International Loon and Diver Workshop

Tvärminne Zoological Station,

Hanko, Finland

21. - 22.9.2013

Workshop program and presentation abstracts

Program overview

Saturday 21 September

8-9	*Breakfast*
9-12	*Opening of the workshop* *Presentations: Diver population status and trends* *Presentations: Diver migration and wintering* *Introduction to Tvärminne Zoological Station*
12-13	*Lunch*
13-14	*Presentations: Diver migration and wintering*
14-14.30	*Coffee*
14.30-17.30	*Presentations: Diver migration and wintering* *Presentations: Diver conservation*
19-21	*Dinner*
Evening	*Sauna* *Red-throated Divers (film)* *Divers in stamps and money (exposition)*

Sunday 22 September

8-9	*Breakfast*
9-12	*Presentations: Diver conservation* *Presentations: Advances in diver research*
12-13	*Lunch*
13-14	*Presentations: Advances in diver research*
14-14.30	*Coffee*
14.30-16	*Presentations: Advances in diver research* *End discussion*

List of presentations

Speaker names are given in bold. Abstracts can be found from page 6 onwards in presentation order.

Saturday 21 September

Session 1: Population status and trends

9.15 **Mats Eriksson** (Sweden)
Trends in population size and reproduction of Black-throated Loon and Red-throated Loon in Sweden

9.40 **Arnold Håland** (Norway)
Breeding habitat and recent population changes in a depleted population of Red-throated diver Gavia stellata in Western Norway

10.05 **Pekka Lehtonen** (Finland)
Population status of Black-Throated Divers in Finland

10.30 **Aevar Petersen**, Guðmundur Ö. Benediktsson and Ib K. Petersen (Iceland/Denmark)
Monitoring and population changes of Red-throated Divers in Iceland

10.55 **Diana Solovyeva** (Russia)
Greetings from the land of four loon species: trends, densities, distribution and habitat use of Gavia adamsii, G. arctica, G. pacifica and G. stellata in West Chukotka, Russia.

Session 2: Migration and wintering

11.20 Kalevi Eklöf and **Markus Ahola (**Finland)
Movements of Finnish red-throated divers during breeding and post-breeding periods
No abstract available.

--- Lunch---

13.00 **Ib K. Petersen** (Denmark)
Study on winter distribution and timing of arrival and departure of Red-throated Divers in Iceland using data loggers
No abstract available.

13.25 **Ramunas Žydelis,** Julius Morkūnas, Mindaugas Dagys and L. Raudonikis (Denmark/Lithuania)
Tracking red-throated divers through the annual cycle using satellite telemetry

---Coffee---

14.30 **Jari Valkama** (Finland)
What do the ringing data tell about migration and wintering areas of Finnish Divers?

14.55 Roberto Bao, C. Bartolomé, A. Barros, C.J. Camphuysen, J.A. De Souza, M. Fortin, **Martin Heubeck**, X. Maside, C.S. Roselaar & A. Sandoval (Spain/France/Netherlands/UK)
Status, genetic diversity and possible breeding origin of the Great Northern Diver Gavia immer in Galicia, northwest Spain

15.20 **Andy Webb** (UK)
An approach for monitoring red-throated diver numbers in the Liverpool Bay Special Protection Area

Session 3: Diver conservation

15.45 Kalevi Eklöf and **Pertti Koskimies** (Finland)
Population dynamics and conservation biology of Red-throated Diver in Finland

16.10 **Mats Eriksson (**Sweden)
Impaired chick survival in Black-throated Loon and Red-throated Loon in parts of Sweden

16.50 **Arnold Håland** (Norway)
Reproductive output of the Black-throated diver Gavia arctica in perspective of a dynamic climate in Western Norway

17.15 **James D. Paruk** and David C. Evers (USA)
Conservation Update on the Great Northern Diver (Gavia immer) across North America

Sunday 22 September

9.00 **James D. Paruk** and David C. Evers (USA)
Threat to the Great Northern Diver (Gavia immer) in North America: Mercury, Lead and Marine Oil Spills

9.25 **Volker Dierschke**, Bettina Mendel and Stefan Garthe (Germany)
Threats for divers in German marine areas - how effective are SPAs in the light of fisheries and growing marine industries

9.50 **Ib K. Petersen** and Chris Topping (Denmark)
Using agent-based models to predict cumulative effects on Red-throated Diver from offshore wind farms
No abstract available.

10.15 **Julie Black**, Ben Dean and Jim Reid (UK)
Identifying marine sites for conservation of breeding red throated divers in Scotland

10.40 **Sue O'Brien**, Kerstin Kober, Jennifer Lawson, Jim Reid and Ilka Win (UK)
Identifying a network of protected sites for divers wintering around the UK

11.05 **Aevar Petersen** and Ib K. Petersen (Iceland/Denmark)
Is there competition between Red-throated Divers and Great Northern Divers in Iceland?

Session 4: Advances in diver research

11.20 **Quentin Sprengelmeyer** and Alec R. Lindsay **(**USA)
Revising the phylogeny of Gavia with second-generation sequencing data

---Lunch---

13.00 **Alec R. Lindsay,** Jeffrey M. DaCosta and Michael D. Sorenson **(**USA)
Multilocus genetic analysis of North American common loon populations using "RAD-tag" second-generation sequence data

13.25 **Julius Morkūnas,** Ramunas Zydelis, Mindaugas Dagys , and L. Raudonikis **(**Lithuania/Denmark)
Surgical and husbandry techniques for red-throated divers marked with implantable transmitters and example of surgeries performed in Lithuania.

---Coffee---

14.30 **Jay Mager** and Charles Walcott **(**USA)
Why might it be important to learn more about loon music?

14.55 **Pekka Lehtonen** (Finland)
Individual identification of Black-throated Divers

Other presentations

Pertti Virta (Finland)
Red-throated Divers (film)

Sandy Fuchs (Finland)
Gavia species in stamps and money (exposition)

Trends in population size and reproduction of Black-throated Loon and Red-throated Loon in Sweden

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The Nordic countries hold substantial parts of the breeding populations of Black-throated Loon (*Gavia arctica*) and Red-throated Loon (*Gavia stellata*) in Europe. Hence, the "health" of these species in Sweden, Norway and Finland are of utmost importance for their conservation status, also in a wider geographical perspective. The future of both species is in much dependant on the appropriate management of the breeding populations in this part of the world.

Against this background, and in combination with worries for low breeding success and a complex of potential threats, a volunteer-based system for surveys of the recruitment of the two species was launched in 1994, "Projekt LOM".

On the basis of annual surveys, 1994-2012, our current assessments can be summarised:

BLACK-THROATED LOON

Population size: Long-term increase of the population size, with an indication of levelling-out during the last 10-15 years (data from The Swedish Bird Survey).

Breeding performance: During the last 10 years (approximately), the assessments of breeding performance have been based on data from ca 4 % of the national population. Average breeding success was 0.42-0.46 large chicks per pair and year, on the same level in whole Sweden and enough to compensate for the annual mortality. But there is an indication of a negative trend in South-central Sweden (Svealand), linked to a decreased proportion of broods with two large chicks.

RED-THROATED LOON

Population size: Long-term increase of the population size, related to northern Sweden, while there is a non-significant indication of a decline in southern Sweden (data from The Swedish Bird Survey).

Breeding performance: During the last 10 years (approximately), the assessments of breeding performance have been based on data from ca 6 % of the national population. Average breeding success was 0.69 large chicks per pair and year in South and South-central Sweden; judged to be too low to compensate for the annual mortality, and linked to a decreased proportion of broods with two large chicks in South Sweden (Sydsvenska Höglandet). In North and North-central Sweden, average breeding success was 0.90 large chicks per pair and year; enough to compensate for the annual mortality and on the same level for inland and coastal breeders, foraging in freshwater and marine habitats, respectively.

Breeding habitat and recent population changes in a depleted population of Red-throated Diver *Gavia stellata* in Western Norway

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The Red-throated diver (RTD) has an extensive breeding range in Norway, occurring as a breeding species both in southern and northern Norway. However, breeding densities varies much on a regional level with the minor part of the national population in Southern Norway.

Since 2000 the RTD population in Western Norway has been in focus to improve our knowledge about the status of breeding RTDs. New information has been gained from own surveys in selected breeding areas, in addition to collecting ad hoc information from several sources. Key issues have been to document the trend of breeding RTD in the region, quantify their breeding habitats and if possible gain insights into threats towards RTD during their breeding period. As we consider the RTD being a regional depleted breeding species, we have also worked on issues dealing with historical distribution and breeding habitats.

Marked short term variation in size of the regional population will be discussed in relation to possible impact factors.

Our work will continue as long term studies are necessary regarding RTD and other long-lived bird species. Our RTD-project has economically granted by regional conservation bodies for several years post 2000.

Population status of Black-throated Diver in Finland

Jukka Virtanen[1] and Pekka J. Lehtonen[2]

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The Black-throated Diver (BTD) was BirdLife Finland's bird of the year 2010. Estimates of the BTD population were asked from the local bird associations. Furthermore, all the freshest calculation results available were collected. In the examination the country was divided into three areas: 1) Main lake region, 2) Other Southern Finland and 3) Northern Finland.

According to the pair estimates given by the associations about 9 900 pairs were obtained in the whole country. By emphasising the calculation results of big lakes and the calculation results of well examined small lakes, an estimation of 12 000 -13 000 pairs was obtained. Among the pairs there could be at least 10 000 nesting pairs. The information is scant from the view of Northern Finland.

In the main lake region the population in big lakes which were comprehensive calculated, has increased by at least 76 % in 15 years and that of the whole country has doubled at most in 25 years. Factors which have affected on growth of population of the BTDs are unclear.

Monitoring and population changes of Red-throated Divers in Iceland

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Present population estimate for the Icelandic Red-throated Diver population is 1000-2000 breeding pairs. This has not altered since the first such estimate in 1975, due to lack of sufficiently detailed distributional and numerical data for the country as a whole. Regional surveys have been carried out but not to the degree that warrants modification of the estimate.

Correspondingly little concrete information has existed until in recent years on population changes in breeding Red-throated Divers in Iceland due to lack of monitoring efforts. Only one large area with reasonable numbers of pairs was sufficiently well censused in the past to allow meaningful comparison with present breeding numbers. Repeated censuses in a 30 km² study area at Mýrar (W-Iceland) with 83 breeding pairs in 1978, showed a serious decline up to near 50% in 2007-2012. Monitoring efforts have also revealed changes in non-breeding numbers, breeding distribution, and productivity.

Three potential reasons can be recognized for the observed decline in breeding numbers between study periods; (1) general population decline, (2) abandonment of study area, and/or (3) non-breeding. The main factors, which are believed to have influenced these changes, are drainage of wetlands, predation, aggression from Great Northern Divers, and food shortage.

In 2012 a comparison was made between the Mýrar study area and Núpasveit/Vestur-Slétta (NE-Iceland). These areas had about equal number of pairs (50-60 pairs) but the monitoring results were totally different. Comparison of population changes could also be made with 2008 at both study areas. While the breeding population increased by 20% since 2008 in the north a 42% decline was found in W-Iceland. In 2012 over 50% of territorial pairs were non-breeders at Mýrar but only 11% in the north. Productivity in 2012 was four times better (1,2 chicks/pair) in the north than the west (0,3 chicks/pair).

The most important factors governing these results are believed to be the food situation and Arctic Fox predation. Primary food in W-Iceland was sandeels (Ammodytidae), but the stock has been poor during the past decade or so affecting several seabird species as well as Red-throated Divers. At the Núpasveit/Vestur-Slétta study area the main food was Capelin and cod species. Fox predation seriously impacted breeding at Mýrar, while no effect was apparent in the north.

Greetings from the land of four loon species: trends, densities, distribution and habitat use of *Gavia adamsii*, *G. arctica*, *G. pacifica* and *G. stellata* in West Chukotka, Russia

Diana V Solovyeva

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Plain and mountain tundras of Chukotka, the eastmost part of Siberia, Russia, are typical with breeding of four loons as follows, Yellow-billed Loon (*Gavia adamsii*), Arctic Loon (*G. arctica*), Pacific Loon (*G. pacifica*) and Red-throated Loon (*G. stellata*). In 2002-2012 we investigated breeding distribution and habitats of all four species over the area of 180 km from the west to the east and of 220 km from the north to the south. This area includes mountain tundra in upper reaches of rivers, river flood plains, deltas, inland tundra and coastal tundra.

Quantitative surveys for breeding density (breeding pair density and nest density) and for post-breeding density (brood density and density of non-breeders) occurred in 2009-2012. Selected plots 1 square km each were surveyed on foot during nesting period in Chaun Delta; and selected areas 6 to 116 square km in size were surveyed on foot during post-breeding (brood-rearing) period. Boat surveys were employed along the rivers from their upper reaches to the sea and along the coastal line of the East-Siberian Sea. All loon signs were mapped.

Inland tundra of West Chukotka supports the highest in the world density of threatened Yellow-billed Loon in 0.998 birds per square km. Our data were compared to the published information on loon abundance and distribution in the area. Although historical data are often scarce and non-quantitated we can state that two species Yellow-billed Loon and Pacific Loon had positive trends during 1971-2012, the number of Arctic Loon seems to be stable and the trend of Red-throated Loon is unclear in Chukotka.

Tracking red-throated divers through the annual cycle using satellite telemetry

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Several red-throated divers wintering at the Lithuanian coast have been implanted with satellite transmitters in 2012 and 2013. The transmitter deployment technique used in this study is already established and successfully applied to track diving birds in North America for many years. In Lithuania we achieved long-term tracking of 6 red-throated divers. Wintering birds differed in their mobility, some of them were relatively sessile and others used a series of distinct wintering sites. Tracked divers occurred in marine waters of nearly all countries surrounding the Baltic Sea, and one individual also flew to the North Sea. During spring migration birds moved in a stepping pattern, stopping over at suitable locations for several days. Five individuals were tracked into the breeding season and all of them migrated thousands of kilometers to the high arctic of Russia, the Kara Sea basin.

Despite small sample size, this telemetry study offers the first close insight into thus far unknown aspects of diver ecology. We gain new knowledge about movement patterns and habitat preferences through birds' annual cycle, as well as information important for species conservation, such as probabilities of bird occurrence in waters of national jurisdictions and use of marine protected areas. No other study method offers matching breadth and detail of data about the long distance migration.

This telemetry study is part of LIFE+ project DENOFLIT designed for protecting marine environment in Lithuania.

What do the ringing data tell about migration and wintering areas of Finnish Divers?

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Since 1913, altogether 421 Black-throated and 1,367 Red-throated Divers have been ringed in Finland. Most Black-throated Divers have been ringed as full-grown individuals in the late 1960s while the majority of Red-throated Divers have been ringed as chicks during the last 30 years. There are no foreign recoveries of Black-throated Divers ringed as chicks in Finland, so strictly speaking we do not know where the Finnish birds spend their winters. However, the full-grown birds ringed in Finland during their spring migration appear to winter in the Black Sea region. The Finnish Red-throated Divers seem to winter in Western Europe and the most remote resighting is from Spain. The ring recovery data indicate that main causes of death for both species are oil spills and drowning in fish nets. In addition, many Black-throated Divers have been killed in their breeding areas in Russia.

Status, genetic diversity and possible breeding origin of wintering Great Northern Divers *Gavia immer* in Galicia, northwest Spain

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We review the status of wintering Great Northern Divers *Gavia immer* in Galicia (NW Spain) based on published data on field surveys, necropsies of beached birds and genetic analyses. The species is mainly present from mid-October to mid-May, preferentially occupying exposed sandy coasts, particularly in late winter and spring when flight feather moult takes place. The average wintering population ranges between estimates of 123 birds (95% CI = 76–166), uncorrected for detectability, and 230 birds (95% CI = 130–330) if a correction factor for detectability is applied. This could represent 2.5% of the European biogeographic population (1% level = 50 birds).

The November 2002 Prestige oil spill (POI) had a severe effect on the population, which was apparently reduced by 36% between 2002 and 2003 and by 57% between 2002 and 2005. However, the population had returned to pre-spill levels by 2008/09, possibly by the redistribution of birds from other Iberian wintering areas. Examination of POI victims stranded in Galicia found a lower proportion of adults (56%, n = 39) than among winter oil incident samples from further north in Europe, and identified drowning in fishing gear as a threat to the species in Galicia.

Genetic analysis of these birds (n = 33) showed very low levels of nucleotide site diversity at three mitochondrial DNA loci. Comparison with sequences available in GenBank suggests the species comprises a single panmictic population of small effective population size. As a result, genetic markers perform poorly as tools for assigning individuals to their region of breeding origin. By contrast, biometrics of the POI birds (n = 41), and the incidence of gunshot in their carcasses, suggest an inconclusive Icelandic and/or Greenlandic origin.

An approach for monitoring red-throated diver numbers in the Liverpool Bay Special Protection Area

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Red-throated diver Gavia stellata is present in UK marine waters throughout the year, but until recently, their wintering distribution was poorly understood, apart from in a few key locations. A number of candidate Special Protection Areas (SPAs) for this and other species were surveyed during 2000 - 2009 using traditional aerial survey techniques and resulted in the classification of the UK largest SPAs in the Outer Thames Estuary and in Liverpool Bay in 2010. In order for these SPAs to mean more than just lines on maps, it was important to set conservation objectives for the sites. For Liverpool Bay, the objective was that the peak number during a single winter of red-throated divers should not fall below the baseline estimated population of 1500 individuals.

The Joint Nature Conservation Committee (JNCC) has been tasked with designing a monitoring scheme for seabirds and marine mammals in order to meet the UK government's requirements under a number of international and domestic obligations. This included how to approach monitoring of new and potential SPAs in marine waters. Liverpool Bay SPA was used as a pilot for whether new digital aerial survey techniques could deliver better power to detect change in numbers of red-throated divers and other inshore waterbirds than was possible using traditional aerial survey methods.

HiDef Aerial Surveying Ltd and WWT Consulting Ltd were contracted to carry out two surveys in Liverpool Bay by JNCC. These surveys were completed in February and March 2011. Detailed analysis of the results showed that high levels of precision were possible using this technique and that it could be used to detect changes in the condition of this site using red-throated divers and other inshore species as a proxy for site condition.

Population dynamics and conservation biology of Red-throated Diver *Gavia stellata* in Finland

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The number of breeding Red-throated Diver pairs in Finland is considerably smaller, and the status of the population is more threatened, than generally thought. In parts of Häme, Satakunta and Pirkanmaa, south-western Finland, for example, the breeding population has declined markedly in numbers in recent decades. In spite of this, the third bird atlas of Finland (2006–2010) estimates the present population as 1 500–2 000 pairs. This estimate is 2–3 times as high as the most reliable recent estimate of the population, 600–750 pairs, which is based on 462 breeding pairs found in a species specific nation-wide inventory by BirdLife Finland in 2010.

The breeding success of the Red-throated Diver has declined in many regions in southern Finland especially since the beginning of the 2000s. In Häme, for example, the mean number of broods (successful nestings) per breeding pair was 0.74 in 1976–1979 (n = 39 nesting attempts), 0.87 in the 1980s (n = 117), 0.89 in the 1990s (n = 19), and 0.72 in 2000–2009 (n = 141), but only 0.58 broods per pair in 2010–2013 (n = 76). The respective figures from South Savo, SE Finland, were 0.79 (n = 28) in 1998–1999, 0.68 (n = 161) in 2000–2009, and 0.62 (n = 203) in 2010–2013. The recent respective figures in the north are higher, for example in the Martimoaapa mire in Simo, south-western Lapland: 0.95 in 1993–1999 (n = 112), 0.88 in 2000–2009 (n = 168), and 0.76 broods per pair in 2010–2013 (n = 74). Also in Taivalkoski, further east, Red-throated Divers nested, on average, more successfully in 1998–2013 than in Häme and South Savo, but the figures are not as reliable as from the three other areas due to somewhat lower intensity in the search of unsuccessful pairs. It is not known whether the present level of natality is high enough to compensate mortality or not, as the ringing data of the Finnish population is too scanty to calculate any real mortality estimates.

The Red-throated Diver population seems to be more viable in eastern and northern than in southern Finland. One of the most significant and alarmingly increasing threats to the breeding success is disturbance by hikers, nature photographers, bird-watchers, fishermen, summer cottage owners, and other people visiting nest ponds. Tens of nesting attempts are destroyed by human disturbance every year especially in southern and western Finland.

Artificial rafts have been built for Red-throated Divers in Häme since the 1970s and later on in various parts of Finland. In many regions the average nesting success has been higher in these rafts surrounded by water than along the shores where also mammalian predators are able to rob diver eggs. Rafts should be built in the future, too, but this work requires expertise, because in too visible or otherwise unsuitable sites rafts may increase the vulnerability of divers for predation and disturbance by humans.

Impaired chick survival in Black-throated Loon and Red-throated Loon in parts of Sweden

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Surveys of the breeding performance by Black-throated Loon (*Gavia arctica*) and Red-throated Loon (*Gavia stellata*) indicate that the percentage of broods with two chicks has decreased (for both species) since the mid-1990s in parts of Sweden. As the chicks' survival primarily is dependent on the parent's ability to provide food, this result might indicate impaired foraging conditions. Three (not necessarily exclusive) explanations are discussed:

Reduced abundance of fish: Less likely, as concluded from results from gill-net fishing.

Reduced light penetration due to increased levels of humus: Humus concentration has increased in lakes in southern Sweden and Norway during recent decades. Having in mind that loons are visual feeders, this might have made fish prey more difficult to detect. In lakes used for breeding or foraging by loons in South Sweden, light penetration has decreased by 17-18 % since mid-1990s, coincident with a decreased percentage of 2-chick broods, for both species. But for Black-throated Loon, a decreased percentage of 2-chick broods was recorded also further northwards, where no reduced light penetration has been noticed.

Thus, there is no perfect evidence of any link between impaired light penetration and the decreased percentage of 2-chick broods.

Increased contents of mercury in prey fish: No direct evidence; no eggs collected after 1997 have been analysed. But indirect evidence so far as Hg-contents in freshwater fish has increased since 1990s, and median contents in Perca fluviatilis correspond to levels where a productivity drop by 50 % cannot be excluded, with reference to findings for Gavia immer in North America.

The increased exposure to methylized mercury is related to leakage of mercury from terrestrial habitats in the catchment area to nutrient-poor freshwater lakes. Using reference values for total phosphorus (<0.03 mg/l), pH (< 6.0) and alkalinity (<0.10 meq/l) proposed for environmental monitoring in North America, it is assumed that around 10 % of the breeding (and foraging) lakes used by Black-throated Loons and 30 % of the lakes used for foraging by Red-throated Loons in Sweden may be at risk.

Definitely, the risk of exposure to methylized mercury must not be neglected, but to be further investigated.

Reproductive output of the Black-throated Diver *Gavia arctica* in perspective of a dynamic climate in Western Norway

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The main objective of our Black-throated diver (BTD) study has been to improve the knowledge about the size and trend of BTD regional breeding population in the coastal and fjord landscapes in Western Norway.

In addition to surveys to map breeding pairs in the region (from 2000 onwards), including both coastal and lowland sites and alpine breeding lakes, we have also focused monitoring a number of breeding lakes to document the reproductive output of our BTD's. We search for pattern in success and failure, and will compare their performance to a set of environmentally factors which may influence their breeding outcome. Comparison with results from other Nordic BTD populations serves as an important perspective to what happens in this regional population.

In perspective of earlier reports we still observe a continuing (but slow) loss of breeding pairs at traditional lakes, but also seeing that a set of pairs continues to reproduce. The key question we have is what factors do influence our BTD population negatively. Are negative factors operating at the breeding grounds, or is it during migration and wintering that survival is too low? Our results so far document a low breeding success in our BTD population, clearly indicating that some negative factors really do operate at the regional level in Western Norway.

Conservation Update on the Great Northern Diver (*Gavia immer*) across North America

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The global population of the Great Northern Diver (Common Loon; Gavia immer) is robust population with a total estimated breeding population of 252,000-264,000 territorial pairs. Across their range, in the northern USA and all of Canada, populations are doing mostly well. The non-breeding cohort is estimated at 607,000 to 635,000 individuals. Estimated 94% of the breeding population resides in Canada with the remainder in USA.

Loons are not a species of concern in any Canadian province, although apparent population declines are occurring in Nova Scotia. Breeding productivity appears lower in the eastern provinces compared to the western provinces.

In the western contiguous USA, approximately 100 breeding pairs occur across 4 states: Washington (~15 pairs), Idaho (1-2 pairs), Montana (60-70 pairs) and Wyoming (15-20 pairs). Loons are listed as a Species of Concern in WY and Special Concern in WA and ID. The central USA supports over half of the entire USA loon breeding population (6000 to 7200 territorial pairs), yet it is also the region showing the greatest decline in historical range and currently requiring our greatest conservation efforts. Breeding populations have been extirpated in Illinois, Indiana, Iowa and Ohio, and have retracted from the southern portions of North Dakota, Minnesota, Wisconsin and Michigan (Species of Concern).

In the eastern USA, populations have rebounded from low levels in the 1970's and are increasing in Massachusetts, upstate New York, Vermont, and New Hampshire, and appear stable in Maine. Currently, loons are still listed as Special Concern in MA and State Threatened in NH, but have recovered sufficiently in VT to no longer be listed. Key threats to loon populations have been identified and steps have been taken to minimize their potential population-level wide impacts.

Threat to the Great Northern Diver (Gavia immer) in North America: Mercury, Lead and Marine Oil Spills

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Many anthropogenic threats adversely impact the survival, health and reproductive success of the Great Northern Diver (Common Loon; Gavia immer). Three key threats have received much national attention and are discussed: mercury (Hg), lead (Pb) and marine oil spills.

Atmospheric Hg deposition is highest in the East and lowest in the West although this pattern may be changing. Areas within the continent with elevated Hg levels have been identified as biological hotspots. Thus, monitoring of loons in these regions is a high priority. Threshold levels have been established for egg, blood and feathers (1.3 ug/g, 3.0 ug/g, and 40.0 ug/g, respectively).

Poisoning resulting from the ingestion of Pb fishing tackle has been identified as a significant cause of Common Loon mortality throughout North America. It affects nerve impulse transmission, causing systemic paralysis. On a national (USA) level, the EPA has not moved any legislation forward to reduce the risk of Pb contamination to wildlife, so many states have passed legislation (NH, NY,ME, MA, VT, and WA) or are/have currently attempted it (WI) that would reduce or restrict its use.

Marine oil spills are a major threat to seabirds (i.e., divers). A historical review of offshore North American oil spills that have impacted loons is discussed including the Exxon Valdez (Prince William Sound, Alaska) and the BP Deepwater Horizon (northern Gulf of Mexico). In 1996, approximately 200 loons wintering off the Rhode Island coast were killed in the Cape Cod oil spill. On-site replacement of loons was deemed logistically impractical because loons do not breed in the state, so state and federal trustees made a precedent-setting decision that mitigation would entail the purchase of lake shoreline breeding habitat in New England. Progress has been made on many fronts which should ensure a bright future for Common Loon populations in North America.

Threats for divers in German marine areas - how effective are SPAs in the light of fisheries and growing marine industries

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Considerable numbers of Red-throated and Black-throated Divers use the German sections of North Sea and Baltic Sea for wintering and staging during spring migration. Growing pressure from shipping, construction of offshore wind farms and aggregate extractions on habitats of divers and other seabirds resulted in conservation action, i.e. a number of marine areas has been designated as SPA. In this paper, threats for divers from the marine industries in German waters are roughly quantified and compared to the protection gained from the SPAs.

Based on aerial surveys, diver densities at sea are known throughout German waters, and from the area used already today (or in future) by marine industries the numbers of divers affected by human pressures can be calculated. Considerung the total area already used or planned for industrial purposes, no less than 5770 Red-throated Divers may be confronted with habitat loss due to avoidance of wind farms and disturbance from shipping and aggregate extraction. This refers to c. 22% of the German spring population. In the Black-throated Diver, which occurs mainly in the Baltic Sea, the number of affected individuals would be 830 (c. 21% of the German spring population). In addition to habitat loss, bycatch in gillnets is a major factor influencing diver populations in Germany, as estimated numbers of 420 Red-throated and 265 Black-throated Divers are killed annually.

A total of 17 SPAs has been designated in German coastal and offshore waters. Though most of them host divers, two are of considerable importance: “Eastern German Bight” in the North Sea and “Pomeranian Bay” in the Baltic Sea. In spring, these SPAs are used in average by 3580 and 1450 divers, respectively. According to the ordinances of these SPAs neither wind farms nor shipping, aggregate extractions and gillnet fishery are excluded. However, wind farms placements inside SPAs are currently impeded as subsidies for renewable energies at sea are currently only available outside Natura 2000 sites.

Identifying marine sites for conservation of breeding red-throated divers in Scotland

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The EU Birds Directive requires Member States to identify Special Protection Areas (SPAs) to protect rare, vulnerable and migratory birds, both on land and at sea. In the UK, JNCC is in the process of identifying a network of marine areas that regularly support aggregations of these birds during winter and summer. Scotland is an important area for red-throated divers, with the entire UK breeding population breeding in Scotland.

We developed a habitat suitability model for breeding red-throated divers in Scotland in order to identify the most suitable marine areas for inclusion within an indicative marine SPA network. At-sea distribution data were collected over five years (2003-2007) around representative red-throated diver breeding territories in Shetland, Orkney, and the Outer Hebrides. A Generalised Additive Model was used to describe the marine habitat of the species based on a range of environmental parameters. Predicted habitat suitability was then used in combination with observed nest distribution to predict use of marine waters near breeding sites. A mathematical tool known as maximum curvature was applied to predicted use to delineate boundaries around the areas of greatest use; the most suitable of these are likely to be proposed for designation as SPAs.

Identifying a network of protected sites for divers wintering around the UK

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The EU Birds Directive requires Member States to identify Special Protection Areas for birds, both on land and at sea. In the UK, JNCC is in the process of identifying a network of marine areas which regularly support aggregations of great northern diver (*Gavia immer*), black-throated diver (*Gavia arctica*) and red-throated diver (*Gavia stellata*) outside the breeding season. The UK is an important wintering area for these three species, which occur around the entire coast of the UK. Their distributions do not overlap greatly; red-throated divers occur in highest densities in south-east England; great northern divers in north-west Scotland; black-throated divers in a few isolated populations mostly in Scotland.

JNCC is advising the statutory authorities on which areas could be included within a network of marine protected areas using objective, repeatable scientific methods. This was done through a programme of data collection and collation on numbers and distribution of waterbirds around the UK outside the breeding season, in 50 areas identified to potentially hold nationally or internationally important numbers of birds. Data were collected by visual aerial surveys, boat-based surveys and land-based counts. Novel methods were developed for modeling survey data to facilitate SPA boundary setting, using distance sampling, kernel density estimation and maximum curvature. These methods have been used to identify two SPAs which are now classified for red-throated diver and are being applied to many other areas around the coast of the UK to form a network of protected areas.

Is there competition between Red-throated Divers and Great Northern Divers in Iceland?

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Present population estimates for Red-throated Divers (RTDs) is 1000-2000 breeding pairs and 300 for Great Northern Divers (GNDs). During past decade information has been collected on breeding site locations of these species in Iceland. The material now includes ca 1000 identified nest sites of RTDs and ca 250 of GNDs.

Analysis of the material clearly shows a general size difference in breeding lochs of the two species. Different general distribution also exists. GNDs nest mostly inland and in highland regions. Most of the RTD population breeds within ca 10 km from sea, and they rarely breed above ca 200m a.s.l. Still the breeding distributions of the two species overlap, as GNDs breed down to coast.

Only rarely is more than one pair of GNDs found on the same lake. Only ca 10 lakes are on record with more than a single pair, mostly the largest lakes in the country. Similarly RTDs and GNDs seldom breed on the same lake. Only around 15 such sites are known. Little is known how long the two species will co-exist on the same lake, when GNDs establish themselves on RTD lakes.

GNDs are well known for their aggressive behaviour on breeding lakes. The pairs seem to vary in aggressiveness and tolerance to other bird species, possibly dependent on the stage of breeding. Many species are known to be attacked, e.g. ducks, Slavonian Grebe, Whooper Swan, as well as Arctic Fox. Many examples exist of birds being killed, even swans, yet these two species sometimes nest only a few meters apart. Examples exist of declines in numbers of ducks and of RTDs following GNDs starting breeding at a new site.

Some general observations can be mentioned where the species co-exist. RTDs usually nest as far away from the GNDs as possible but distance depends on the shape of breeding lake. RTDs usually keep a much lower profile than on lakes without breeding GNDs. The RTD off-duty birds spend much less time on breeding territory than where they breed alone. GNDs may charge RTDs, which respond by flying away or jump on land and stay there until GNDs leave.

Lakes where GNDs and RTDs co-exist clearly could form an interesting study. Quantified observations need to be carried out, including behavioural work.

Revising the phylogeny of *Gavia* with second-generation sequencing data

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The evolutionary history of the extant five species of loons (*Gavia* spp.) has not been a contentious issue for evolutionary biologists or ornithologists. However, the species-status of the pacific loon (*G. pacifica*) has fluctuated – especially in North America – over the past century, at times being considered a sub-species of the arctic loon (*G. arctica pacifica*). Previous authorities and morphological analyses considered *G. pacifica* to be sister to *G. arctica,* but surprisingly, recent molecular phylogenetic work has indicated *G. pacifica* is sister to a *G. immer-G. adamsii* clade.

In this work, we test these phylogenetic hypotheses using massive amounts of second-generation sequencing data (hundreds of independent loci) from multiple samples of each *Gavia* species to arrive at a robust phylogeny of the family. These genetic data along with the estimated divergence times for each species will help illuminate which geologic events (e.g., glacial maxima/minima) may have played significant past roles in diversifying the *Gavia* lineage.

Multilocus genetic analysis of North American common loon populations using "RAD-tag" second-generation sequence data

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Common loons (*Gavia immer*) breed on lakes in the mid- and high-latitudes of North America and winter on the Pacific and Atlantic near-coastal waters. Establishing linkages between breeding populations, migratory routes and overwintering regions is important for providing a comprehensive understanding of threats to loon populations. Using second-generation DNA sequencing technology on samples from breeding, migrating and overwintering loons from across North America, we created single-nucleotide-polymorphism (SNP) genetic profiles based on hundreds of loci.

Analysis of this large dataset provides evidence that, 1) common loon populations show patterns of genetic diversity consistent with isolation by distance, 2) the North American Great Lakes are an important migratory stopover site for birds that breed across a greater range than previously described, and 3) these genetic markers provide enough resolution to assign wintering individuals back to their breeding populations. These results improve our understanding of common loon demographics and conservation. Further, they demonstrate the dramatic power of second-generation sequencing data for informing studies of loon populations.

Surgical and husbandry techniques for Red-throated divers marked with implantable transmitters and example of surgeries performed in Lithuania

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Satellite telemetry has been used in many studies around the world to learn more about breeding, molting and wintering areas of diving birds. During these projects ~ 1800 diving birds of at least 12 species were implanted with the transmitters.

In Lithuania, Red-throated divers were studied along with Velvet Scoters and Long-tailed ducks as a part of the EU LIFE+ funded DENOFLIT project, with the aim to investigate their movements off the Lithuanian cost of the Baltic Sea during the wintering period. The divers were captured on wintering grounds 0.5-2 km off the coast of Lithuania using the night lighting technique. The captured divers were transported in well ventilated animal travel crates and cardboard boxes to a veterinary clinic ~20 km away for surgery. The surgery procedure was adopted from veterinarians at the USGS-Patuxent Wildlife Research Center.

PTT-100 transmitters manufactured by Microwave Telemetry were surgically implanted into the bird's abdominal cavity to right abdominal air sac, following general anesthesia using isoflurane gas for both induction and maintenance. In some cases divers were additionally premedicated with Xylazine and Ketamyne. Two types of transmitters were used: larger ones measured approximately 6×3.5×1.5 cm and weighed 46 g, while smaller units measured 4.5×2×2.5 cm and weighed 31 g. Transmitters were made to withstand pressure at depths of up to 30 m.

The transmitter's 20 cm antenna exited the skin laterally to the sacral vertebrae. The transmitters used in this study were with no abrupt edges and were additionally dressed with nylon mesh. After the surgery divers were spritz bupivocaine as an analgesic to the incision place.

After the surgery divers injected with fluids and carefully washed with water and dried. Birds were kept for ~1 h in crates at a room temperature for recovery. The next 3-7 hours before the release, divers were kept at a temperature of +1 - -4 °C. After the sunset birds were force-fed with small fish and released from the seacoast, close to the capture site.

In 2012-2013 transmitters were implanted to 9 divers, 6 of them survived longer than 1 month, 1 bird survived about 10 days, and two birds produced no signals. Five divers were successfully tracked for over 6 months from the wintering areas to the breeding grounds.

Why might it be important to learn more about loon music?

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Although it is perhaps one of the more identifiable characteristics of loons in general, we know very little about the "messages" and "meanings" of the various calls that constitute the loon vocal repertoire. The advent of technologies to analyze acoustic signals as well as reliable methods to individually-mark and identify individuals in the field have allowed biologists to conduct empirical investigations of the function of long-distance acoustic signals in loons.

Here, we review research that we and others have conducted considering acoustic signaling among loons, and delve into our specific work investigating the information communicated specifically by the territorial 'yodel' of male common loons (*Gavia immer*). We then explore what benefits can be gained, from the perspectives of animal acoustic communication as well as loon conservation and management (across all species), by continuing studies that explore the structure and function of acoustic signals within loons. Such future work can greatly enhance our understanding of the behavioral and ecological adaptive significance of such acoustic signals in this unique group of non-oscine birds.

Individual identification of Black-throated Divers

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Individual differences in the plumage of Black-throated Divers (BTDs) have been studied on lake Suontee (61° 39´ N, 26° 31´ E). Three different criteria were found: 1) white stripes on the sides of the neck, 2) Number of dots close to water on both sides in the rear of back, and 3) angular dots at shoulder just back of the neck.

Males and females can be distinguished be observing BTDs exactly from the side. The end face of female is curved smoothly while the male has a sharp angle of the forehead and top of the head. The male is slightly larger than the female. The difference in size is, however, often difficult to observe.

Most often BTDs have white five vertical stripes on both sides of the neck. In general, the second stripe from front is the highest, next highest is usually the first or the third stripe, then the fourth and the fifth is the shortest stripe. Often, the first and the fifth, and at least the fifth stripe are narrower and fainter than the other ones. Stripes are of different thicknesses and the thicker they are the more powerful-looking figure is. Great criteria for individual identification is, however, small deviations from the normal: there are sometimes short stripes or white dots or partly broken stripes. In addition BTDs may have four, and even only three stripes and sometimes six or even seven stripes.

BTDs have at the in rear of the back on both sides 20-55 white dots. They can be calculated in floating bird. The number of these dots remain the same from year to year. Angular dots at shoulder just on back of the neck can also be used for individual identification.

The same BTD pair was followed during six consecutive years 2007-2012 and all criteria remained almost the same from year to year.