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ABUNDANCE AND SEASONAL MIGRATION OF GULLS (LARIDAE) ON THE LITHUANIAN BALTIC SEA COAST

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On the basis of long-term visual observations carried out according to E. Kumari's methodology in 1974-2006 at the sea coast of Palanga, an analysis of spring migration of nine species of gulls has been done. The main migratory characteristics, seasonal and annual dynamics, phenology and dependence of migration intensity on weather variables are reported. During observations were registered nine species of gulls. The Little Gull (*Larus minutus*), Black – headed Gull (*Larus ridibundus*), Common Gull (*Larus canus*), Lesser Black – backed Gull (*Larus fuscus*), Herring Gull (*Larus argentatus*) and Great Black – backed Gull (*Larus marinus*) were abundant and the Kittiwake (*Rissa tridactyla*), Yellow – legged Gull (*Larus cachinnans*) and Glaucous Gull (*Larus hyperboreus*) were uncommon. Numbers of black – headed gulls, common gulls, lesser black – backed gulls and great black – backed gulls were on the statistical decrease. On the average, spring migration of the Little Gull was started on the 12th of April and other species of gulls – on the 12 – 17th of March. The duration of the Common Gull migration was the longest (on the average 67 days) and the Little Gull migrated the most shortly (on the average 29 days). Gulls abundantly migrated from the fifth 5 - day period in March to the third 5 - day period in May. The majority of gulls migrated in the flocks of 1 - 5 individuals. The most of them moved northward at 1 – 20 m altitude during the 2nd, 3rd and 4th hours after sunrise. The intensity of migration was depended on 8 meteorological factors for northward and 6 factors influenced the migration for southward. The paper contains the main information about environmental and anthropogenic factors affecting abundance of gulls breeding in the Baltic Sea region which is regarded to be among the most polluted marine ecosystems of the world.

Key words: gulls, Laridae, migration, dynamic of abundance, phenology, migratory characteristics, weather variables.

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INTRODUCTION

Gulls may be indicators of pollution because they are widespread, abundant and at the top of food chain. Because of increasing gull populations in urban areas, the role of gulls in the dissemination of human diseases has been examined and gulls have been reported to carry bacteria and viruses that cause disease of humans. Although causal relationships for transmission of diseases from gulls to humans are difficult to document, increasing evidence suggests that gulls may be important vectors. Gulls have significance as a major source of faecal contamination to reservoirs and recreational waters and at the bathing beaches. Gull faeces have also been implicated in accelerated nutrient loading of aquatic systems (Belant 1997, Brown et al. 2006, Fogarty 2003). In addition, gulls are frequently considered a general nuisance because of their noise, defecation, and harassment of people (Enticott & Tipling 1997). They may steal food from patrons of outdoor restaurants, frightening tourists, defecating on statues or benches and competing for food with domestic turkeys and captive animals at a zoo (Belant 1997, Steele 2002). These birds might reduce commercial catches by eating large numbers of fish that would otherwise be caught by man (Furness & Monaghan 1987). Gulls may breeding together with other species of birds and make negative impact on other birds' eggs or chicks as well. However gulls are known as efficient garbage collectors. They scavenge off dead animals washed ashore and human debris so they have helped to keep beaches a bit cleaner due to their scavenging nature. This in effect, cuts the cost of maintenance of beaches (Enticott & Tipling 1997, Steele 2002).

Some of gull species move away from their breeding area for winter but during the period of egg formation prior nesting, gulls obtain all their food in the area around breeding colonies. The rest of the species spend their entire life cycle locally in a contaminated ecosystem and can be expected to accumulate significant body burdens and in some cases to manifest adverse effects. Thus they can be an effective indicator of nonpoint source pollution and of the health of marine ecosystems (Gochfeld 1997, Olsen & Larsson 2003). Fluctuations in marine bird population or breeding success often signihy shifts in the physical or biological characteristics of marine environmentals (Furness & Monaghan 1987, Gilchrist & Mallory 2005). Gulls compose from 30-50 % of spring migrants on the Lithuanian Baltis Sea coast which is one of the main bird migratory pathways crosses of the Baltic Sea (Žalakevičius 1986).

The purpose of the study is to estimate dynamics of abundance of gulls during spring migration on the seacoast of Palanga. In addition, the paper contains the main information about environmental and anthropogenic factors affecting abundance of gulls breeding in the Baltic Sea region

MATERIAL AND METHODS

Long - term visual observations of spring migration were performed during 1974-2006 at the sea coast of Palanga (55° 552 03 N, 21° 32 503 E), located in the eastern Baltic. Observations were accomplished according to E. Kumari's methodology (1979) defaulting observations in early 4 hours (from sunrise) from a pier of Palanga. Spring migrations were done during March – May considering coursing of spring, consequently durations of observations varied year by year. On average, observations were performed for 67,2 ± 14,9 days per season.

In the paper is analyzed spring migration of six gull species. The analysis consist the main migratory characteristics, seasonal and annual dynamics, phenology and dependence of migration intensity of gulls on weather variables. Statistical calculations of long-term data of gull migration were performed using the STATGRAPHICS Plus programme. Dynamics of abundance of gulls were measured using pair-wise comparisons (Student's t-test, Two Sample Assuming Unequal Variances). The dependency of migration density on meteorological factors was measured using multiple regressions (R^2 – coefficient of determination). The following 13 weather variables from Klaipeda Meteorological Station (1974-2000) and Palanga Aeronautical Meteorology Station (2003-2006) were used in analyzing the dynamics of migration density:

x_1 – surface temperature (ţC)
x_2 – 24-h change in surface temperature (ţC)
x_3 – relative humidity (%)
x_4 – 24-h change in relative humidity (%)
x_5 – barometric pressure (hPa)
x_6 – 24-h change in barometric pressure (hPa)

x_7 – visibility (%)
x_8 – cloud amount (scale number)
x_9 – low cloud amount (scale number)
x_{10} – cloud type (scale number)
x_{11} – surface wind direction (angle between flight and wind direction, degrees)
x_{12} – surface wind velocity (m/s)
x_{13} – precipitation (mm)

Phenology parameters were estimated using counting of days from the beginning of the year, considering January, February, March and May composed of 31, 28, 31 and 30 days, respectively. Standard deviation accompanies all reported averages.

RESULTS AND DISCUSSION

Species composition

During the long - term visual observations were registered nine species of gulls. The Little Gull (*Larus minutus*), Black – headed Gull (*Larus ridibundus*), Common Gull (*Larus canus*), Lesser Black – backed Gull (*Larus fuscus*), Herring Gull (*Larus argentatus*) and Great Black – backed Gull (*Larus marinus*) were abundant and the Kittiwake (*Rissa tridactyla*), Yellow – legged Gull (*Larus cachinnans*) and Glaucous Gull (*Larus hyperboreus*) were uncommon. The Black-headed Gull and Common Gull were the most abundant migrant species of gulls (both presented 79,6 % of gull migrants) (Table 1).

Dynamics of abundance

Throughout the migration observations 3 rare gulls species in Lithuania have been registered. One individual of the Kittiwake were found in May 1987. Three individuals of the Yellow – legged Gull were registered in March 2000. One by one individual of the Glaucous Gull were recorded in March and May 1980, 1987 and 1999. During the study, 4.407 individuals of the Little Gull were registered. The abundance of little gulls varied among the study years. On the average, 157,4 ± 207,5 birds were registered per season. The most numerous abundance were in 1980 (n=897), 1989 (n=392) and 1999 (n=548) – an increase of abundance of little gulls occurred every second decade. In the last decade in particularly in 2003 and 2005 little gulls were registered in bigger abundance (Fig. 1).

During all the spring seasons, the Black-headed Gull was the most abundant gull species on the spring migration season. A total number of registered black-headed gulls is 117424. On the average, 4193,7 ± 4918,9 birds were registered per season. More numerous abundance were registered before 1980 and a peak was occured in 1975 (n=18181). The abundance of black-headed gulls was up to 10.000 individuals per season since 1981. The abundance was up to 3.000 gulls per season since 1987 and up to 800 gulls per season since 2000. In comparison to abundances of black-headed gulls before 1985 and abundance since 1987, the difference was statistical significant ($t = 4{,}43$, $p<0{,}05$) (Fig. 2) thus the species decreased in the last decades (Fig. 2).
A total number of the registered Common Gull is 82.212. On the average, 2725,3 ± 2459,4 birds were registered per season. A peak of the abundance

Table 1. Composition of gull species during spring migration at the seacoast of Palanga

Gull species	Species composition, %			
	Minimum	Maximum	Average	Standard deviation
The Little Gull	0.04	15.48	3.52	6.84
The Back-headed Gull	16.12	83.3	40.69	3.06
The Common Gull	9.83	64.96	38.89	5.62
The Lesser black-backed G	0.24	9.75	2.16	1.18
The Herring Gull	1.45	36.58	13.97	6.96
The Great black-backed Gu	0.04	1.97	0.77	0.53

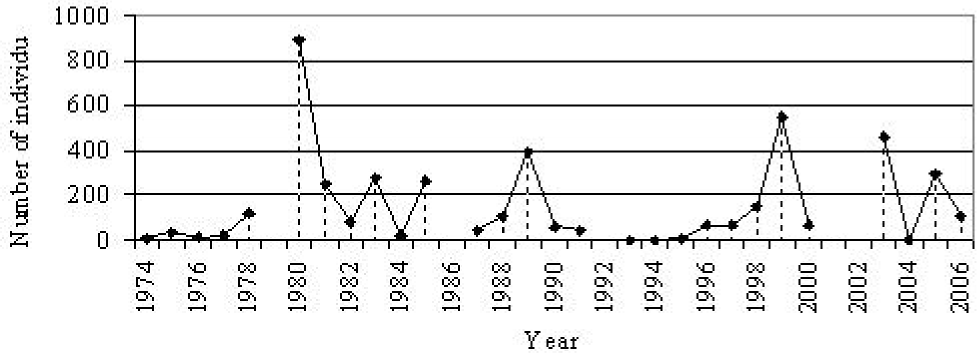

Fig. 1. Annual intensity dynamics of the Little Gull (Larus minutus) spring migration on the Lithuanian Baltic Sea coast

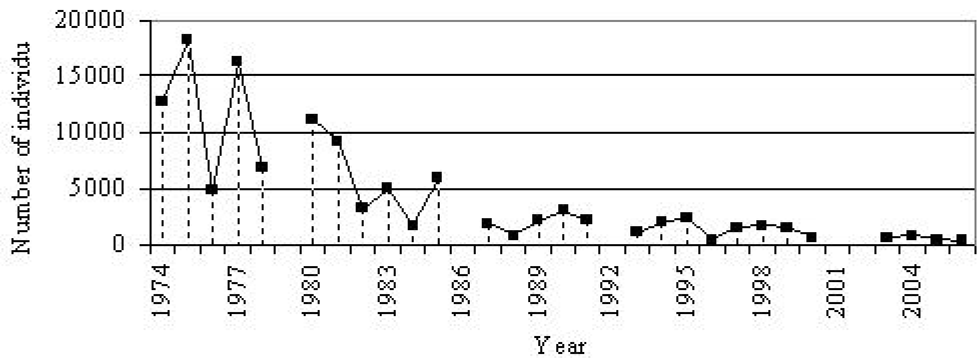

Fig. 2. Annual intensity dynamics of the Black-headed Gull (Larus ridibundus) spring migration on the Lithuanian Baltic Sea coast

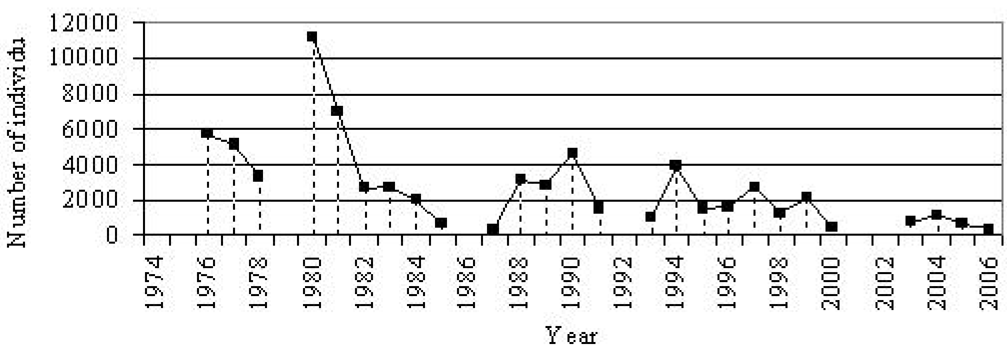

Fig. 3. Annual intensity dynamics of the Common Gull (Larus canus) spring migration on the Lithuanian Baltic Sea coast

was registered in 1980 (n=11141). The abundance of common gulls was decreased in subsequent years and it was up to 1.200 birds per season since 2000. In comparison to abundances of common gulls before 1999 and since 2000, the difference was statistical significant (t = 4,94, $p<0,05$) (Fig. 3).

During the long - term visual observations were registered 5.407 lesser black-backed gulls. On the

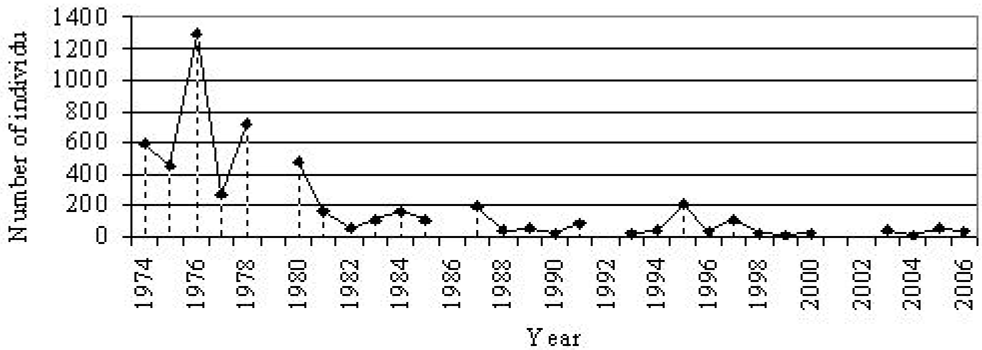

Fig. 4. Annual intensity dynamics of the Lesser black-backed Gull (Larus fuscus) spring migration on the Lithuanian Baltic Sea coast

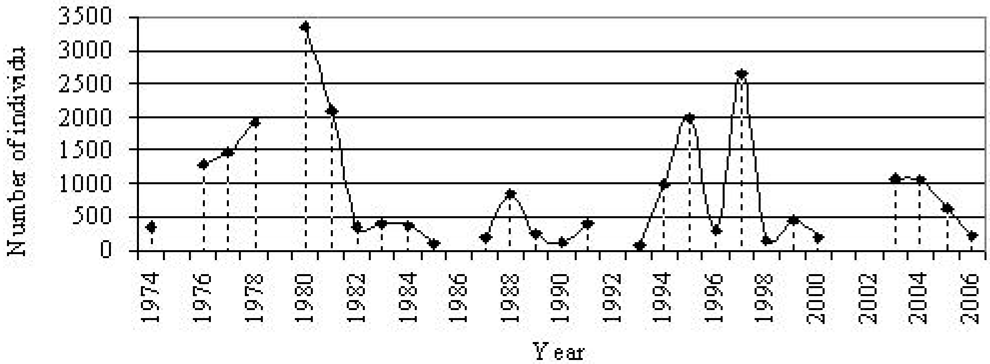

Fig. 5. Annual intensity dynamics of the Herring Gull (Larus argentatus) spring migration on the Lithuanian Baltic Sea coast

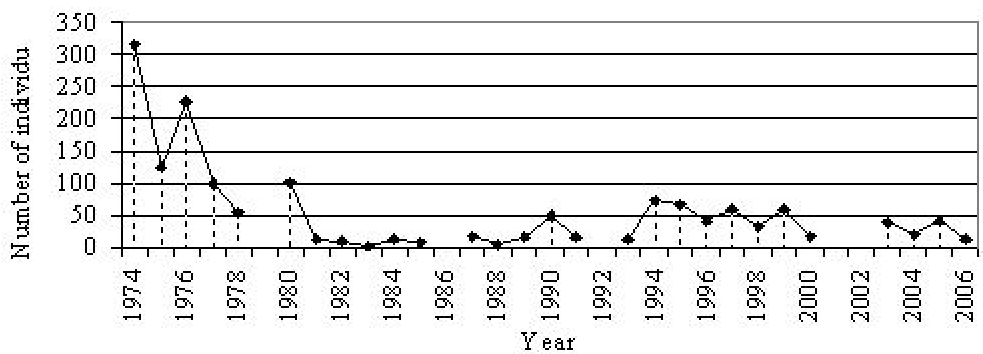

Fig. 6. Annual intensity dynamics of the Great black-backed Gull (Larus marinus) spring migration on the Lithuanian Baltic Sea coast

average, 193,1 ± 285,6 birds were registered per season. A peak of abundance of lesser black-backed gulls was registered in 1976 (n=1296). The abundance of lesser black-backed gulls was decreased in subsequent years: it was up to 200 birds per season since 1981 and up to 60 gulls per season since 1981. In comparison to abundance of lesser black-backed gulls before 1997 and since 1998, the difference was statistical significant (t = 3,19; *p*<0,05) (Fig. 4).

During the long - term visual observations 24.064 individuals of the Herring Gull were registered. On the average, 858,7 ± 865,8 birds were registered per season. Bigger amount of herring gulls were observed 1979-1981, 1988, 1994, 1995 and 1997. Thus the abundance were increased every 6-7 years. A peak of abundance was registered in 1980 (n=3350) (Fig. 5).

Throughout observations 1.558 individuals of the Great black-backed Gull were registered. On the average, 55,6 ± 69,7 birds were registered per season. Great black-backed gulls had migrated abundantly during 1974-1976 and a peak were registrated in 1974 (n=316). The abundance of great black-backed gulls was up to 100 birds per season since 1977 and it was up to 50 birds since 2000. In particular a little number of great black-backed gulls was registered during 1981-1989 (up to 20 birds per season). In comparison to abundance of great black-backed gulls before 1980 and abundance since 1981, the difference was statistical significant (t = 3,10; p<0,05) (Fig. 6.).

Phenology

In spring various species of gulls began spring migration at different times. Dates of spring migration of gulls are presented in Table 2. During the observation period, the earliest beginning of spring migration was registered on 19 February 1998 (the Herring Gull) and the latest beginning was on 15 May 1975 (the Little Gull). The earliest end of spring migration was observed on 15 March 1975 (the Little Gull) and the latest end was on 28 May 1991 (the Little Gull and Common Gull). On the average, spring migration of the Little Gull started on the 12th of April and other species of gulls – on the 12 – 17th of March.
The average duration of the migration of the Common Gull was the longest (on the average 67 days) and the Little Gull migrated the most shortly (on the average 29 days). Duration of gull spring migration in different years at the seacoast of Palanga is from 1 (the Little Gull in 1977, 1993, 1996, 2004) to 89 days (the Herring Gull in 2000) (Table 2).

Seasonal dynamics of spring migration

Dynamics of migration intensity of different gulls species varies considerably per spring migration season. During all the study seasons most of little gulls (on the average 72,1 ± 35,2 %) passed during VI 5-days of April – III 5-days of May. Even 31,1 ± 40,0 % migrants were recorded during II 5-days of May. On the average, 45,7 ± 18,8 % migrants of black-headed gulls were registered on VI 5-days of March, I-II 5-days of April and I 5-days of May. Most of common gulls (on the average 35,9 ± 18,5 %) migrated on IV – VI 5-days of April (Fig. 7).

During all the study seasons 29,2 ± 21,4 % of migrating lesser black-backed gulls passed on IV-V 5-days of April. Herring gulls were registered in bigger numerous on V-VI 5-days of March when passed 29,5 ± 22,4 % migrants. Most records of great black-backed gull were made on VI 5-days of March and III-IV 5-days of April (on average 40,4 ± 17,8 %) (Fig. 8).

Observations were carried out in the course four morning hours (beginning with the sunrise) thus it was possible to estimate intensity of migration in the morning hours. During spring migration the majority of gulls migrated during the second and third after sunrise (on the average, from 55.5 to 64.7 % migrants of different species). The Little Gull was registered in the equal number during the third and the fourth hours after sunrise (32,5 ir 33,8 % respectively).

Flocks composition

Numbers of migratory gulls in the flocks showed fluctuations but generally gulls migrate in flocks of 1-5 individuals (on the average, 55.1-97.0 % of different gull species). The Little Gull and Black-headed Gull more frequently than other species of gulls migrated in more numerous flocks (Fig. 9). Medium size of a flock of the Little Gull was 10,8 ± 12,8 individuals and for the Black-headed Gull it was 8,9 ± 4,6 individuals. The Common Gull and Herring Gull migrated in smaller flocks (5,2 ± 1,5 and 4,0 ± 1,4 individuals, respectively). Medium sizes of a flock of the Great black-backed

Gull and Lesser black-backed Gull were 1,9 ± 0,5 and 2,3 ± 1,0 individuals, respectively.

A biggest flock of the Black-headed Gull consisted of 2.000 individuals which were registered in 1975. A biggest flock of the Common Gull consisted of 300 individuals (in 1976, 1980 ir 1981). A largest flock of the Little Gull consisted of 180 (in 1999) and a bigger flock of the Herring Gull was of 100 (in 1977). Other species did not migrate in such big flocks and the largest flock of Lesser black-backed Gull consisted of 50 birds (in 1978) and Great black-backed Gull had a maximum flock of 31 individuals (in 2000).

Flight altitudes

Flight altitudes of different gull species were different. The majority of gulls migrated at the altitude to 50 m (89.0-97.5 % of individuals of different gull species). The flights at lower altitudes (to 5 m) were characteristics of the Little Gull and Great black-backed Gull (on the average, 48,7 ± 34,2 % and 43,1 ± 27,2 % of all the individuals, respectively). Other species migrated the most at the altitude of 11-20 m (Fig. 10).

Flight directions

An obvious tendency of gulls to move along the coastline was demonstrated during the period of observations. Most of birds demostrate a tendency northward fligth during spring migration. On the average, from 55,6 to 84,0 % of migrants of different gull species expressed movements northwardly. The least proportion of movements southward were showed by little gulls (on the average, 16,1 % migrants) and even 44,4 % of great black-backed gulls migrate southwardly.

The modelling of spring migration

Northward fligth

It is determined the contribution of 13 weather variables to the variance of the spring gull migration on the seacoast of Lithuania. The positively effect on the process of the Little Gull spring migration to the main direction (northward) was made by relatively humidity, 24-h change in barometric pressure, visibility and cloud amount. The negative effect was made by 24-h change in relative humidity and low cloud amount. The equation was as follows:
$y = -380,70 + 4,05 \cdot x_3 - 1,51 \cdot x_4 + 3,66 \cdot x_6 + 4,04 \cdot x_7 + 11,4 \cdot x_8 - 8,12 \cdot x_9$ ($R^2 = 0,53$; $p<0,05$).

For spring migration of the Common Gull essiantial were 24-h change in relative humidity and visibility in the negative and surface wind velocity in the positively. The equation was as follows:
$y = 66,80 - 2,60 \cdot x_4 - 8,29 \cdot x_7 + 20,54 \cdot x_{12}$ ($R^2 = 0,09$; $p<0,05$).

In spring migration of the Herring Gull 3 weather variables have an significant positively impact:

Table 2. Phenology parameters of gulls during spring migration at the seacoast of Palanga

Species of gulls	Beginning of migration (date)			End of migration (date)			Duration of the migration (number of days)		
	The earliest	Average	The latest	The earliest	Average	The latest	The shortest	Average	The longest
The Little Gull	3.09 (in 2000)	04,12±19,3 d.	5.15 (in 1996)	3.15 (in 1975)	05,09±14,1 d.	5.29 (in 1991)	1 (in 1977, 1993, 1996, 2004)	28,7±18,3	60 (in 1994)
The Black-headed Gull	3.01 (in 1977)	03,16±7,4 d.	3.31 (in 1995)	4.29 (in 1975)	05,16±8,2 d.	5.3 (in 1981)	38 (in 1985)	62,8 ± 9,7	85 (in 1991)
The Common Gull	3.01 (in 1975)	03,12±7,7 d.	3.27 (in 1985)	4.18 (in 1974)	05,17±8,6 d.	5.29 (in 1991)	49 (in 1974)	67,1 ± 10,1	88 (in 1995)
The Lesser black-backed Gull	3.01 (in 1975)	03,17±9,5 d.	4.04 (in 1980)	4.14 (in 1975)	05,13±10,3 d.	5.3 (in 1981)	38 (in 1977)	58,0 ± 10,7	82 (in 1991)
The Herring Gull	2.19 (in 1998)	03,14±10,2 d.	4.08 (in 1987)	4.24 (in 1974)	05,15±8,7 d.	5.28 (in 2000)	38 (in 1974)	63,0 ± 12,1	89 (in 2000)
The Great black-backed Gull	2.21 (in 1995)	03,17±12,2 d.	4.10 (in 1985)	4.09 (in 1991)	05,05±11,8 d.	5.28 (in 1981)	20 (in 1983)	50,6 ± 15,6	78 (in 1995)

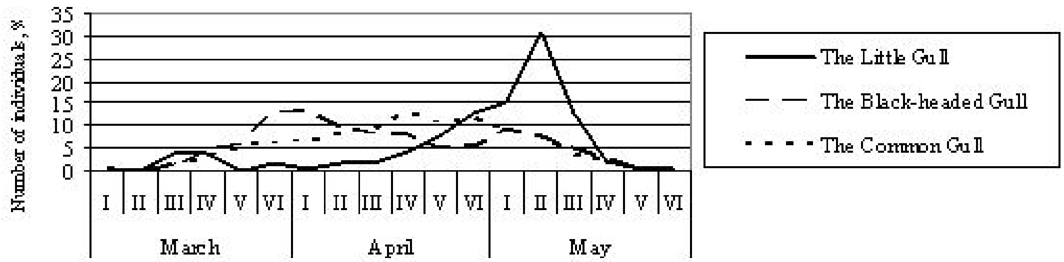

Fig. 7. Dynamics of the Little Gull, Black-headed Gull and Common Gull spring migration (5-days averages)

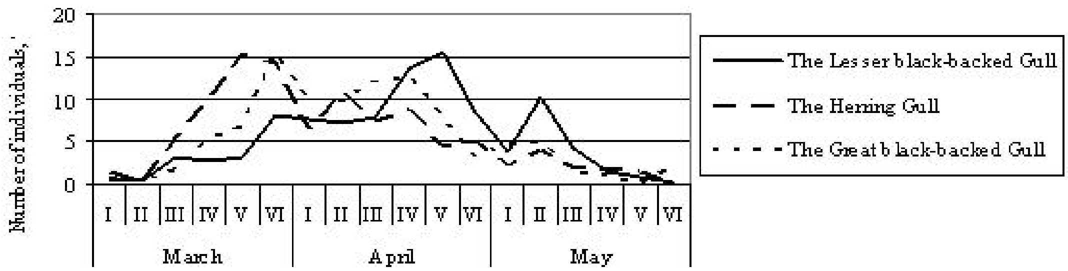

Fig. 8. Dynamics of the Lesser back-backed Gull, Herring Gull and Great black-backed Gull spring migration (5-days averages)

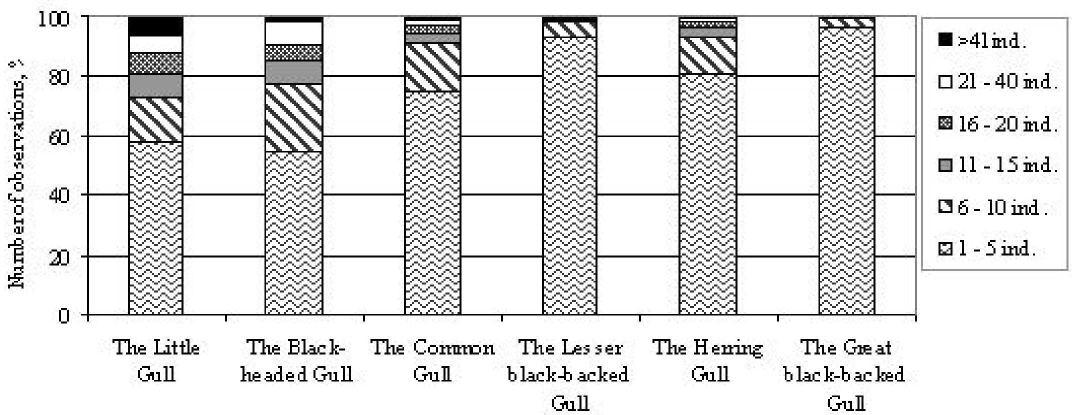

Fig. 9. Gull number in the flocks during spring migration on the seacoast of Lithuania

relative humidity, barometric pressure and surface wind velocity. The equation was as follows:
$y = -1196{,}11 + 0{,}83 \cdot x_3 + 1{,}12 \cdot x_5 + 3{,}37 \cdot x_{12}$ (R^2= 0,08; p<0,05).

Statistical dependable equations representing the total influence of 13 meteorological factors on migration intensity of the Black-headed Gull, Lesser black-backed Gull and Great black-backed Gull was not derivered.

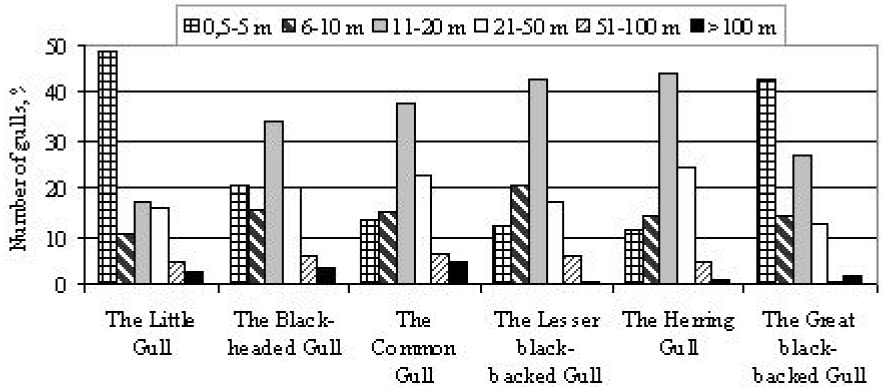

Fig. 10. Flight altitudes of gulls migration

Southward fligth

In spring 27,2 ± 20,3 % individuals of the Black-headed Gull moved southward and the flight correlated with surface temperature in the negative. The equation was as follows:
$y = 127,8 – 11,3 \cdot x_1$ ($R^2 = 0,06; p<0,05$).

In spring 21,6 ± 16,6 % individuals of the Common Gull migrated southwardly and the flight correlated positively with 24-h change in relative humidity. The equation was as follows:
$y = 21,3 + 0,66 \cdot x_4$ ($R^2 = 0,05; p<0,05$).

During the study period, on the average, 25,2 ± 17,5 % individuals of the Lesser black-backed Gull moved to the south. The migration to the south was under the positive influence of 24-h change in barometric pressure and 24-h change in barometric pressure. The equation was as follows:
$y = 0,46 + 0,13 \cdot x_6 + 0,70 \cdot x_{12}$ ($R^2 = 0,25; p<0,05$).
During the study period, on the average,

27,7 ± 22,4 % individuals of the Herring Gull moved to the south. The migration to the south was under the positive influence of visibility and low cloud amount. The equation was as follows:
$y = -16,9 + 2,48 \cdot x_7 + 3,19 \cdot x_9$ ($R^2 = 0,11; p<0,05$).
In spring 44,4 ± 26,0 % individuals of the Great black-backed Gull expressed movements southwardly and that flight positively correlated with surface wind velocity. The equation was as follows:
$y = 0,71 + 0,42 \cdot x_{12}$ ($R^2 = 0,34; p<0,05$).

Statistical dependable equations representing the total influence of 13 meteorological factors on southward migration intensity of the Little Gull was not derivered.

DISCUSSION

Gulls compose from 30-50 % of spring migrants on the Lithuanian Baltis Sea coast which is one of the main bird migratory pathways crosses of the Baltic Sea (Žalakevičius 1986). The most abundant migrant species of gulls on the seacoast of Lithuania breed in the Baltic Sea countries. Four gull species breeding in Lithuania and in the Klaipeda region breed in each of the Baltic Sea country (the Common Gull, Herring Gull, Black–headed Gull and Little Gull). The Lesser black-backed Gull and Great black-backed Gull do not breed in Lithuania but breeding pairs are found in majority of Baltic Sea countries. The Yellow-legged Gull breeds only in several of the countries because the Baltic Sea is in the periphery of their breeding area. The Yellow – legged Gull is regularly recorded passage migrant in Lithuania. More species of gulls appear during spring / autumn migration and vagrancy in the Baltic Sea. The Glaucous Gull and Kittiwake are species breeding North of the Baltic Sea and thus frequently occur during colder season and they are rare in Lithuania (Kurlavičius 2003, Olsen & Larsson 2003).

The geographical variation of the Little Gull is not fully documented. The species breeds mainly in North-East Europe, which accounts for less than half of its global breeding range. Its European breeding population is relatively small (up to 58,000 pairs). Also it is not abundant in Lithuania (200-300 pairs) and in the Klaipeda region (20-280 pairs). European breeding population underwent a moderate decline 1970–1990. Although the species increased markedly overall during 1990-2000 - with stable, fluctuating or increasing trends across the vast majority of its European range - its population has probably not yet recovered to the level that preceded its decline. Consequently, it is provisionally evaluated as depleted (Birdlife… 2004, Jusys et al. 1999, Kurlavičius 2003, Olsen & Larsson 2003). Even if abundance of little gulls did not decreased during observation period it looks that quite big fluctuation of numbers of migrants can be explained on decreasing and recovering to previous level breeding population in whole Europe.

The geographical variation of the Black-headed Gull is small and the species is often regarded as monotypic. The Black-headed Gull is a widespread breeder across much of Europe, which is now thought to hold >50 % of its global breeding population (>1.500.000 pairs). The species is widespread and common in Lithuania (30.000-60.000 pairs) and in the Klaipeda region (8.000-15.000 pairs). In S, W and N Europe black-headed gulls spread since the Nineteenth century, especially 1950-1980. The increase involved large percentage of coastal breeders. Probably the increase was caused by increased amount of agricultural land and new food supplies, including scavenging opportunities in urban areas. In Denmark the species was mainly an inland breeder until the strong increase in the extent of breeding area, and now it is mainly coastal. Since 1980 the population increase was slower or the population stabilized and since 1990, there was a strong decrease in S Scandinavia and Baltic. Abundance of black-headed gulls during spring migration was on the statistical significant decrease in the last few decades on the Lithuanian Baltic Sea coast too. Reasons for the decrease is mainly change of food availability caused by more „extensive" agriculture with limited areas of grazed land and also by competitive scavenging of the Herring Gull. Now the species is provisionally evaluated as secure (Birdlife… 2004, Jusys et al. 1999, Kurlavičius 2003, Olsen & Larsson 2003).

The Common Gull is a widespread breeder across much of Northern Europe, which constitutes >50 % of its global breeding range. Its European breeding population is large (>590,000 pairs). Every year 120-150 pairs of the Common Gull breed in Lithuania and 2-3 pairs breed in the Klaipeda region. Abundance of common gulls during spring migration in the last few decades was on the statistical significant decrease on the Lithuanian Baltic Sea coast and showed the same tendency of decline of common gulls as number of European breeding population which underwent a moderate decline 1970–1990. Although the species was stable or increased in some countries during 1990–2000, it declined across much of North-West Europe, and the trend in its Russian stronghold was unknown. Nevertheless, its population has clearly not yet recovered to the level that preceded its decline, and consequently the species is provisionally evaluated as depleted although Lithuanian breeding population is evaluated as secure and even slightly increasing (Birdlife… 2004, Jusys et al. 1999, Kurlavičius 2003, Skorka et al. 2006). Lesser Black-backed Gull is a widespread breeder in coastal areas of Northern and Western Europe, which constitutes >75 % of its global breeding range. Its European breeding population is >300,000 pairs, and increased 1970–1990. This trend continued during 1990–2000, with declines in the Northern Norway and Baltic Sea. Number of spring migrants on the Lithuanian Baltic Sea coast was on the statistical significant decrease in the last few decades too. Consequently, it is evaluated as secure because the decrease is compensated for by increasing or stable trends elsewhere (Birdlife… 2004, Bustnes et al. 2006). The Herring Gull is a widespread breeder across much of Northern Europe, which probably holds

>50 % of its global population. Its European breeding population is more than 760,000 pairs. Lithuanian breeding population spread and increased in the last few decades and now 10-20 pairs of the Herring Gull breed in Lithuania thus only 2-3 pairs are registered breeding in the Klaipeda region. Abundance of spring migrants of the species on the seacoast of Lithuania fluctuated. It can be explained with bigger changes in number of breeding pairs in other European countries. Dramatic increase is known in the Twentieth century, following protection from persecution and eggs-collecting, and with increasing availability of refuse. The number of herring gulls increased 1910-1975: 15-20-fold increase in Denmark and Germany and 5-fold increase in the Nederland. In some areas increase was arrested by preventive measures; in Britain the population decreased by 50 % 1969-1987 owing to combination of culling, botulism and salmonella, reduction food availability through better refuse disposal management, and improved utilization of commercial fishing. Also, in Saltholm, Denmark, a colony of 43,000 in 1979 was reduced to 7,000 in year 2000. Although populations declined in some countries declined, losses were more than compensated for by increases in most other European populations and the species increased overall (Birdlife… 2004, Jusys et al. 1999, Kurlavičius 2003, Lietuvos… 2006, Olsen & Larsson 2003).

Lithuanian herring gulls have demonstrated roof-nesting in the last decade. Single pairs breed on the roofs of many-storeyed buildings in towns of Klaipeda and Kaunas (Lietuvos…2006). One pair has bred on the roof of Amber Museum of Palanga for few years. Also one pair has bred on the high-tension electricity pole already for twenty years in the Seaport of Klaipeda (Lietuvos… 2006). Initial dispersal of gulls to roofs for nesting occurs typically during rapid growth of colonies on natural sites in surrounding areas. Success of roof-nesting colonies is attributed partially in response to their exploitation of anthropogenic food (Belant 1997).

The geographical variation of the Great Black-backed Gull is negligible. The Great Black-backed Gull is a widespread breeder in coastal areas of Northern and Western Europe, which constitutes >50 % of its global breeding range. Its European breeding population is >110,000 pairs. The species range expanded in the Twentieth century and the gulls started to breed in Denmark (1930), Germany (1984), and Nederland (1993). Although the population is stable or slightly declining in Norway, Great Britain, Iceland, the Republic of Ireland and W Sweden, populations in the rest of its range increased or were stable (Baltic Sea region, France). Consequently, the species increased overall and it is evaluated as secure (Birdlife… 2004, Olsen & Larsson 2003). Number of spring migrants on the seacoast of Lithuania fluctuated and was on the statistical significant decrease for the few decades because spring migrants of the species on the Lithuanian Baltic Sea coast breed to north if Lithuania (Olsen & Larsson 2003).

The last decade of the 20th century was distinguished by a unique climatic phenomenon of several successive warm winters. Besides, there are no enough information on global climate change impact on wildlife, biodiversity and waterbirds. Under climate warming conditions, species ranges are expected to move Northwards and Eastwards. On the basis of the investigations in Baltic countries, ranges of many bird species move Eastward or North-Eastward: populations of Southern (South-Western) bird species are increasing and the abundance of Northern (North-Eastern) bird populations is decreasing. Changes of wintering areas have radically changed the migration patterns of some waterfowl species. Due to continuous warming of winter seasons the majority of species shifted Eastward and Northward; the main stop-over areas of migrating populations changed; the number of resident birds in different populations was increasing (Zalakevicius & Svazas 2005).

It is also possible that migrants are declining due to factors operating on their breeding grounds, particularly as competition mediated by climate change may put migrants at a competitive disadvantage. Milder winters within Europe may lead to short-distance migrants and residents experiencing more favorable wintering conditions, leading both to enhanced survival and an earlier onset of breeding. The increased competition may disadvantage inter-continental migrants. Poor food supply on the wintering grounds or staging areas may both affect birds' energetic condition and retard their departure, potentially introducing a competitive disadvantage in breeding areas (Sanderson et al. 2006).

The fixed clutch size, the reproductive lifespan and survival of offspring from hatching to maturity, affected mainly by winter severity, are the prime creators of the variation in lifetime reproductive success. The lifetime reproductive success of any individual may result from the action of chance events, environmental and social factors, a phenotype (and an underlying genotype), or some combination of those. An individual's reproductive lifespan may depend on climatic conditions (warm winters, cold winters, mixture of these) under which an individual chances to live. Similarly, one can expect that the survival of immature individuals (and the breeding success of their parents) depend on prevailing climatic conditions during their pre-reproductive life. Furthermore, on a long temporal scale, global warming may lead to the prolongation of an average lifespan. Climatic conditions influence both the annual breeding success and the age at first breeding through the laying date (Rattiste & Tartes 2005).

Both et al. (2004) have confirmed, that climate warming causes birds to breed earlier. Rattiste & Tartes (2005) research on the Common Gull in Estonia have showed that in early years (those with advanced average laying date) reproductive success is higher and recruits from these cohorts start to breed at younger age. Thus, early years are more favorable for breeding and offspring from these seasons are of higher quality. Most probably, a warm winter followed by a warm spring will promote a better and earlier breeding condition. Individuals, which chance to live in a warmer period may have not only a longer lifespan but also higher annual breeding success. However, over the 35 years-long period of studies of the population of the Common Gull in Estonia any persistent advancement in laying date has not been founded (Rattiste & Tartes 2005).

Besides climate change, other alterations in the ecological situation may have a pronounced effect on gulls' populations. The invasion of the Herring Gull in Matsalu National park, Estonia, in 1970s has increased predation pressure and diminished the number of suitable breeding sites for the Common Gull. The evolutionary consequence of that process in increased inbreeding, which can lead to reduced individual fitness (inbreeding depression) and loss of genetic diversity. The later may reduce ability of the population of the Common Gull to adapt to environmental changes (Rattiste & Tartes 2005). In addition, the decrease of the Black-headed Gull in S Scandinavia and Baltic Sea and strong decline of the Common Gull in Fennoscandia is linked to strong competition with the increasing the Herring Gull population, forcing birds to move away from the coast and settle in inland areas (Olsen & Larsson 2003).

In colonial seabirds, nesting density, egg-laying date and microhabitat affect the probability of eggs and chicks being taken by avian predators. Mammals and larger birds (e.g. crows) are predators of eggs and chicks of gulls. As in birds species egg predation strongly limits breeding success, predation could affect various breeding properties of birds (Enticott & Tipling 1997, Lee et al. 2006, Kazama 2007).

Breeding success of gulls can be under the influence of various environmental conditions. Weather conditions such a heat or strong wind indirectly influences survival of eggs and chicks. The physical conditions surrounding nests (e.g. vegetation cover, nest-wall and slope) provided concealment against predators of nesting gulls. Important ecologically limiting factors are the availability of foods and the conditions of breeding areas what are generally unstable. Environmental conditions show year-to-year variations: the breeding habitats could be favorable one year but they can turn out to be hostile for gulls in the next year. In addition, gulls mostly breed colonially in isolated islands, which are more vulnerable to extreme weather such as typhoons or high temperatures (Lee et al. 2006, Pons & Migot 1995).

Food availability for gulls has been increased by the urban waste and fishing rejects and possibly also by the overfishing of large predatory fish, resulting in an increase of smaller fish. These main factors are used to explain the increase of gulls' abundance, even sometimes gulls using refuse tips die of botulism. The opportunistic foraging behavior of gulls enables them to exploit new food sources rapidly and efficiently, particularly those originating from anthropogenic activities. Food from human refuse, discards and offal from fisheries was found in 10 % of all food samples in the Black-headed Gull, Common Gull and Herring Gull in the North Sea and occurred in up to 40 % of the Lesser Black-backed Gull pellets and has reported at higher frequency in other regions. Feeding behavior is important to explain about changes of gulls' abundance as well. For example, in Great Britain, for some 15 years most of the Herring Gull populations either have been declining or have remained stable. At the same time, the British Lesser Black-backed Gull, a close relative with similar demographic characteristics but a more piscivorous diet, has increased by 30 %. From these facts, it seems likely that both feeding behavior and artificial food resources play a prominent role in gulls' population fluctuations (Kubetzki & Garthe 2003, Pons & Migot 1995).

Food choice, feeding habitat use and spatial distribution of different species of gulls are different. Kubetzki & Garthe (2003) has reported about clear nutrition differences between the four species of gulls in the North Sea. The Lesser Black-backed Gull is species that feeds extensively at sea, often far from the breeding colony. The Herring Gull forages primarily in the intertidal zone. The Black-headed Gull and Common Gull divide their foraging between the intertidal zone and terrestrial habitats. Dietary niche breadth reflects the diversity of foraging habitats used, being greatest in the Black-headed Gull and the Common Gull; these are the most omnivorous of the four gull species. The extensive use of food from the open sea by the Lesser Black-backed Gull, being apparently largely without competition from other seabird species in the South-Eastern North Sea, has possibly enabled or at least facilitated their strong population increase since the 1970. The Herring Gull is the only species in that study that is not increasing, and it also had the smallest dietary niche of all four species studied. In the intertidal zone, they compete, not only with gulls, but also with other species of birds such as the Eurasian Oystercatcher (*Haematopus ostralegus*) and the Common Eider (*Somateria mollissima*). During the time the Herring Gull were building up their high breeding population size, there was little competition, because all possible competitors were much less abundant and there was also reduced winter mortality, due to the utilization of refuse and discard (Kubetzki & Garthe 2003).

In Northern Norway, the Lesser Black-backed Gull feeds mainly offshore on the wing on pelagic fish and fishery discards. It avoids competition with other large gulls for concentrated stationary food sources such as garbage dumps and fish-factories. It is also inferior to the Herring Gull and the Great Black-backed Gull when competing for large food items behind stationary or slow-moving fishing boats. During the last decades the breeding population of the Lesser Black-backed Gull in Northern Norway has decreased alarmingly. Food shortage is thought to be the main reason for this decrease (Strann & Vader 1992).

The Herring Gull population explosion which occurred in the mid-Twentieth century in North America and Eurasia has been attributed to the increasing availability of garbage at landfills. However, it is known that gulls feed mainly on natural foods during the egg formation period when higher quality nutrition is required and when provisioning their growing young. Assimilation efficiency is much higher for natural foods (earthworms, mussels and starfish) than for garbage. Moreover, breeding females are less likely to use landfills than are males. The landfills served mainly to sustain young birds during their first winter, as well as wintering and nonbreeding adults. In addition, latterly has seen the closing of many landfills, so this concern should be become much less of these possibilities (Gochfeld 1997).

Human activities have impaired not only nutrition advantages for gulls but also new habitats. Industrial water bodies and roof of buildings have become important alternative breeding habitats for gulls (Belant 1997, Skorka et al. 2006). Organisms that live in systems containing many toxic substances can bioaccumulate organic and certain inorganic substances over time, and are at risk from both lethal and sublethal effects, as their body burdens increase (Gochfeld 1997). Concentrations of certain elements or compounds may impair the survival and breeding success in gull. The low breeding rates effectively mean that populations cannot recover quickly from catastrophic declines in the numbers of breeding adults, as might occur as a result of pollution near breeding colonies (Furness & Monaghan 1987).

Contaminants, such as heavy metals, enter the water through industrial processes, urban and suburban runoff, agricultural practices, natural erosion, and geochemical cycles. Once in aquatic systems, they enter the food chain where they can biomagnify in the food chain. Top-level carnivores and piscivores can have much bigger levels of contaminants than organisms that are lower on the food chain. Gull often feed relatively high in the food chain and they seem to be prone to accumulate more persistent contaminants than many other seabirds' species. Gulls not only feed on crustaceans and fish but also on other seabirds and carrion (e.g. seal). Burger & Gochfeld (2001) have represented that mercury levels in gulls from the coast of Namibia in Southern Africa are five times higher than cormorants taking higher levels in the food chain. This is surprising, given that gulls eat insects, worms and garbage, in addition to the fish and mollusks eaten by the cormorants. It is possible that the higher levels of mercury in the gulls result because gulls consume offal from fishing vessels and dead fish along the shore, both of which could represent larger fish that would be caught by the cormorants or gulls. In general, larger fish have greater mercury levels than younger and smaller fish) (Gochfeld 1997, Pusch et al. 2005). Thomson et al. (1993) results have showed that mercury concentrations in the Herring Gull from the German North Sea coast did not increase linearly during this century but there were two main phases of increase. First, a sudden increase during the 1940s and, secondly, after a sharp decline in mercury concentrations in the 1950s, a prolonged increase during the 1960s and 1970s. The first peak may be explained by additional input of heavy metals during the Second World War (1939-45). Ignition devices of ammunition, mines and bombs contained mercury. Also, industrial production Germany was unlikely to have been concerned with pollution control at that time. The second increase can be explained by the increasing industrialization in European countries after the Second World War (Thomson et al.,1993).

Gilchrist & Mallory (2005) reported some possible causes of the decline of the Ivory Gull, *Pagophila eburnea*. Authors suggested that causes of the decline might be related to factors occurring during migration or on wintering grounds. Observed ecological changes on the wintering grounds have a bad influence for the Ivory Gull. In addition, few breeding colonies were potentially threatened by disturbance and oil development. Hunting of during migration period may be a contributing factor (Gilchrist & Mallory 2005). So one of the factors used to explain the increase of gulls' abundance may be a decrease in human predation following the species' legal protection (Pons & Migot 1995).

One of the reasons of population declines can be small reproduction rate, which is affected by various factors. For example, in Norway two subspecies of the Lesser Black-backed Gulls are breeding. All the back-mantled nominate *L. f. fuscus* in mid and Northern Norway, and the grayish-mantled *L. f. intermedius* in the south.

All *L. f. fuscus* populations have decline from the late 1960s in the Baltic Sea and Northern Norway. The Norwegian *L. f. intermedius* population, on the contrary, has decreased steeply in some areas, which were previously occupied solely by *L. f. fuscus.* One of possible causes of the decline in the Lesser Black-backed Gull have been hypothesized that it is related to poor feeding condition following the collapse in the Atlanto-Scandic stock of the Herring, *Clupea harengus* (Bustnes et al. 2006).

In the Gulf of Finland, the Lesser Black-headed Gull food consists almost entirely (>90 %) of the Baltic Herring during courtship feeding and chick rearing period. The Herring Gull relies heavily on fish in their diet. However in Finland have been no report of food shortage, but high frequencies of chick mortality has been documented (Bustnes et al. 2006, Hario et al. 2004).

The chick diseases are not necessarily induced by starvation. Hario et al. (2004) studies have shown that the diseased chicks of lesser black-backed gulls appeared too sick to digest, and they died by the fourth day showing no weight gain despite having free access to food. Their diseases were innate, reflecting dysfunction of the degenerated liver that cannot cope with common inflammations. The organochlorine concentrations in liver of the diseased chicks were high, especially for DDE. In fact, DDE concentrations were disproportionately high considering the decreasing trend found in other biota in the Baltic since the 1970s. Compared with other species biomagnifications of DDE in the Lesser Black-backed Gull occurs outside the Baltic Sea largely (Hario et al. 2004, Malling & Olsen 2003).

Recent strong decrease in the Lesser Black-backed Gull, breeding in Northern Baltic, was caused mainly by poor reproductive rate. Hario et al. (2004) studied reproductive parameters of the Lesser Black-backed Gull and Herring Gull in the same colony located at Soderskar, Gulf of Finland. Some important breeding parameters as a mean clutch size, percentage of addled eggs, egg mortality and a number of chicks hatched did not differ between two gull species. But the number of chicks disappeared and diseased in the Lesser Black-backed Gull was far higher than in the Herring Gull and that determined the breeding success of the gulls. The final fledging result of the Herring Gull at Soderskar in 1995 was 1.15 fledglings/pair and that of the Lesser Black-backed Gull only 0.019 fledglings/pair. The difference in breeding success among species was due to differences in chick mortality rates. The population decline of the Lesser Black-backed Gull in the Gulf of Finland is caused by exceedingly high chick mortality due to diseases. The chick diseases include degeneration in various internal organs (primarily liver), inflammations (mainly intestinal), and sepsis, the final cause of death (Hario et al. 2004).

According to ring recoveries, the Lesser Black-backed Gull spends the winter in equatorial Africa, mainly in Uganda and to a lesser extent in Ethiopia, Kenya, and Tanzania in the South. They travel long distances with apparent ease and use the Black Sea and the Eastern Mediterranean as stopover sites. In all East African countries, DDT is still used to a considerable degree. DDT is a very effective and economical pesticide for controlling malaria-transmitting mosquitoes and tsetse flies carrying sleeping sickness in both man and cattle. DDT pesticide has a relatively weak human health risk at environmental concentrations, while it has a clearly harmful effect on wildlife, particularly on birds. It is difficult to describe what extent the Lesser Black-backed Gull adults are exposed to toxicants in Africa because almost nothing is known of their feeding ecology there. However, it seems safe to conclude that they are prone to bioaccumulation from the numerous point sources of toxicants that exist in East African countries. A high PCB loading in the liver of Finnish breeders – absorbed from pesticide-treaded grasshoppers in winter quarters – is probably a promoting factor, although grasshoppers presumably only are a secondary food in winter's quarters after fish offal. Herring gulls, on the other hand, are sedentary in the Baltic, or short-distance migrants within Europe. Their contaminant burdens mostly reflect the environmental situations in these areas (Hario et al. 2004, Olsen & Larsson 2003).

Contaminants have been found in various tissues and blood of the Glaucous Gull as well. Monitoring of organohalogens in that species has been given high priority in Svalbard (Norwegian Arctic) due to its widespread distribution and important role as top avian scavenger-predator in the marine food web. The Glaucous Gull like other birds have reported to accumulate some of the highest concentrations of organohalogen contaminants (Verreault et al. 2007).

Bustness et al. (2003) have represented that the Glaucous Gull with high blood concentration of organochlorine pollutants need more time to gather food as a result of either endocrine disruption or neurological disorders. It means that birds may be absent from the nest and not incubating too long. In addition, females with high blood levels of organochlorins are likely to have nonviable eggs than females with low blood levels. It is important if levels of various contaminants are above or below the levels that are known to cause adverse in birds. In addition, environmental pollutions may play a role in the decline of gulls in combination with other stress factors; i.e. poor feedings may make the birds able to cope with the pollutants, and more susceptible to their effects (Bustnes at al. 2006). Climate change and exposure various pollutants are regarded as two of the most serious anthropogenic threats to biodiversity and ecosystems. Even through is evidence that levels of classic persistent organic pollutants are decreasing it is likely that the exposure of biota to them will increase during the next decade (Jensen 2006). Various factors or combinations of those may be implicated for different species of gulls differently. Some factors can affected on the gulls at the same time and it is difficult even to determine which factor is more important. Besides it, migrant birds can be influenced by factors effecting on their wintering grounds, breeding grounds or migration routes.

CONCLUSIONS

Numbers of the Black – headed Gull, Common Gull, Lesser Black – backed Gull and Great Black – backed Gull were on the statistical decrease and abundance of the Little Gull and Herring Gull represented fluctuations during spring migration on the Lithuanian Baltic Sea coast. The Little Gull began spring migration on the average on the 12th of April and other species of gulls – on the 12 – 17th of March. The migration duration period of the Common Gull is the longest (on the average 67 days) and the Little Gull migrated the most shortly (on the average 29 days). The gulls of various species abundantly migrate from the fifth 5 - day period in March to the third 5 - day period in May. The majority of gulls migrate in the flocks of 1 - 5 individuals. The most of gulls migrated northward at 1 – 20 m altitude during the 2nd, 3rd and 4th hours after sunrise. The intensity of migration was depended on 8 meteorological factors for northward and 6 factors influenced the southward migration.

Migrant birds can be influenced by factors effecting on their wintering grounds, breeding grounds or migration routes. Climate change may affect the timing of arrival in breeding areas and survival opportunities during winters, prolong average lifespan, increase a competition between long- and short-distance migrants and thus affect on abundance of gulls. Competition, predatory and disturbance of bigger birds, mammals and human reduce breeding success of gulls. Anthropogenic activities have extended food availability and quantity of alternative feeding and breeding habitats that have led to gulls population explosion in urban areas and less winter mortality. Due the contaminants, such heavy metals and organochlorine, adult gulls may gather food longer, chicks may show very high levels of diseases and mortality, and that determine low breeding success of gulls. Decreased numbers of some gull species may lead to increased numbers of other species. Thus it is not possible to determine an exact cause of changes in abundance of gulls because the birds are affected by the combination of various factors, occurring in different periods and places of gulls' life.

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