**Lisa 1**

**Extended summary in English**

This article provides an overview of autumn migration of waterbirds (*Anseriformes, Charadriiformes, Gaviiformes, Podicipediformes, Pelecaniformes*) monitored at Cape Põõsaspea in 2014. Cape Põõsaspea (or Spithamn according to a village nearby) is located in the South-Western part of the Gulf of Finland, Baltic Sea (59°13′N, 23°30′E). The survey was carried out during consecutive 130 days, between July 1st and November 6th, covering on average 11.6 hours per day (figure 1). The survey was carried out in a similarly to those in 2004 and 2009.

In total 1.89 million migrating waterbirds were counted including several species, which are breeding in the arctic, subarctic and northern taiga region (table 1). About 487 000 of all counted birds were aged in order to study the proportion of juveniles among the migrating birds (in this study defined as the relative measure of breeding success).

To compare the number of migrating individual for each species between different age groups in years 2009 and 2014, analyses were conducted on a pentad basis (number of individuals for every five-day period). Firstly, we wanted to know if the number of identified first calendar year old (1st cy) birds differed from the number of older birds (+1st cy) to study the relative "breeding success". However, for three species (velvet scoter *Melanitta fusca*, long-tailed duck *Clangula hyemalis* and Eurasian wigeon *Anas penelope*) we examined if the number of identified adult males and other plumages (1 cy birds and +1 cy females) differed from each other. We corrected the number of aged individuals for each pentad by adding unaged birds to the aged ones according to the observed ratio of identified 1. cy / +1. cy birds ("age") or observed ratio of adult males / females and non-adult males ("plumage") , respectively for models. The corrected numbers were used in the analyses. For described analyses, we used generalized additive models (GAM) with log-link and negative binomial error. This was done in R version 3.1.1 using package "mgcv". Separate models (model 1–3) were fitted for each species and comparison. The response variable was the corrected number of birds in each age group in each pentad respectively. The explanatory variables "year" and "age" were both included in the model as categorical factors. Further, the migration phenology was accounted for by including "pentad" as a continuous variable, which effect was modelled separately for each age group by using smoothing functions. It is important to note that no significant residual autocorrelation was found in the final models.

For each species and response variable we first fitted "model 1", in which only main effects of "year" and "age" were included. This model was primarily used to study whether observed numbers differed between the two study years.

In addition, we fitted "model 2", which is similar to "model 1" but also included the interaction "year × age". Using these models we explicitly investigated whether the relative proportion of 1st cy birds may have differed between years. Interpreting this as an effect of per capita reproductive success, however, relies on the assumption that

the proportion of young does not vary due to e.g. varying age specific migration routes. ″Model 2″ also assumes that the migration phenology is the same between the years within each group. While this is surely not the case, strictly speaking, the model should still identify clear patterns of abundance properly, as long as the general phenological pattern holds approximately and the between-year phenological shifts are fairly small.

Variation in flock size was investigated using "model 3": a generalized additive model with log-link and quasi-Poisson family (error Poisson distributed and result corrected for over- or underdispersion) using the same software as in previous analysis. "Flock size" was the response variable, and each separate flock was included as an observation in the analysis. The explanatory variables were "year" (categorical factor) and "pentad" (continuous variable). The effect of the latter variable, i.e. the seasonal variation in flock size, was accounted for using smoothing functions fitted separately for both years and no significant residual autocorrelation was found in the final models.

In general, it appeared that the proportions of juveniles were slightly higher in 2014 compared with 2009, but they were still very low, and there were hardly any statistically significant differences (see tables 2, 3 and 4). The observed proportion of juveniles was probably close to what is needed to compensate for annual adult mortality in Bewick's swan (*Cygnus columbianus*; 10.5% of juveniles), red-throated diver (*Gavia stellata*; 10.4% of juveniles) and brent goose (*Branta bernicla* 14.9% of juveniles). Low proportions of juveniles were observed in arctic ducks: common scoter (*Melanitta nigra*; 0.4% of juveniles), velvet scoter (5.5% of juveniles) and long-tailed duck (7.5% of juveniles), and most likely in greater scaup (*Aythya marila*) as well. In some species we suspect that juveniles have more nocturnal migration habits than adults, and thus, we probably underestimate "breeding success" of some species, especially in common scoter and greater scaup.

It has been shown that arctic predators switch their main food resource from birds to rodents in peak years of rodents, especially to lemmings. The periodic cycles of rodent populations seem to have ceased, or have turned into irregular and acyclic during last two decades. Good reproductive success of Skuas is also positively related to peak years of rodents. As the best ever recorded influx of juvenile pomarine skuas (*Stercorarius pomarinus*) in the Baltic Sea occurred in autumn 2014 (more than 1 000 birds recorded, normally a rarity), we expected also much higher proportions of juvenile ducks in 2014 compared with 2009. However, our results didn't support this expectation.

In contrast to so called true arctic and subarctic breeders, species, which nest in the taiga or Baltic Sea region, showed on average higher proportions of juveniles, although this pattern varied across species. Both red-breasted merganser (*Mergus serrator*) and smew (*Mergellus albellus*) showed higher proportion of juveniles as well as higher overall number of birds in 2014 compared to 2009. Relatively low proportion of juveniles were recorded in Cape Põõsaspea for goldeneye (*Bucephala clangula*), which was consistent with the fact that the poor breeding success for this species was also confirmed across breeding grounds in Finland. In addition, little gull (*Hydrocoloeus minutus*) and Arctic tern (*Sterna paradisaea*) both displayed relatively low proportions of juveniles, whereas common tern (*Sterna hirundo*), Sandwich tern (*Sterna sandvicensis*) and black-headed gull (*Larus ridibundus*) apparently may have had relatively good breeding success in 2014 (tables 2, 3 and 4).

Furthermore, we observed statistically significant differences in total number of migrating birds between the years 2009 and 2014 for some species. Barnacle goose (*Branta leucopsis*) showed significant decline during this period, probably because they had slightly changed their migration route more northwards. The described declining pattern between the years 2009 and 2014 for brent goose, is probably due to the shift towards more nocturnal migration during this period. Apart from the well-known long-term decreasing trends of velvet scoter (endangered, according to the IUCN Red List) and long-tailed ducks (vulnerable, according to the IUCN Red List), we fear that several other species are showing similar sharp long-term decreases in number of individuals, including e.g. red-throated diver, little gull and even Eurasian wigeon. Recorded numbers of Slavonian grebe (*Podiceps auritus*) were alarmingly low as well.

It seems that the long-tailed duck, which population has recently shown a rapid decline, has likely not decreased further since 2009. This is also consistent with data by some other monitoring sites elsewhere in Gulf of Finland. However, the long-tailed duck population is seriously depleted. The population of velvet scoter probably did not decreased between years 2014 and 2009, but the observed "stability" needs to be confirmed by further studies with better temporal coverage.

Further information on field work, see http://www.eoy.ee/poosaspea/home