this difference is that the MN samples had falsely elevated potassium levels due to differences in sample handling such as delayed separation of plasma or hemolysis. Conditions such as kidney failure can cause elevated plasma potassium levels in avian species, however, based on the other bloodwork values in the MN chicks this is very unlikely explanation.

MT chicks also had a lower mean plasma lipase (34.5 U/L) than MN chicks (135.8 U/L). Lipase is an enzyme released by the pancreas following a meal to aid the digestion of fats. Lipase levels become elevated following ingestion of food, so one possible explanation for this difference is the time interval between the last time the chicks had eaten and the time of capture. Because MN chicks were being captured as part of a translocation project, they tended to be caught earlier in the night than the MT chicks. Therefore, MN chicks may have eaten their last meal of the day more recently before capture than MT chicks that were captured later in the night, causing the higher lipase levels in the blood. Abnormally elevated or abnormally low levels of lipase levels can be caused by pancreatitis or pancreatic insufficiency respectively, however, this is a very unlikely cause in a healthy wild loon chick.

As mentioned above, normal reference ranges for most hematology and plasma biochemistry tests have not yet been established for common loons. One of the

major goals of this loon health assessment study is to use the data collected to establish normal health reference ranges for common loons. This will enable biologists and veterinarians to more accurately assess the health status of individual loons in the future.

2. ***Aspergillus* Panel**: Aspergillosis is a fungal disease of the respiratory tract in birds caused by the fungus *Aspergillus sp.* These fungal spores are widely present in nature, and often causes opportunistic infection in loons that are physiologically stressed. The *Aspergillus* panel tests for both antibodies and antigens in blood, and provides valuable data on *Aspergillus* exposure and infection rates in apparently healthy wild loons.

   2014 Aspergillus Results

   Montana chicks did not have evidence of *Aspergillus* infection based on antibody and antigen titers.

B. Common Loon Health Data: Results Pending

The following tests are currently in queue at laboratories for analysis, but results have not yet been obtained by BRI.

1. Hemoparasites- Both PCR and direct examination of blood smears is used to identify hemoparasites present in loon blood, such as *Leucocytozoon*, *Plasmodium*, and *Haemoproteus*.

2. Contaminants and Heavy Metals
   a. Blood Lead (Pb) levels
   b. Blood Mercury (Hg) levels
   c. Persistent organic pollutants- samples are archived for future analysis

i. Organochlorines
ii. PBDE's
iii. Perfluorinated compounds

3. Cyanotoxin Detection and Bioaccumulation- Loon blood is screened for toxins such as microcystins and beta-Methylamino-L-alanine (BMAA) which are produced by cyanobacteria (blue-green algae). Phytoplankton and zooplankton samples from the same lakes where loons are samples will also be analyzed for these toxins to study how these compounds bioaccumulate through the aquatic food web.

4. Infectious Disease Surveillance
   a. Eastern Equine Encephalitis Virus (EEEV) Serosurvey
   b. Avian Influenza (AI) Surveillance
      i. Exposure
      ii. Viral shedding
      iii. Viral subtyping
   c. Bornavirus Surveillance

5. Stable Isotope Analysis (C + N)

Stable isotopes can provide insight into various aspects of loon diet. The ratio of ^{13}C to ^{12}C ($\delta^{13}C$) is used to differentiate among different sources of primary production (i.e. vegetation type). For example, loon foraging preferences can be differentiated among bethic and pelagic fish, and potential differentiation can be made between fish originating from a lake with a sphagnum shoreline versus one with a bedrock shoreline. Stable nitrogen isotope ratios, ^{15}N to ^{14}N ($\delta\ ^{15}N$), can be used to determine the trophic level at which loons are feeding. For example, loons dependent on piscivorous fish, such as bass and perch, can be distinguished from loons feeding on planktivores, such as ciscoes and alewife. Examined

together, $\delta^{13}C$ and $\delta\ ^{15}N$ can help illuminate differences in food sources (and preferences) across various trophic levels.

8.0 DISCUSSION

Statewide, the Montana loon population is increasing and the average annual reproductive success (chicks surviving/territorial pair; also "CS/TP") is above the recommended level of 0.48 for maintaining a stable population (Mitro et al. 2008, Grear et al. 2009). In 2014, annual monitoring efforts by MFWP, Glacier National Park (GNP), and BRI recorded and estimated 75 territorial pairs, with a statewide estimate of 60 chicks, for an overall productivity of 0.80 CS/TP.

While loon productivity is higher than 0.48 CS/TP, Montana has not been experiencing the expected increase in territorial pairs associated with this high productivity. Loons spend their first 2-3 years of life on the ocean, (Evers et al. 2010), and there have been enough continuous years of sustainable chick production that we would expect to see either an increase in either territorial pairs or in unpaired adults on, or adjacent to, existing breeding lakes. Hammond et al. (2012) showed that territories in Montana shift spatially but have held constant through time. Continued banding in the region will help determine if territory holders are returning each year or if other (possibly younger) loons are over-taking or replacing territory holders. Monitoring for unpaired adults in the region will also help to determine the number of potential breeding birds that are available in the population and will also provide insight into juvenile dispersal and population expansion.

Mercury levels in secondary flight feathers, blood samples, and whole eggs are below the lowest observed adverse effect levels. Sources of mercury in remote western ecosystems are a mixture of both local and global sources (Siegneur et al. 2004, Schmeltz et al. 2011) and mechanisms of mercury deposition can be complicated in these systems where local and global signals are mixed. In general, however, environmental mercury levels are lower

in the western United States than the eastern United States, so these lower mercury values are not unexpected (Evers et al. 2002).

One scapular feather from a deceased loon in Glacier National Park had mercury levels above the lowest observed adverse effect level and due to when this feather was grown; this value likely reflects winter mercury levels. This finding has sparked an interest in quantifying and understanding mercury in all feather types in loons. Feathers earlier in the molt cycle are expected to be higher in mercury because the body burden decreases as feathers are grown. Future analysis of mercury in various feather types will help to understand mercury depuration through feather molt.

The preliminary health assessment results provide promising insight into nationwide loon health, particularly for establishing baseline health information. Deviations from expected values will be used to flag potential compromised health in individuals. Data obtained from Montana's chicks was particularly helpful for baseline comparison with Minnesota's chicks, which were translocated from northern to southern Minnesota (n=5) and fledged from the southern lake. Some of the health parameters fell within different ranges of values for Montana versus Minnesota chicks (e.g. white blood count, lactate, plasma biochemistry panel, protein electrophoresis) and future samples will determine whether these are regional differences or if, in fact, some loons chicks are of poorer health than others. Additionally, the pending results (hemoparasites, contaminants and heavy metals, cyanotoxin bioaccumulation, infectious disease surveillance, stable isotope analysis) will contribute incredibly valuable insight into the stresses and burdens on common loon health and overall survival.

9.0 RECOMMENDATIONS

Organized under Montana's Common Loon Working Group, which includes the Montana Department of Fish, Wildlife and Parks, the Montana Department of Natural Resources and Conservation, the U.S. Forest Service, Glacier National Park, Plum Creek Timber Company,

Avista Corporation, Confederated Salish and Kootenai Tribes, the U.S. Fish and Wildlife Service, the University of Montana, BRI, and lakeshore homeowners, as well as other interested citizens and organizations, Montana has more detailed information about loon population demographics across a longer time period than any other western state. In the coming years, under the direction of the working group, BRI hopes to collaborate on further monitoring efforts, following the goals outlined in Montana's Common Loon Conservation Plan (Hammond 2009, Hammond 2011).

Evidence of the loon's ability to acclimate to human activities suggests that properly designed conservation efforts can be beneficial in many instances (Evers 2007). Montana's Common Loon Conservation Plan includes the goals stated below related to monitoring, management, research, and outreach (Hammond 2009). The purpose of the plan is to maintain a stable common loon population by monitoring important demographic parameters within known breeding areas of Montana. The following recommendations are primarily based on Montana's Loon Conservation Plan.

9.1 MONITORING RECOMMDATIONS

Implement effective monitoring programs and strategies through collaboration and coordination with all members of the Montana Common Loon Working Group. Specifically, aim to collect demographic data about the number of territorial pairs, nesting pairs, location of nests, chicks hatched, chicks surviving >6 weeks of age, and number of non-breeding individuals. Other priorities include determination of the status of returning color-banded individuals and the annual capture of individuals to color-band, assess health, and measure contaminants. The goal is to maintain a marked population of at least 50% of the breeding adults.

Resulting from 2013 surveys along the Wyoming/Montana borders, it was determined that there are very likely not any MT loons (or loons associated with the Wyoming population) breeding on lakes in southern Montana. Still, there are a multitude of lakes in

this region and other areas near existing pairs in western Montana which are difficult to monitor, but may support loon pairs. Given the high elevation and remote locations of many of these lakes, the effort required to physically access them is likely to be cost-prohibitive. If aerial wildlife surveys are being flown for other reasons (wolves, bears, etc.) we recommend that as many of these remote lakes as possible be surveyed for loons during the breeding season.

9.2 RESEARCH RECOMMENDATIONS

Develop new research projects as needed and maintain current projects that best guide conservation and management. Such projects include analyzing existing demographic data, assessing the effectiveness of management efforts, and tracking dispersal and movements for adults and sub-adults (using color-marked individuals and transmitters). Existing and emerging potential threats (e.g. contaminants, nesting threats, invasive species, and sources of adult mortality) should be identified and quantified through the use of new and existing approaches (e.g. trail cameras at nest sites, necropsies). Continuation of sample collection during capture will add valuable data to BRI's common loon health assessment study.

9.3 OUTREACH RECOMMENDATIONS

Provide agencies and the public with the best available science and information related to factors affecting loon breeding success. Maintain and improve communication, coordination, and collaboration, including (1) developing a web-based information center to integrate standardized georeferenced loon databases and other information into a cooperative system; (2) providing a greater awareness of the needs of loons by using educational and outreach programs, including dioramas, exhibits, and printed and web-oriented communication piece; and, (3) establishing partnerships between developers, local governments and conservation organizations to incorporate site-specific low impact uses and loon friendly "Best Management Practices" in shoreline projects.

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Appendix A. BRI monitoring efforts and notes, Montana, 2014.

Lake	Date	Area	Survey Method	# Ad	TP (1/0)	NP (1/0)	On the nest date	Est. Hatch Date	Nest Status	Floater Adults	Chicks Hatched	LL Top	LL Bottom	RL Top	RL Bottom
Lake Mary Ronan	5/20	Kalispell South	shoreline	0	0	0				0					
	comments:	surveyed for 15 hours from various view points, many different fishermen or locals said they have not seen them on the lake "yet", the park host said he saw 2 loons 3 days ago, I did not see any loons													
Logging Lake	5/22	GNP	canoe	2	1	1	before 5/22			0					
	comments:	hiked to get loon carcass, only a bone and feathers remain; found nest of pair on lake, 2 trumpeters on N end of lake													
Little Bitteroot Lake	5/23	Kalispell West	kayak	2	1	0				0					
	comments:	surveyed for about 2 hours, heard a loon and went out on kayak, loons at N end of lake, no nest located, never saw evidence of nesting, raven and immature bald eagle seen here, calm lake but several boats, not a large amount of suitable nesting shoreline on north portion of lake													
Hubbard Reservoir	5/23	Kalispell West	shoreline	1	0	0									
	comments:	only saw one loon; many, many vistors there as it was Friday of Memorial Day weekend, did not see ample nesting habitat but certainly not impossible													
Bowman Lake	5/27	GNP	kayak	1	?	?									
	comments:	only one loon seen, paddled bottom 1/2 of lake shoreline, no nesting mate located													
Winona Lake	5/27	GNP	shoreline	2	1	1?									
	comments:	many deer by previous year's nesting location, both loons swam away from deer, then back into cove, and then only one returned to lake. Could not see bird on nest, but seemed promising that there may be nest there													
Meadow Lake	5/27	GNP	shoreline	1	?	?									
	comments:	solo bird there, I walked a distance from the perimeter of the lake looking for evidence of nest or nesting bird but no luck; single loon riding low in the water the entire time													
Babb-Beaver Lake	5/28	GNP	shoreline	2	1	1	before 5/28								
	comments:	2 birds on lake, saw bird on nest if you walk up "private road" just past bend in tall grass at "back" of lake													
Swiftcurrent Lake	5/28	GNP	shoreline	2	1	1									
	comments:	2 birds along shoreline, eventually began nest building; location given to Jamie Belt													
Lake Josephine	5/28	GNP	shoreline	1	?	?									
	comments:	1loon up west end of the lake, could not see until I hiked all the way up trail, checked with shoreline for nest/nesting w/ binos but did not see a nest													
Harrison Lake	5/29	GNP	shoreline	0	0	0									
	comments:	hiked 12 miles in, monitored/listened along entire shoreline; scoped lake from cabin in evening; checked entire lake on hike out; no evidence of loon presence													
Alvord Lake	6/19	Kootenai	kayak	2	1	1		5/22	hatch		2	white	orange stripe	green dot	silver
	comments:	male stayed near area I initially saw him, female swam away w/ 2 chicks, did not see if female banded; loons towards south end of lake away from boat launch; chicks look to be 3-4 weeks old													
Skinner Lake	6/19	Kootenai	shoreline	1	?					1		unb			
	comments:	the map I had labeled Skinner as Kilbrenan Lake!...I only realized this error, however, when I returned to Maine! 1 unbanded adult fishing and sleeping													
Hoskins	6/20	Yaak	shoreline	1		?									
	comments:	short hike in, did not see loon until 45 minutes surveying lake-- was it on nest?, believe unb but could not confirm; brow raised, spooky; waited additonal 45 min hiding hoping for it to go to nest or show leg...it never went on a nest													
Okaga	6/20	Yaak	shoreline	1											
	comments:	very windy day, difficult to see clearly across lake; saw one loon on far end of the lake from the cabins, got angry call from cabin owner where I left my card													
Frozen Lake	7/7	Kootenai	shoreline	0	0										
	comments:	short hike down, trail getting grown over, sat out on log on water with tripod and could see length of the lake, no loons													
Bull Lake	7/10	Eureka	kayak	1				6/10	hatch		1	blue	blue	blue?	silver?
	comments:	1banded adult, 1unbanded adult, 1chick (about 4 weeks old)													

Appendix B. Complete capture efforts for common loons in Montana, 2014.

Date	Lake	Capture Type	Team	Capture/Banding	Notes
6/22	Carpenter (Terault) Lake	Boat	Chris, Allie, Alyssa, Kaitlyn	2 unb adults, M and F	Caught unb male and unb female
6/23	Beaver Lake	Boat	Allie, Alyssa, Kaitlyn		UNB adult never located (left lake?), chicks too small to band
6/24	Skyles Lake	Diurnal	Allie, Alyssa, Kaitlyn		adults came in towards decoy/net, but did not get caught
6/24	Sylvia Lake	Diurnal	Allie, Alyssa, Kaitlyn		adults came in towards decoy/net, but did not get caught
6/25	Sylvia Lake	Diurnal	Allie, Alyssa, Kaitlyn		1 adult present, came in, did not get caught
6/25	Loon Lake (Kraft Creek)	Canoe	Allie, Alyssa, Kaitlyn	2 chicks (too small to band)	BOTH adults left 8 day old chicks on the lake alone. Caught chicks and took measurements and small
6/26	Lost Coon Lake	Canoe	Allie, Alyssa, Kaitlyn		1 adult spotted-- dove immediately when spotlight hit it
6/26	Skyles Lake	Canoe	Allie, Alyssa, Kaitlyn		very foggy- never even saw adults
7/13	Lower Thompson Lake	Boat	Allie, Alyssa, Kaitlyn	2 chicks	2 chicks banded
7/13	Little MacGregor Lake	Boat	Allie, Alyssa, Kaitlyn		2 older chicks evaded us
7/14	Upper Middle Thompson	Boat	Allie, Alyssa, Kaitlyn	1 chick	1 chick capture
7/14	Upper East Thompson	Boat	Allie, Alyssa, Kaitlyn	1 unb adult M	Caught unb adult male
7/15	Spencer Lake	Canoe	BRI traveling team	2 chicks	
7/15	Skyles Lake	Canoe	BRI traveling team	1 chick	
7/15	Placid Lake	Boat	Allie, Alyssa, Kaitlyn	1 chick	Found pair with chicks, one chick split off, caught that one, did not locate adults or other chick again
7/16	Dickey Lake	Canoe	BRI traveling team		saw pair and chick as light was fading, then never located them again! Party boat had just gone down into their territory
7/16	Carpenter (Terault) Lake	Boat	Allie, Alyssa, Kaitlyn		could not locate adult or chicks but they were all there a few days later
7/16	Beaver Lake	Boat	BRI traveling team	1 chick	spooky adults
7/17	Blanchard Lake	Boat	Allie, Alyssa, Kaitlyn		spooky bird- unb bird has a strange spot of missing feathers (?) on its face… look for that feature again next year
7/17	Lower Stillwater Lake	Boat	Allie, Alyssa, Kaitlyn	1 chick (too small to band)	could have easily netted male but it was female who has unb, saw her one time as she dove when light hit her, captured chick and took some measurements and genetic sample
7/17	Pierce Lake	Canoe	BRI traveling team	1 chick	
7/18	Ashley Lake -East	Boat	BRI traveling team	2 chicks, 2 adult recaptures	
7/18	Ashley Lake - Eagle	Boat	BRI traveling team	1 adult M	
7/19	Half Moon Lake	Canoe	BRI traveling team		only one chick seen most of the time, only got close to it once, 1 spooky adult, as well
7/21	Upsata Lake	Diurnal	BRI traveling team		came in but not caught
7/21	Hidden Lake	Diurnal	BRI traveling team		came in but not caught
7/22	Rainy Lake	Diurnal	BRI traveling team		came in but not caught
7/22	Summit	Diurnal	BRI traveling team		came in but not caught
7/23	Murphy Lake	Diurnal	BRI traveling team		came in from way across the lake but not caught, demo for MTCLWG