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Migration and appearance of Black-throated *Gavia arctica* and Red-throated Divers *Gavia stellata* in the Gulf of Finland

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The Gulf of Finland is an important migration flyway for divers of the genus *Gavia* in both spring and autumn. Four species occur, Black-throated *Gavia arctica*, Red-throated *G.stellata*, Yellow-billed *G.adamsii* and Great Northern Diver *G.immer*. The two latter species are scarce and not treated here. Watching the arctic migration is popular in Finland and Estonia, and the migration is relatively well known. However, most of the literature is published in local languages and much information is therefore unavailable in English. In this article, we summarise the literature and add some analysis of additional data. We concentrate on the comparison of the timing of the migration and the numbers in different areas, as well as the appearance of the birds during migration, which is related to their moult. Several important issues related to migration are excluded here, including population changes, see Ellermaa & Lindén (2015) and Hario *et al* (2018) about this, and the effect of weather on the visible migration, daily migration schedules, resting areas *etc*.

Breeding and wintering areas and migration in the Baltic

Both species breed widely in northern Eurasia, both on the tundra and in the taiga, the distribution of Red-throated Diver extends somewhat more to the north. For example, it breeds in Spitsbergen, where the larger species does not occur. Red-throated Diver prefers smaller and shallower lakes for breeding, but they also fish in larger lakes (Cramp & Simmons 1977). The wintering areas of the western populations of both species are spread out over the coasts of Europe. For Black-throated especially, an important wintering area is the Black Sea, which gathers birds from a large area (*e.g.* Schüz 1974). A similarly important area is the Baltic Sea, mostly for migration, especially in spring, but also in winter. According to Durinck et al (1994) Black-throated is the commoner wintering diver species in the central parts of the Baltic from the coast of Poland to Öland, and west of Rügen. The wintering area of Red-throated Diver is concentrated to the northerly areas of the Baltic Sea, the North Sea and the Atlantic coasts around the British Isles. The most important areas in the Baltic are the Gulf of Riga to the Irbe strait, the coast of Lithuania, the Pomeranian Bay, the northwest Kattegat and Smålandsfarvandet (Durinck *et al* 1994). Around the British Isles the most important area is the Thames estuary (Scott *et al* 2019). The Finnish breeding Red-throated Divers spend their winter in an area extending from Denmark to the Bay of Biscay (Saurola *et al* 2013). The Baltic Sea is also an important migration area for this species.

Although most of the breeding areas of these two species overlap, there is a distinct average difference in the wintering areas, and also, related to that, in the migration routes of the Baltic. Many Black-throated arrive at the Baltic Sea overland, from the south (*e.g.* Schüz 1974). These birds mostly originate from the Black Sea and Southern Ukraine. They continue to the Gulf of Finland and the Gulf of Bothnia. The relative numbers between these two routes vary, but often they

are equal, as in the 1994 study by Leivo *et al* (1995b). It is not well known if these two routes correspond to different populations or if single birds choose different routes in different years, depending, for example, on the weather. The latter option was preferred by Leivo *et al* (1995b). In any case, there seems to be a negative correlation between the numbers on any given day between the sites along these two routes (Pöyhönen 1995). At some point the birds of both routes cross overland, some already in southwest Finland or at some other known sites on the northern shore of the Gulf of Finland (see Leivo *et al* 1995b), but many only cross in the Vyborg area while the birds of the western route cross in the northern parts of the Gulf of Bothnia. Many of them are heading to the northern areas in Russia, and are making a long detour to the Baltic Sea. The most distant ring recovery of a Black-throated Diver ringed in the Baltic is from the lower Lena river (Schüz 1974).

It is thought that in autumn many Black-throateds cross overland from northern Russia to the southern Ukraine and the Black Sea and consequently their numbers in the Baltic are lower. This was deduced from ringing studies (*e.g.* Schüz 1974). A satellite-tagged adult female breeding in Finland left the inland lakes on 25 October and headed to a direction between south and south-west, to the Gulf of Riga, from where it continued after only one day,flying straight to the Black Sea, therefore needing only less than three days for the whole of its autumn migration. The bird spent its winter at the Black Sea, moulting wing feathers in January. Another individual, a juvenile, left the inland lakes of Finland on 3 November, spent two days in the Gulf of Finland close to the northern coast of Estonia, and continued overland to Ukraine, to the vicinity of Kiev. It spent three weeks there, after which it slowly continued towards the Black Sea, reaching it by the last days of November (Birdlife Finland 2016). So those individuals flew almost straight to the Black Sea, not following much of the Baltic coast, and therefore corresponding well with the classic loop migration strategy. However, quite a lot of Black-throated Divers are seen at the migration watching points along the Gulf of Finland in autumn as well, flying in the same direction as Red-throateds. Also, the migration of this species in the southwesterly direction may be quite strong in the interior of southern Finland, and regularly seems to be strong in the southern White Sea, also towards southwest.

In spring, many Red-throated Divers arrive in the Baltic from the west. They fly through Kattegat and cross southern Sweden inland, or from the North Sea across the northernmost parts of Germany to the southernmost parts of the Baltic. They stop for about a month, mostly close to the shores of northern Germany and western Poland, around the Gulf of Riga or the Gulf of Finland (Kleinschmidt *et al* 2015). A few continue to the Gulf of Bothnia, with most continuing via the Gulf of Finland. This species is also a numerous migrant in northern Norway in spring, unlike Black-throated (Trektellen.org 2019). It seems logical to think that Red-throated Divers aiming for the westerly breeding areas in the Nordic countries or further north fly along the Norwegian coast, while Black-throateds coming from the south use the Gulf of Bothnia to reach the same destination. Red-throated Divers are heading more or less for the same breeding areas as Black-throateds but fly there by a straight route, without the detour of the larger species. The autumn migration of Red-throated follows broadly the same route as the spring migration but in the opposite direction.

Quite a few Red-throated Divers have been tagged with satellite transmitters when wintering in Lithuania and Germany (Kleinschmidt *et al* 2015, Žydelis *et al* 2017). These birds mostly bred along the shores of

	Spring	Autumn
Ristna (W Estonia)	10%[1]	
Puhtu (W Estonia)	79%[2]	
Põõsaspea (W Estonia)	75%[3], 76%[19]	78%[16],86%[17],74%[18]
Halias (Finland)	12%[4]	35%[13]
Rönnskär (Finland)	6%[5], 8%[6]	48%[14]
Santahamina (Finland)	12%[7]	32%[15]
Kummelskär (Finland)	25%[8],21%[9]	
Vyborg (Russia)	32%[10],35%[11]	
Kurortny (Russia)	88%[12]	

Table 1. The ratio of identified Red-throated Divers to all identified divers.
1) Spring of 1994 (Leivo et al 1995b). The divers at Ristna were mostly Black-throated heading ENE-NE and the same birds were apparently seen in the Porkkala archipelago on the south coast of Finland 1,5-2 h later. So although situated in Estonia, this western site is part of the "Black-throated Diver main road."; 2) Spring of 1993 (Leivo et al 1994); 3) Spring of 1993 (Leivo et al 1994); 4) April-June 1979-2017 (Tringa 2018); 5) Spring of 1993 (Leivo et al 1994); 6) April-June 2000-2017 (Rönnskär bird observatory 2019); 7) April-June 1952-2018 (Tiira 2018); 8) Spring of 1993 (Leivo et al 1994); 9) Springs 1973-1995 (Pettay 1995) 10) Spring of 1993 (Leivo et al 1994); 11) Kontiokorpi & Rusanen 2014; 12) Kontiokorpi & Rusanen 2014; 13) August-November 1979-2017, Tringa 2018); 14) August-November 2000-2017, Rönnskär bird observatory 2019); 15) August-November 1952-2018, Tiira 2018) 16) September-October 2013 (Jörpeland 2013); 17) Autumn 2004 (Ellermaa et al 2010); 18) Autumn 2009 (Ellermaa et al 2010); 19) Spring 2019, see the appendix.

the Kara Sea and somewhat more to the south in inland Russia. Their route from Germany to the breeding areas continued along the southern shore of the Baltic Sea and to the Gulf of Finland, the same route that is known from the visible migration studies.

The migration observation sites referred to and the study material

Halias - the Hanko bird observatory, is located at the southernmost mainland tip of Finland, about 100 km west of Helsinki, in the western parts of the Gulf of Finland. At the observatory there are regular migration counts on most days, often around the year. Divers migrate on both the south and north side, with the birds to the north seeming to

	Black-throated Diver		Red-throated Diver	
	Spring average (min-max)	**Autumn average (min-max)**	**Spring average (min-max)**	**Autumn average (min-max)**
Põõsaspea (W Estonia)	8564[4]	4050[1], 7888[2], 11 377[3], 3098[5]	23 424[4]	25 479[1], 22 523[2], 28 633[3], 10848[5]
Halias (Finland)	5720 (2630-11 180)[6]	490 (130-1190)[6]	780 (240-1550)[6]	280 (75-550)[6]
Rönnskär (Finland)	3270 (580-7170)[7]	290 (65-790)[7]	290 (41-590)[7]	260 (16-260)[7]
Santahamina (Finland)	3550[8]	135[8]	430[8]	70[8]
Kummelskär (Finland)	24 000[9]		6 400[9]	

Table 2. Season totals.
1) Ellermaa et al (2010) autumn 2004; 2) Ellermaa et al (2010) autumn 2009; 3) Ellermaa et al (2010), autumn 2009, unidentified included; 4) Leivo et al (1994) spring 1993, unidentified not included. The total number of divers was 43124; 5) Jörpeland (2013) between 24 August and 26 October, unidentified not included; 6) Unidentified included, years 1996 – 2017; 7) Unidentified included, 2000 – 2017; 8) Unidentified included, 2007 – 2017; 9) Pettay (1995)

head inland. Data from the years 1979-2017 and 1996-2017 is used here, originating from the Ornithological Society of Helsinki,Tringa ry (2018).

The Porkkala archipelago - located southwest of Helsinki. There are several migration watchpoints along the north-south axis, of which the outermost, Mäkiluoto, is in the outer archipelago, Pampskatan is on the mainland in the inner archipelago and Rönnskär is located between those two. Divers fly eastwards on a broad front, some well south of Mäkiluoto but many also to the north of Pampskatan - some of the latter birds seem to head inland, but some cross the Porkkala headland just north of Pampskatan and continue northeast along the coast. Rönnskär is a bird observatory, but the data unfortunately also includes some incomplete seasons. (Rönnskär bird observatory 2019).

Santahamina - located in Helsinki. The migration watchpoint is at the outermost point of the inner archipelago. Migration counting has been carried out for dozens of years at the site, almost around the year, but never really in a standardised fashion, and with a varying activity level. Most of the divers fly quite far south, along the outer chain of

islands, and even south of the southernmost ones, over the open sea. There is data from 1952 to 2018, but with more activity from 1971. The best data is stored in digital format, beginning from 2006.

Söderskär - located at the outer archipelago of the Borgå municipality, southeast of Helsinki, Finland. For decades quite active counting has been carried out every spring. Nowadays Söderskär is also a bird observatory. There is less keen counting there in autumn. A majority of the divers pass south of the island, over the open sea, but many also on the northern side.

Kummelskär - located in the archipelago of the Borgå municipality, east of Söderskär. Active migration counting in spring during the 1980's and 1990's, less so after that. Pettay (1996) has been used as the source of data.

Vyborg - a town close to the bottom of the deep bay in the western parts of the Isthmus of Karelia, Leningrad Oblast, Russia.This is the last point where to head inland for the divers migrating along the Finnish south coast and many divers only fly inland here. The data is mostly from Kontiokorpi & Rusanen (2014).

Ristna - the westernmost tip of the large island of Hiiumaa in western Estonia. Migration counts have been sporadic, with some seasons closely watched.

Puhtu / Virtsu - located on the west coast of mainland Estonia (not in the Gulf of Finland), at the northern end of the Gulf of Riga, where the mainland coast reaches close to the large islands of Muhu and Saaremaa. Migration counting has been sporadic, with some seasons more closely watched.

Põõsaspea - The northwest tip of mainland Estonia. Lots of migration watching in autumn, including several complete seasons (July to November) of organised counts (2004, 2009, 2014, 2019). Some counting also in spring, but less intensively with no organised counts after a major effort in 1993 (Leivo 1994, Pettay 2014). Most of the divers fly between the point and Osmussaar island, 6 km away. Some also pass on the inland side, but normally not far inland.

Pakri neem, Paldiski - The tip of a long headland west of Tallinn, Estonia. It is situated 35 km east of Põõsaspea.

Kurortny - A district in Russia, part of the administrative area of St Petersburg. Located at the northern shore of the extreme eastern part of the Gulf of Finland. Several observation points have been used with counts being sporadic. The data is from Kontiokorpi & Rusanen (2014).

Relative numbers

The ratio of Red-throated Divers compared to all identified divers is shown in Table 1 for the above described sites. It is well known that the ratio of Red-throated Divers grows higher towards the south and east, see for example Leivo *et al* (1994) and Pettay (1995). In autumn in the interior of southeastern Finland, the ratio, as well as the total numbers, vary between the years, but the migration may include both species at about similar numbers (*e.g.* Kontiokorpi 1992).

Absolute numbers

See Table 2. The total numbers of observed Black-throated Divers are much lower in autumn, as is well known already. This is because of the low numbers of divers following the Finnish south coast (Pettay 2014), even though the numbers counted in Estonia are comparable in both seasons. The numbers of Red-throateds are roughly equal on the Estonian side in both seasons (Pettay 2014), but along the south coast of Finland Red-throated is also distinctly less common in autumn. This is not true in the interior of Finland.

	Black-throated Diver		Red-throated Diver	
	Spring median	**Autumn median**	**Spring median**	**Autumn median**
Põõsaspea (W Estonia)	15 May[10]	7 October (n=3098)[1] 10 October (n=5758)[11]	15 May[10]	28 September (n=10848)[1] 29 September (n=17155)[11]
Halias (Finland)	20 May (n=53050)[2]	8 September (n=5952)[3]	20 May (n=7369)[2]	17 September (n=3129)[3]
Rönnskär (Finland)	17 May (n=21042)[4]	21 September (n=1301)[5]	14 May (n=1769)[4]	2 October (n=1216)[5]
Santahamina (Finland)	13 May (n= 15176)[6]	12 September (n=702)[7]	20 May (n= 2034)[6]	2 October (n=329)[7]
Kummelskär (Finland)	25 May[8]		28 May[8]	
Vyborg (Russia)	20-23 May ("peak")[9]			

Table 3. Median migration dates.
1) Jörpeland (2013); 2) Unidentified not included, April-June 1979-2017; 3) Unidentified not included, August-November 1979-2017; 4) Unidentified not included, April-June 2000-2017; 5) Unidentified not included, August-November 2000-2017; 6) Unidentified not included, April-June 2007-2018; 7) Unidentified not included, August-November 2007-2018; 8) Pettay (1995); 9) Kontiokorpi & Rusanen (2014); 10) Spring 2019, see the appendix; 11) Unidentified included.

The season totals at Põõsaspea from spring and autumn are roughly comparable. Leivo *et al* (1994) made an estimation of the total numbers of divers that migrated in the northern Baltic during the spring of 1993, based on data from many sites. They estimated that the total number was close to 150 000 individuals, and they were roughly equally both species, and of the Black-throateds roughly equal numbers flew via the Gulf of Bothnia and the Gulf of Finland.

The much lower numbers of Black-throated Divers in autumn at the Finnish sites are normally explained by the loop migration strategy. At both Halias and Rönnskär 92% of the Black-throated Divers were seen in spring, and at Santahamina 96%. However, it should be noted that the numbers of Red-throated in autumn are also much lower. At Halias 74% of Red-throateds are seen in spring and at Santahamina the corresponding figure is 86%. At Rönnskär, on the other hand, numbers are almost equal, with 52% of Red-throated Divers in spring. Also it should be noted that in Estonia Black-throated numbers are not lower in autumn than in spring. Good autumn migration of both species is sometimes seen in the interior of the southern part of Finland, but less so in other years (*e.g.* Kontiokorpi 1992, Kontkanen

1994 and 1995). When this happens, the migration is spread out on quite a wide front, and the total number of individuals may be rather high. Kontiokorpi (1992) reported a season total of 10 175 divers at one site in 1991, consisting of about equally both species. However, that was a good year, and the season total for the same site in 1989 was just 563 birds. Another good season number reported from an inland site was a total of 12 500 divers, mostly Red-throateds, in Lappeenranta in 1984 (Kontiokorpi et al 1996). It can be said that in autumn in the interior of southeastern Finland it is possible to see very good diver migration, but the migration is much more variable and less predictable than along the coasts. In many other waterbirds the numbers along the Finnish south coast are much lower in autumn compared to spring, e.g. Brent Goose *Branta bernicla*, Common Scoter *Melanitta nigra* and even the scarce Steller's Eider *Polysticta stelleri*. These all migrate north-east in spring and south-west in autumn, and concentrate closer to the Finnish coast in spring and closer to the Estonian coast in autumn. Unlike these species and Red-throated Diver, Black-throated Diver has a strong southern component in its migration direction in autumn, and although the observed numbers along the Estonian coast are rather high, it may be that the migration concentration to the coast is weaker, and the total numbers visiting the Gulf of Finland are higher than previously thought. For example, it is very probable that neither of the Finnish satellite-tagged individuals referred to above would have been seen at the normal migration observation points. On the other hand, in the southern part of the White Sea in autumn, Black-throated uses a more southeasterly route (Leivo *et al* 2001, Lehikoinen *et al* 2006) after which they tend to turn southwards (Leivo 2012) - therefore it is possible that many of them do not reach the Baltic at all, performing a true loop migration.

Some of the most remarkable top days in spring in Finland have been:16 May 2016 Söderskär 12660 unidentified, 13267 total (Tiira 2019); 21 May 2002 Söderskär 10732 unidentified + 700 Black-throated and just six Red-throated (Tiira 2019); 31 May 1996 Pyhtää, Ristisaari 10732 unidentified, 700 Black-throated, 80 Red-throated (Tiira 2019); 31 May 1996 Santahamina 10118 unidentified, 311 Black-throated, 32 Red-throated (Tiira 2019).

So far a total of a thousand identified Red-throated in a day has not been reached on the Finnish south coast in spring, and very rarely in autumn. The biggest numbers are from autumn: 22 September 2010 in Joutseno (now Lappeenranta) 2314 individuals, and there have been several other good days in the interior of southeastern Finland.

The all time biggest day of diver migration in Finland was on 20 October 1991 when at Uukuniemi (now Parikkala) 23 962 divers were seen, mostly Black-throated (Kansonen & Karhu 1992). The site is well inland in southeastern Finland, close to the Russian border.

The best spring day count of identified Red-throated Divers in Estonia was 3528 at Põõsaspea on 12 May 1993. Even bigger migrations were 13 000 unidentified at Virtsu on 20 May 1992 and 11 000 unidentified at Osmussaar (very close to Põõsaspea) on 23 May 1996 (Pettay *et al* 2004). Also days such as 20 May 2002 with 5500 unidentified and 21 May 2010 with 5250 unidentified should include a lot of Red-throated. The best autumn days are all from the 1990's and include 5698 birds on 3 October 1994, 4867 on 30 September 1995 and 4191 on 2 October 1994, all at Põõsaspea. After the year 2000, in spite of quite decent coverage, somewhat smaller numbers have been seen, although still many days with over a 1000

Photo 1. Black-throated Diver, adult summer on spring migration. Looks essentially the same in autumn. Easy to identify when the characteristic patterns are visible. Thick neck, roundish head and straight bill are visible from afar, as is the black area on the foreneck, which is larger than in Red-throated. Porkkala 29 April 2013.

birds during autumn are typical. During the two latest whole season counts, 1000 birds was reached five times, between 19 September and 3 October.

The biggest day counts of Black-throated Divers in Estonia are from spring. Elurikkus (2019) includes data of four days with over 3000 birds, between 18 May and 3 June, all from the 1990's, three at Põõsapea and one at Hiiumaa island, at a site close to Ristna. The biggest day count from autumn is 2829 birds at Paldiski 10 October 1994. The 6416 unidentified at Põõsapea on 11 October 2001 with 878 identified Red-throated and 272 Black-throated was a remarkable day for both species. In the latest season counts in 2014 and 2019 the six best days were 505-690 individuals, between 3 and 17 October. As late as in 2006, on both 5 and 6 October over 1000 birds were identified.

In Russia, 11920 divers were seen in the southern White Sea on 3 October 1999, of the identified birds 93% were Black-throated (Leivo *et al* 2001). Another 11718 individuals were seen on 2 October 2004, of which 92% were identified as Black-throated (Lehikoinen *et al* 2006). The peak Red-throated daily numbers on these expeditions were 1583 and 1537 individuals on 7 and 8 October 1999 (Leivo *et al* 2001). In spring, the highest day total reported from Vyborg is 6196 divers on 23 May 1994.

Photo 2. Black-throated Diver, adult summer on spring migration. The white barring on the scapulars and mantle is visible from great distances when the bird turns. Porkkala 26 April 2008.

Timing

See Table 3. These dates are from migration hot-spots and represent the peak migration of the arctic passage migrants. Both species breed in Finland, but these local breeders arrive at the lakes earlier, as soon as the first lakes lose their ice cover.

On the whole, Red-throated Diver is an earlier migrant in spring. This is because the main diver migration off the coast of Estonia takes place earlier than the Black-throated-dominated migration off the coast of Finland (Leivo *et al* 1994). Leivo *et al* (1994) calculated that by 15 May, 60% of Red-throated Divers and 35% of Black-throated had migrated at Põosaspea in 1993. In Finland, Red-throated is not an earlier migrant, the peak is broadly at the same time as that of Black-throated and distinctly later than in Estonia.

The Santahamina spring median date of Black-throated is comparatively early. The main reason is likely to be that the migration has turned considerably earlier during the years and recent years dominate in that data compared to, especially, Kummelskär. Also in spring for Red-throated, the difference in timing between the sites may be wholly explainable by the change in timing during the years.

Photo 3. Black-throated Diver, adult summer on spring migration. It is not that rare that this species flies with the neck somewhat downturned and the bill pointing slightly upwards, showing a shape not that different from the typical one of Red-throated Diver. The feet are larger in this species, but this is not an infallible character. Porkkala 30 May 2010.

The early autumn migration of Black-throated on the Finnish side is strange. Or rather, it could be said that the main autumn migration is totally lacking there, only the early stages pass by the northern shore. It may be that breeders and non-breeders from nearby areas dominate there, and the arctic birds are mainly lacking. However, it has to be remembered that the Finnish satellite-tagged Black-throated left the country very late compared to the migration median. The early autumn migration of Red-throated at Halias may originate in similar reasons as the early migration of Black-throated along the northern side of the Gulf.

As a whole, Red-throated is distinctly the earlier autumn migrant. This is visible in the Põõsaspea data (see Figures 4 and 5), as well as in SE Finland (*e.g.* Kontiokorpi 1992).

Notes on field identification

The flight identification characters of the two small species of diver are quite extensively studied and published in the literature including Appleby *et al* (1986), Blomdahl *et al* (2003) and Leivo & Kapanen (1995a,b). The identification is often regarded as difficult. In earlier works it is often regarded as almost impossible, for example Kumari (1958) noted

Photo 4. Black-throated Diver, moulting adult on autumn migration. Many adults are still in full summer plumage on autumn migration, but by mid October, most show some signs of moult on the head - this individual already quite a lot. Põõsaspea 13 October 2018.

Photo 5. Black-throated Diver, 2cy on spring migration. Very typical individual in winter plumage aspect. Santahamina, 1 June 2012.

Photo 6. Black-throated Diver, juvenile. The colour contrast on the neck is somewhat muted, the scaly scapular pattern is just visible in this photo. Note also the very fresh wing feathers. Põõsaspea 19 October 2019.

Photo 7. Red-throated Diver, adult in summer plumage aspect. Porkkala 29 April 2013.

Photo 8. Red-throated Diver, moulting 2cy on spring migration. These birds are very variable. Porkkala 1 May 2017.

Photo 9. Red-throated Diver, moulting adult on autumn migration. Põõsaspea 19 October 2018.

Photo 10. Red-throated Diver, adult in winter plumage aspect. This individual still shows black on the bill tip. Põõsaspea 15 October 2017.

that ”it is rarely possible to determine the species of divers with any degree of precision in field conditions”. This has changed, and the ratio of identified individuals has grown during the years. This reflects better optics and also better understanding of the identification characters. Nowadays it is often possible to photograph problematic individuals and ascertain the identification. In the old days it was more difficult, as reported by Kumari: ”At the Puhtu Bird Station we have made repeated attempts to determine the species of divers passing overhead with the aid of powerful field-glasses, afterwards checking our identifications by shooting some of the birds. In this way we were forced to admit that we had often been at fault, and that, in the spring at least, many of the birds we had taken for Black-throated Divers were in fact Red-throated Divers.”

The improved identification ratio may also partly be connected to less massive peak migrations during 2000's, because in slow days, the ratio of identified individuals is higher. See Figure 1, which shows the ratio of identified divers at the Hanko bird observatory during the years, as well as the total numbers.

The species identification character which is visible at the greatest distance is the downturned neck of Red-throated Diver. Not all of them fly like that and some Black-throated’s also fly with downturned neck. When Red-throated shows a very typical neck posture this is a reliable character. The problem is that at distances where this

Photo 11. Red-throated Diver, juvenile. A typical individual with mostly brownish-grey neck and wholly pale bill. Põõsaspea 15 October 2017.

character is the only visible identification character, many birds have to be left unidentified - this will cause bias in the species ratio and if distance codes are not used, in systematic counts, divers should not be identified solely using this character. The habit of Red-throated Diver of dipping its head is also characteristic (although this can also be seen in Black-throateds sometimes), but in the same way, it cannot be used identifying birds in systematic counts, especially if distance codes are not recorded. The size of legs and feet is also useful, but not a wholly reliable character. We have not been able to use the commonly described differences in wing action when separating flocks of Red and Black-throated Divers on migration (but it is useful for picking out Great Northern and White-billed Diver individuals from the flocks).

The differences used when counting large numbers of divers in a consistent way are the rounder head, thicker neck, less angled throat and straighter bill of Black-throated and longer rear part of the body behind the wings. In summer plumage, the larger dark area on the chin and foreneck of Black-throated and white pattern on the scapulars visible in some positions, and lack of those in Red-throated, can also be used. In winter plumage the best field character is the large white area on the neck of fully winter-plumaged Red-throated,and the strong contrast on the neck of Black-throated. Juvenile Red-throated flying alone may often be difficult to separate from Black-throated, especially juvenile ones, but structural differences still apply, as do the colour differences, but they are less pronounced. It has to be remembered that juvenile Black-throateds is quite similar to adults in winter plumage of the same species, but in Red-throated these two plumages are much more different. Otherwise, there is no great difference as to the distance where summer and winter plumage divers can be identified as to species. But on many occasions, the conditions are much more important than the

Photo 12. Red-throated Diver, adult and juvenile. On migration it is typical to see an adult attending a juvenile. Põõsaspea 13 October 2019.

distance, such as possible heat haze and angle of light. Therefore it can be very difficult to set a certain distance at which the divers can be identified.

Black-throated Diver plumages

The birds were observed in active migratory flight. In those circumstances, the patterns of head and neck are quite well visible and the plumage classes noted are mostly based on those characters. The underparts of the birds are often well visible too, but these do not show a lot of variation.

During spring migration, Black-throateds are easy to separate into two classes. Most of the birds are in adult summer plumage, and a minority shows what looks like winter plumage. There is some variation in the extent and blackness of the dark areas in the latter plumage aspect, but all of them have a uniform pale area from the breast through the fore-neck to the chin.

These observations agree well with what is written by Jonsson & Tysse (1992) and Leivo (1995b). They state that Black-throated Divers become impossible to separate from adults during the spring of their third calendar-year, and that all birds with winter-type plumage aspect during May-August are second calendar-year individuals. However, Pyle (2008) describes 3cy spring birds as variable but intermediate between 2cy and adult - with variably indistinct black and white stripes and the throat variably mottled dull blackish and white. These kinds of birds do not occur in the Gulf of Finland during spring. However, from what we see in the field, we cannot rule out that the immature plumage aspect is retained longer than one year, but not much is pointing in that direction.

During the springs of 2018 and 2019 we classified the plumage aspect of Black-

	Breeding	Intermediate	Winter	n
April	97%	0%	3%	543
1st half of May	98%	0%	2%	1236
2nd half of May	98%	0%	2%	3386
June	73%	0%	27%	130

	Breeding	Intermediate	Winter	n
July	97%	0%	3%	69
August	48%	0%	52%	392
September -22	58%	1%	41%	469
September 23-	84%	2%	14%	185
October	79%	9%	12%	815
Early November	27%	33%	40%	15

Table 4. Black-throated Diver plumage aspect ratio.

throated Diver as summer-plumage or winter-plumage-like. The classification is straightforward and the two classes are distinct. The observation period was from April to June and the sites were located around Helsinki, Finland including the Porkkala peninsula, Santahamina and Söderskär, as well as Põõsaspea in northwestern Estonia. It seems that adult birds are already in summer plumage when they reach the northern Baltic in spring. Young birds show a winter plumage aspect and retain it all through spring. The proportion of young birds / winter plumage aspect grows higher towards the end of the migration. In the Halias material, only 11.5% of the migrating Black-throated Divers were seen in June, and if we assume the same proportion of 2cy birds at Halias as in our study, the majority of the 2cy birds are seen in June. In this species, a sizable proportion of the population consists of non-breeders and these are thought to be subadults, even if many of them are in full summer plumage, and therefore older than 2cy (Lehtonen 1965). These birds arrive late at the breeding sites, when the breeding is already going on, and spend their summer in flocks. The later stages of spring migration may be assumed to include many of these subadult birds, and those birds do not migrate very purposefully. One good example of late migration was observed by us at Põõsaspea on 16 June 2019, when 49 Black-throated Divers migrated south-west and five north-east. Of these birds 46% showed winter plumage aspect.

In autumn, most of the records are from Põõsaspea, mostly from 2018 and 2019 but some also from 2016 and 2017. Some additional records are from Santahamina.

	Breeding	Intermediate	Winter	n
April	81%	10%	9%	419
1st half of May	92%	6%	2%	1839
2nd half of May	95%	4%	1%	1821
June	74%	15%	10%	78
July	100%	0%	0%	43
August	96%	4%	0%	368
September -22	95%	2%	1%	1600
September 23-	94%	3%	3%	860
October	35%	37%	28%	1467
Early November	5%	44%	51%	106
December	0%	33%	67%	125

Table 5. Red-throated Diver plumage aspect ratio.

In July there is little diver migration in the Gulf of Finland, and therefore the sample size is small, but at that time the majority are in summer plumage aspect. The real migration starts in August, when a very big proportion of Black-throated Divers were in winter plumage aspect. It was in fact the highest proportion of the year, therefore the 2cy birds are still in that phase,starting their second autumn migration earlier than adults, without moulting to summer-like plumage at all. From then on, the proportion of 2cy birds, but not necessarily their absolute numbers, decrease towards the main migration period of the species, which starts in late September and peaks before mid October.

In late September, at peak migration time, the majority of the adults are still in summer plumage, although some are already acquiring white feathers around the bill. During the peak migration in October the majority of migrants still show summer type plumage. The first adults with white winter type feathers appearing on the chin are seen in the second week of September. However, at that time of the year winter-type plumage birds still include 2cy individuals, but also some juveniles.

Separation of 1cy and winter plumage-type +1cy birds is not easy and only possible in good conditions, when it may be possible to see that the hindnecks of juveniles are somewhat more brownish, less blackish, with the fore neck and chin somewhat brown-tinged with only muted colour contrasts, but these differences are not big. The scaly pattern of the scapulars, which from a distance give a somewhat paler overall impression of the upperparts, is often visible

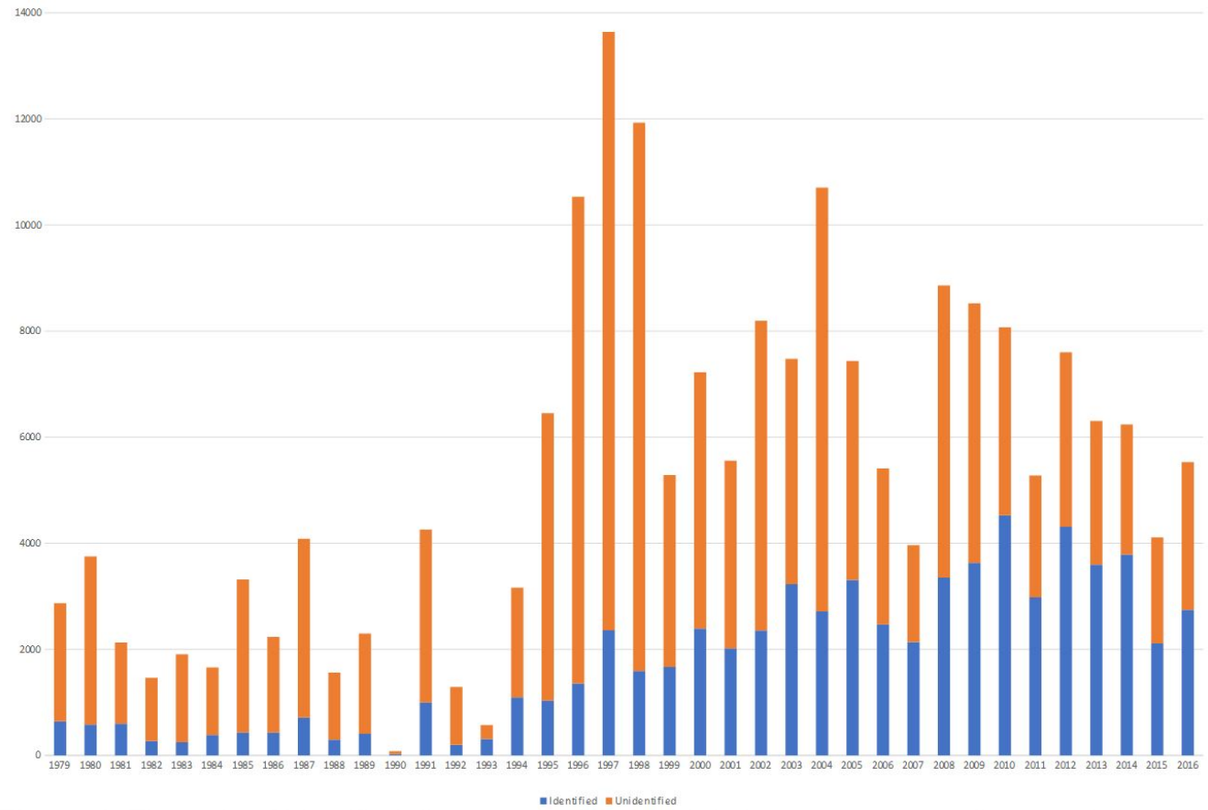

Figure 1. The ratio of identified divers at the Hanko bird observatory, as well as yearly totals.

at closer distances from a suitable angle, constituting a more certain identification character. Most of the 1cy and 2cy birds were just classified as of winter plumage-type. As late in autumn as in September we still could not find many juveniles, but could easily have overlooked some. It seems that the migration of 2cy birds is mostly over by late September, and after that most winter plumage-type birds can be regarded as juveniles until November when the first adults reach that stage. To summarise, and as stated by Leivo (1995), there are three types of Black-throated Divers in winter-type plumage aspect in autumn: 1cy, 2cy and adult birds. These are identifiable only in very good circumstances, but in the Gulf of Finland they mostly occur at different times.

From September on, “intermediate” birds were also noted, these being moulting adults. By mid-October rather many of the adults were clearly moulting and the appearance had changed distinctly in many, but a majority were still in almost full summer plumage. The moulting birds first show some white at the base of the bill, and later a larger whitish area on the chin. In early November the summer plumaged birds were in a minority, even when including those that were clearly moulting. However, our sample size from November is very small, because most of the migration of the species around the Gulf of Finland is over by that time.

Red-throated Diver plumages

Red-throated Divers are very variable-looking on spring migration - most are normal fully

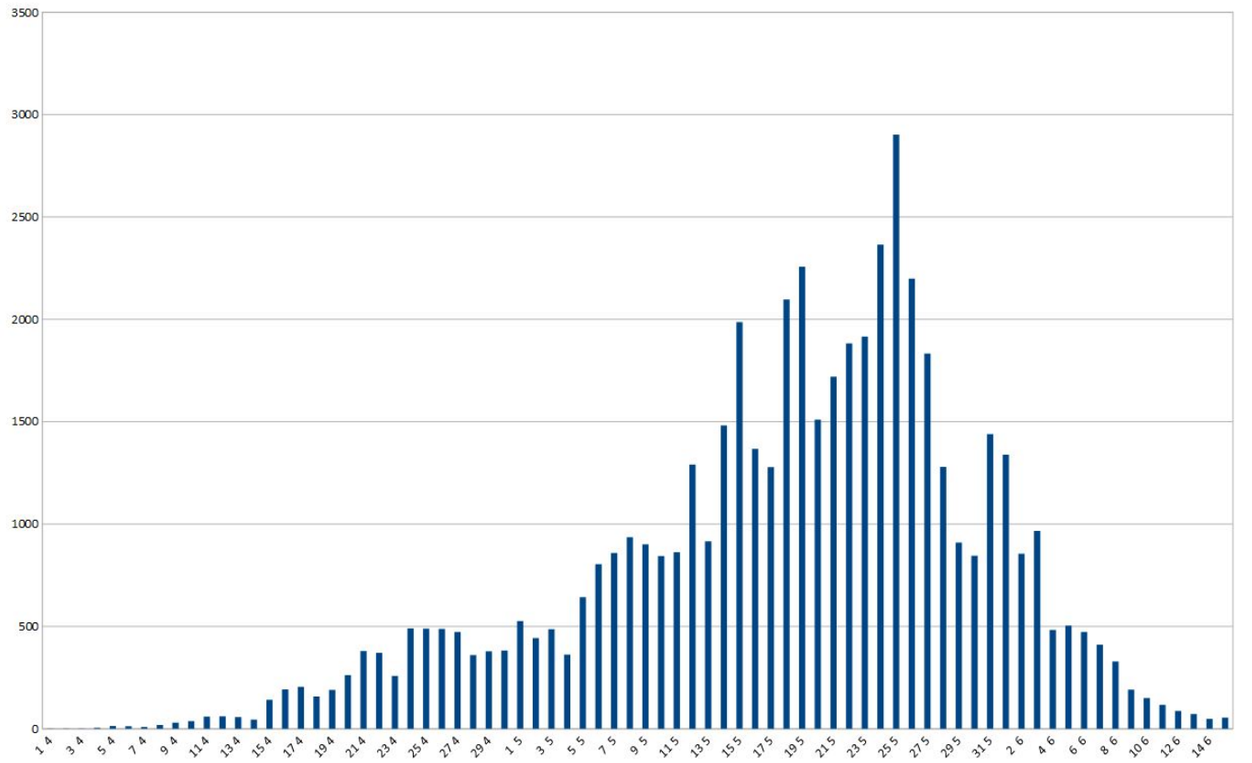

Figure 2. Black-throated Divers on spring migration, Hanko bird observatory 1979 - 2016, totals by date.

matured summer-plumaged adults but others vary from winter plumage-like birds to those with a grey neck and variable whitish or reddish patches on the face.

Finnish migration watchers have traditionally aged Red-throated Divers in spring as follows: normal summer-plumaged birds as +2cy (older than second calendar year, and therefore at least almost two years old), with the others, less-matured looking birds as 2cy (second calendar year, almost one year old). This is compatible with what has been written about the subject by Jonsson & Thysse (1992): 'First summer... the plumage is like adult summer-plumage, but not fully developed... with typically white feathers on the throat, grey feathers inside the red throat patch and whitish areas on the upperparts... probably some 2cy are in full summer plumage in May... starting from 2cy autumn not possible to separate from adults'.

However, Pyle (2008) sees ageing and plumage development quite differently. According to him, the 2cy birds show a whitish, or sometimes mottled greyish and reddish throat with a pale grey bill. Birds one year older (3cy) show a throat that is variably mixed with greyish and reddish anda medium-pale grey bill. (According to that work, these two age classes can be separated by details and moult contrasts of the back feathers). In addition, some 4cy birds are somewhat less red on the throat and can be difficult to separate from advanced 3cy birds.

In 2018-2019 we classified the plumage aspect of Red-throated Diver in three

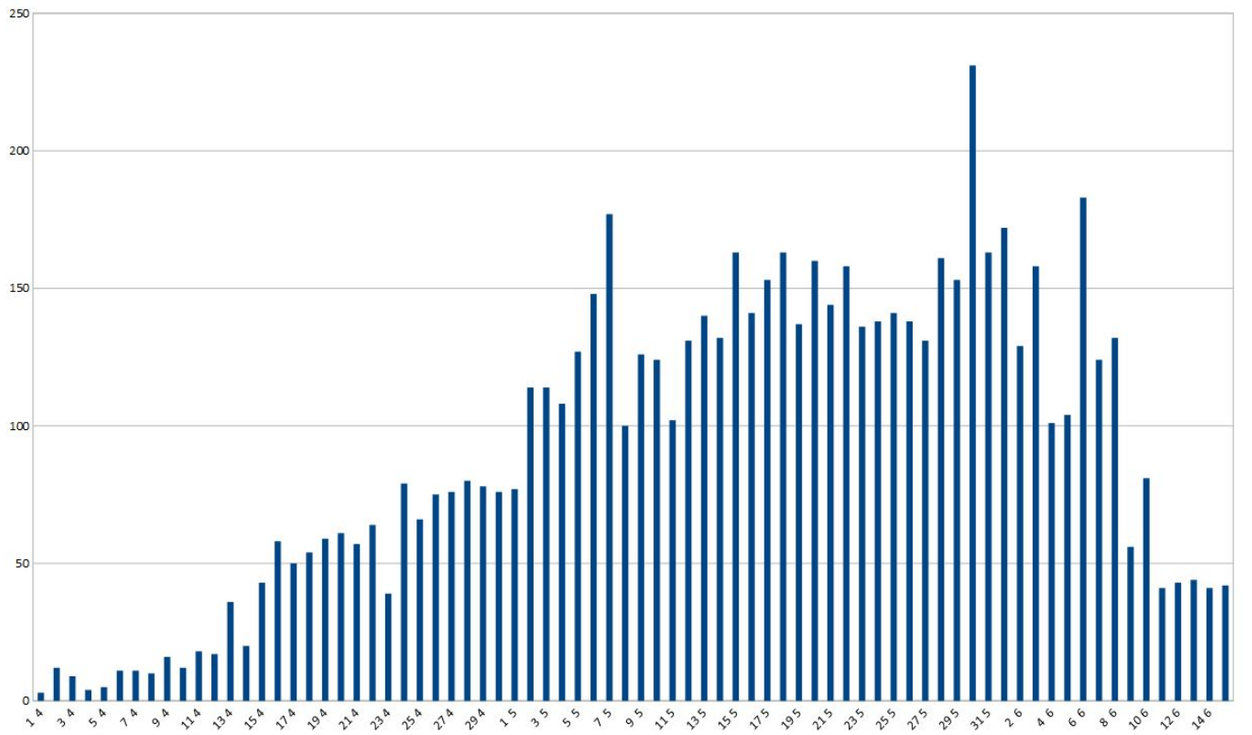

Figure 3. Red-throated Divers on spring migration, Hanko bird observatory 1979 - 2016, totals by date.

groups. 1) summer plumage - with some whitish feathers close to the base of the bill allowed, 2) intermediate aspect - distinct whitish areas on the head, with the neck mostly greyish, 3) winter plumage-like - more white than grey on the neck. These are not distinct classes, but the variation is continuous both in spring and autumn.

The observation period used for spring migration was 1 April - 10 June, after which the numbers of divers seen during seawatch were low, and their migration directions variable. The table seems best interpreted with adult birds in April already being in summer plumage and the younger ones more or less in winter plumage. In spring the younger birds attain more of the summer plumage aspect and some will be very similar to adults in late spring. In June, the proportion of 2cy birds is large.

In July and August, almost all Red-throated Divers seen were in summer plumage aspect. The few “intermediate” birds were aged as juveniles in the field - they appear on migration during the latter half of August, and were invariably attended by adults.

Juvenile Red-throated Divers are quite greyish-necked and can fairly easily be separated from winter-type plumage birds. In less than good conditions many of the juveniles were put into the general “intermediate” class - they are not too different from some “intermediate” spring birds and also from some moulting adults in autumn. The darker individuals are not too different from summer-plumage adults, when seen from a distance, but they have some paler areas on the head and the colour of the neck is not really deep grey, but greyish. During autumn, some juveniles variably moult some white feathers, and when adults

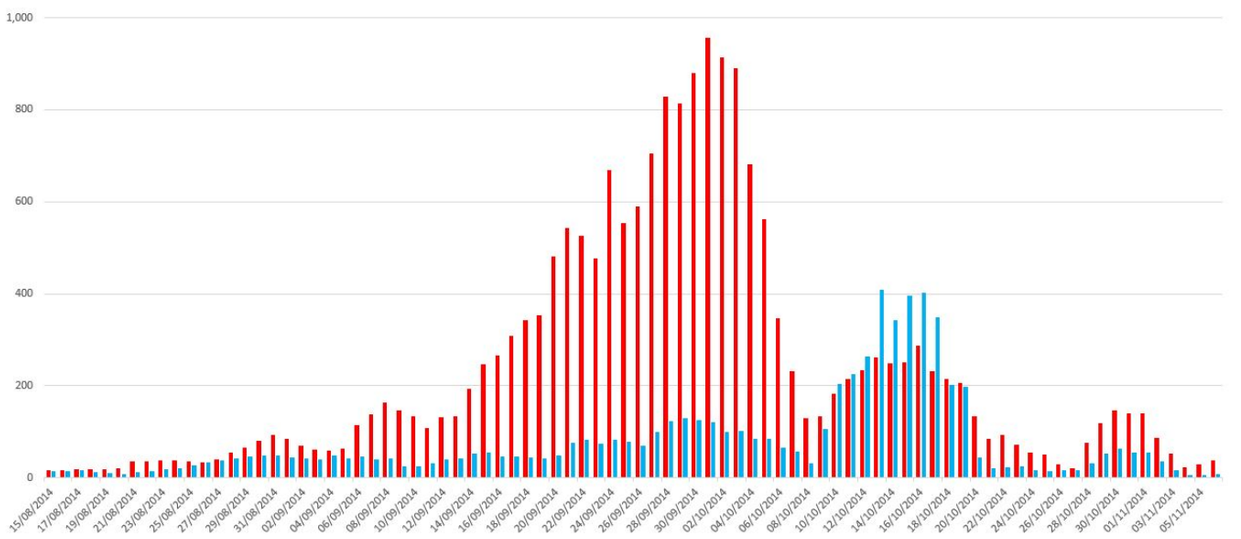

Figure 4. Autumn migration at Põõsaspea in 2014. Red – Red-throated Diver, blue – Black-throated Diver. Unidentified are included - the ratio used to classify unidentified is the ratio of identified in the pentad in which the shown day is the middle day. The number shown is not the daily observed number, but the average of the pentad in which the shown day is the middle day.Numbers before 15 August were on a constant low level.

start to moult too, new ageing problems occur. When seen well, grey-necked post-juvenile birds can be separated from juveniles because they often still show a blackish bill, or at least some blackish on the tip of the bill (juveniles have a wholly pale greyish bill), and as the moult advances they tend to get paler lores quite soon while the cap and hindneck stay dark - thus attaining the pale winter aspect of head and neck faster than first-year birds. On autumn migration, juveniles are very often accompanied by an adult. Leivo *et al* (1995a) saw 436 juveniles on migration on the north coast of Estonia, in three weeks during September and October 1993. 77% of those were attended by an adult in summer-type plumage, somewhat less than 10% migrated with several adult birds, and in some cases an adult flew with two juveniles, but only in two cases was a juvenile attended by a winter-plumage adult while 10% of the juvenile Red-throated Divers migrated alone. This behaviour is also mentioned in Lehikoinen *et al* (2006). At Põõsaspea, in early December 2019, juveniles were still accompanied by adults, but after mid-December it seemed that most divers were not really migrating any more, but flying in different directions searching for good fishing areas - at that time the majority of the birds were first-years and most of them were on their own.

In late September, during peak migration, the adult Red-throated Divers are still typically in breeding plumage, with some beginning to show whitish feathers on the head. In the material of Leivo (1995) over 90% of Red-throated divers were in full or almost full summer plumage aspect during peak migration in late September to the first days of October. The timing of the onset of the adult moult is quite similar to that of Black-throated

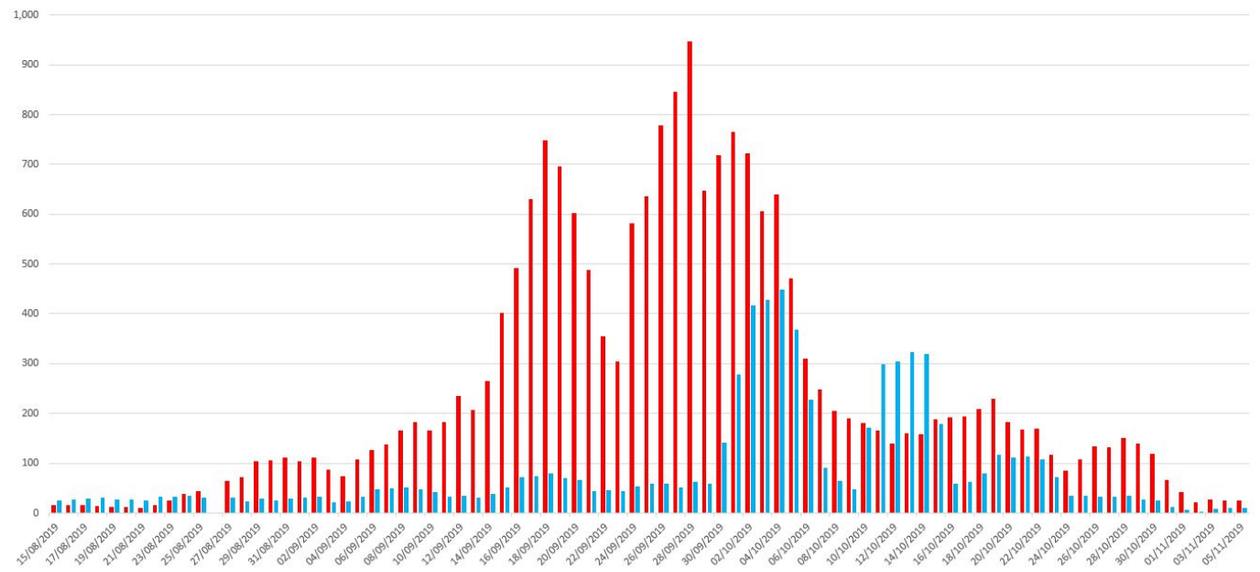

Figure 5. Autumn migration at Põõsaspea in 2019. Red – Red-throated Diver, orange – Black-throated Diver. Numbers calculated as in Figure 4.

Diver in relation to the migration period. The first adults with white winter type feathers appearing on the chin are seen in the second week of September. After that more and more birds show an increasing amount of winter plumage and were classified as "intermediate" - in fact they start to resemble "intermediate" birds in spring. Of intermediate birds in September many were identified as juveniles, but some were moulting adults. Some birds were in full winter-like plumage already in late September. They are unlikely to be juveniles and are either adults or 2cy birds. At that time the majority of adults are still in the summer plumage aspect, and these winter-type birds are likely to be unsuccessful breeders or non-breeding subadults, that have moulted earlier (Leivo 1995). Leivo (1995) reported that on 13 October 1992 75% percent of the 700 migrating birds were in winter plumage aspect already. In the majority the change in appearance is quite fast - it may be because some individuals have stopped for moulting in more northerly areas and continue migrating after that, but it is fully possible that moulting body feathers does not slow down the migration at all. The wing-feather moult which makes birds flightless for some time occurs soon after autumn migration (*e.g.* Jonsson & Tysse 1992) and is most often regarded as part of the same moult as the body moult occurring during the autumn migration. (In Black-throated the wing feather moult occurs late in winter and is normally regarded as part of the same moult in which the summer plumage aspect is acquired).

Already in late spring most 2cy birds show fairly summer-like plumage. It would seem most probable that 2cy birds acquire a superficially full summer plumage during their first summer. It is possible that the timing of the 2cy migration in these two diver species is not that different - and that 2cy birds are the first to migrate in autumn - but the plumage development is different and therefore we see only summer-plumaged Red-throateds in the early stages of the autumn migration.

By early November, a minority can still be

classified as summer plumage birds, but most of them show some moult into winter plumage. Moulting and winter plumage birds are numerous. First-years may still be in almost complete juvenile plumage. In December at least most adults are already in winter plumage aspect, but most first-year birds are still more or less in juvenile plumage. As the winter progresses juveniles will show increasingly more of the winter plumage aspect, and ageing in flight becomes very difficult.

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Appendix - Spring 2019 at Põõsaspea

Because of the scarcity of spring data from the Estonian site, some numbers from Põõsaspea in spring of 2019 are referred to in the text, although there was no extensive study there at that time. The divers were counted from 12 April until 30 May. Migration was watched from sunrise to about noon, at most. For the seven days when there was no migration watching at Põõsaspea the numbers counted at Pakri neem, Paldiski, 35 km eastwards, were used. This still left 19 days (39%) with no counting at either site. With unidentified birds divided by percentage into the two species, 9580 Red-throated and 2960 Black-throated were counted, 76% of the birds were Red-throated. The species ratio is very comparable to that of Leivo et al (1994) at the same site, but absolute numbers were significantly lower. Even when taking into account the days without migration watching it seems very probable that the numbers in 2019 were lower in both species. It is however still possible that in Leivo's project the watching was more intense, and they also counted during many evenings. The median day for both species in 2019 was 15 May, which was largely because 67% of numbers were counted in just three days on 15-17 May. After that day, the migration probably continued at good levels for a day or two, but visibility was very bad because of heat haze, and the observed numbers probably very low compared to the true migration. These kinds of problems are typical in visible migration studies.

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