



УДК 598.333.2+591.543.43

MORPHOLOGICAL VARIATION AND SEX DIMORPHISM IN ADULT AZOV YELLOW-LEGGED GULL *LARUS CACHINNANS CACHINNANS*

Neubauer G.¹, Koshelev A.I.², Koshelev V.A.², Zagalska M.³

¹ - Dept. of Vertebr. Zoology, Nicolaus Copernicus University, Torun, Poland

² - Melitopol Pedagogical University, Melitopol, Ukraine

³ - Dept. of Genetics and Animals Breeding, University of Agricultural, Poznan, Poland

Морфологические вариации и половой диморфизм взрослых чаек-хохотуний *Larus cachinnans cachinnans*. Нойбауер Г. (Nicolaus Copernicus University, Torun, Poland); Кошелев А.И., Кошелев В.А. (Мелитопольский государственный педагогический университет, Украина); Загальска М. (University of Agricultural, Poznan, Poland).

Исследования проводились в 2000-2001 гг. на юге Запорожской области, на о-вах Молочного лимана Азовского моря. Сетевыми ловушками типа «цилиндр» было отловлено, прижизненно обследовано и окольцовано 80 экз. взрослых чаек, окольцовано свыше 3500 подростков птенцов. Измерения проводились по 28 параметрам (14 метрических и 14 цветовых). Бралась пробы крови из полой вены для последующего генетического анализа, проведена цветная фотосъемка внешнего вида чаек (окраски глаз, ног, масти и др.).

Выявлены достоверные различия между самцами и самками по всем метрическим показателям (самцы крупнее и тяжелее), размах индивидуальной изменчивости и частота встречаемости отдельных признаков у *L. c. cachinnans*, ее отличия от *L. c. michahellis* и *L. argentatus*. В изучаемой колонии доля птиц, отнесенных к подвиду *L. c. michahellis* составила 5%. Остальные птицы по всем показателям относятся к номинальному подвиду *L. c. cachinnans*.

Introduction

Введение

The project is supported by KBN 6 PO4C 04719. The taxonomic status of the gulls from *cachinnans* group is not clear and still discussed (Johnson 1985; Filchagov, 1992; Wink et al., 1994; Helbig, 1994; Heidrich et al., 1996; de Knijf et al., 2001) Many authors described field characters of these forms (Klein 1994, Gruber 1995, Garner et al. 1997, Jonsson 1998). Still heated discussions under *cachinnans* could be caused among other things by poorly known populational variability within different populations of the Yellow-legged Gull. There



are only two papers describing just some aspects of the morphometric problems (Mierasuskas et al., 1991; Liebers & Dierschke, 1997). In this article we show morphological variability within the Azov breeding population and features to recognize sexes.

Material and methods

Материал и методика

Gulls were trapped in the breeding colony at Molochny Liman in 2000-2001, a salt reservoir near the north Azov seashore (20 km southeast from the Melitopol city). Natural formations around the Liman are the salina and steppe. Total number of Yellow-legged Gulls on the Liman varies between 5000 to 6000 of breeding pairs (Koshelev, 2000; Chernichko et al., 2000). All gulls were trapped on the nests on the Podkova Island, located near the Girsovka village, where 2,000 pairs nested then. Most of the area is open and flat and only partially vegetated by reeds *Phragmites australis*. Birds nests are usually located on the ground, in low, dense vegetation (*Salicornia sp.*) or at the edge of reeds. Some nests were found in old Cormorant's nests (to 0.5 m above ground) or just on the open ground with no vegetation.

Some dead gulls found in the breeding colony and specimens collected in the INFS – Italian Wildlife Institute (Bologna, Italy) from Sivash Lake and the Danube Delta were measured. The total of measured *cachinnans* is 80 birds (50 birds were trapped on Molochny liman, 20 birds on the Sivash and 10 birds were caught on the Danube).

Measurements description

Описание измерений

For trapped birds a total of 28 parameters (14 metrical and 14 colour features) were taken, based on our adapted version of the instruction by P. Chylarecki, W. Meissner and A. Sikora. Among standard measurements were: total head length (HE), bill length (BI), tarsus length (TR), wing length (WI). Additional measurements were: bill height at gonydeal angle (HBIG), minimum bill height between gonydeal angle and skull (HBIN), middle toe length (MT), and "hand" – the distance between tip of 1st and 10th primary (DL) on maximum spread wing, not measured in moulting birds. Colours were determined for the following parts of the gull: iris (IR), scale 1 to 4, where (1) was pure pale with no dark pigmentation, (2) – a few and tiny dark spots, (3) – many, tiny or big dark spots (at the distance usually seems to be dark iris) and (4) – lots of dark pigmentation, covering all or almost all of the iris surface - at distance looked as a totally dark eye; eyering (ER) colour was determined in the following scale: (1) – yellow or yellowish, (2) – pale orange, (3) – dark orange and (4) – reddish/red. Leg colour was determined separately for tarsus, toes and a swimming web with the same scale: (1) – "cadaverous" (pale grey, greyish, green-grey), (2) – pinkish to flesh pink, with no yellow tone admixed, (3) – pinkish with slight yellowish tinge, (4) – yellowish or pale yellow and (5) – deep yellow. It has to be stressed, that all the colours were determined just after the bird was trapped (colours may change a bit after few minutes because of bird's stress!). Mantle colour (M) was determined on alive, captured gulls or later, on the feathers taken from the mantle with the use of Kodak Gray Scale (Small) CAT 152 7654 1995 where 0 is white and 20 is black. The colour of tongue on P10 (Z) was determined in three categories: (1) white/whitish, (2) grey, but lighter than mantle and (3) grey, as dark as a mantle.



To characterize black and white pattern on the outer primaries, following measurements were taken: maximal length of the white on P10 tip (W10); length of the white on P9, measured as the distance between the beginning of the white spot and the tip of the feather (W9); minimal length of the black bar on P10 (B10), length of the black on P9, measured from the distal end of grey/white tongue to the end of black bar (B9), in the same way length of black bar on P7-8 was measured (B7, B8). All the measurements were taken along the shaft. For two outermost primaries (P9-10) the types of black/white pattern was noted in scales from 1 to 5. On P10 the following types were recognized (T10): (1) - "*thayeri-pattern*" - a grey or white tongue connected with the white primary tip, regardless of presence or absence of the black bar (2) all white tip of the primary, no black markings, (3) - traces of black near the tip, (4) - an incomplete subterminal black bar and (5) - a complete subterminal black bar. For P9 the types were (T9): (1) - "*thayeri pattern*", grey/white tongue connected with the white tip, regardless of presence or absence of a subterminal black bar, (2) - a huge white spot, reaching both feather's edges, (3) - white spot does not reach the feather edge, but do reach the second one, (4) - a small white spot on one web only, not reaching any edges of the feather and (5) - no white spot. Also the number of black-tipped primaries was noted (NB), and the type of black pattern on the innermost primary with dark (TI) in three categories: (1) - only dark spots, (2) - an incomplete black bar and (3) - a complete black bar.

Blood samples were obtained from the most of the captured birds. Blood was conserved with EDTA buffer. Sex of gulls was determined with use of molecular methods (Polymerase Chain Reaction, Griffiths et al., 1998; Backer, 2000; Kahn et al., 1998).

Results

Результаты

Standard measurements. In wing length obvious sexual dimorphism is shown, with only a small overlap. It means that length of wing for males was a bit higher than that of for females (Table 1). The total head length is distinctly higher for males (mean 137.1 mm) than for females (mean 122.9 mm). Combination of wing length and total head length is very good character distinguishing sexes (Table 1, Fig. 1). Bill is longer and higher (at gonydeal angle) in males. Both sexes have the same bill proportions, so the bill ratio is the same. A longer bill with less prominent gonydeal angle in *cachinnans* results in general bill 'jizz' - it seem to be thinner and more elongated, what is useful in field identification. Note however, that some *cachinnans* males can look very heavy-billed, in both hand- and field-appearance and some females surprisingly delicate- and thin-billed. Both tarsus and middle toe are longer in males (Table 1), although covering of parameters between the sexes was found.

Iris & Eye-ring. Strong variability was noted in the eye-colouration within examined gulls. No birds with a pure pale iris (scale 1), without any dark spots were trapped. 26 out of 58 gulls, have a pale iris with a few dark spots admixed (scale 2). Next 11 birds showed a lot of dark pigmentation, covering most of the iris (scale 4), what looked as a completely dark eye from distance. At the end of the scale (4) - completely dark iris - were 21 gulls. Background variability of the iris was also recorded, from very pale yellowish to khaki with greenish shade. Within birds no yellow eye-ring was found. Most of gulls (n=56) have eye-ring pale- (24) or dark-orange (30) and only two individuals have it reddish. Correlation between colours of iris and eye-ring was weak (Pearson $r = 0.31$).

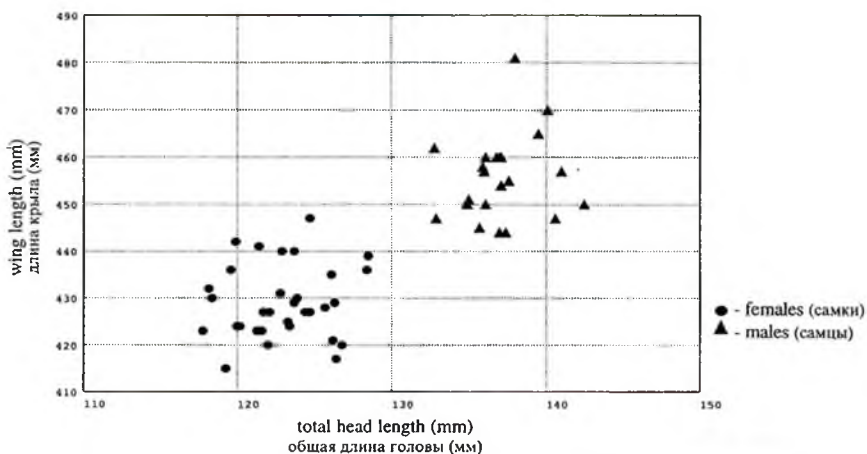


Fig.1. A combination of two metric parameters (head length and wing length) is well enough to determine the sex of Yellow-legged Gulls.

Рис.1. Комбинация двух метрических параметров (длина головы и длина крыла), используемая для определения пола чайки хохотуны.

Table. Variability of morphological characters within adult Yellow-legged Gulls *Larus cachinnans cachinnans*. For each character mean \pm standard deviation are given, in parentheses sample size is shown. Significance levels of differences between sexes are solved with the use of Multi-Factor ANOVA-test, NS – not significant ($P>0,05$).

Таблица. Изменчивость морфологических характеристик взрослых особей чайки-хохотуны. Для каждого показателя дано среднее значение \pm стандартное отклонение, в скобках указан объем выборки. Для определения уровня различий между полами использовался мультифакторный ANOVA-тест, NS – различие не достоверно ($P>0,05$).

Character Показатель	Character value, males Значение показателя, самцы	Significance level, P Степень достоверности различий между самцами и самками	Character value, females Значение показателя, самки
1	2	3	4
WI	454.8 \pm 7.2 (20)	NS	429.3 \pm 7.8 (31)
DL	239.0 (1)	-	220.9 \pm 4.9 (13)
HE	137.1 \pm 2.4 (22)	<0.000000	122.9 \pm 2.9 (33)
BI	63.2 \pm 2.4 (25)	<0.000000	55.0 \pm 2.9 (34)
HBIG	19.9 \pm 0.8 (25)	<0.000000	17.4 \pm 0.6 (34)
HBIN	18.7 \pm 0.1 (25)	<0.000000	16.1 \pm 0.5 (34)
Bill ratio	3.17 \pm 0.1 (25)	NS	3.17 \pm 0.1 (34)
TR	73.6 \pm 2.0 (22)	<0.000000	67.2 \pm 2.5 (31)
MT	69.9 \pm 1.6 (21)	NS	64.0 \pm 2.2 (26)
IR colour	3.0 \pm 0.9 (24)	NS	2.8 \pm 0.9 (33)



Continuation of the table

1	2	3	4
ER colour	2.5±0.6 (23)	NS	2.7±0.5 (33)
Legs colour	1.8±1.3 (24)	NS	1.9±1.4 (31)
M	6.4±0.5 (14)	NS	6.2±0.7 (22)
NB	6.4±0.5 (24)	0.05	6.1±0.4 (34)
TI	1.9±1.0 (24)	NS	2.4±0.8 (34)
T10	2.8±1.1 (24)	NS	2.6±1.1 (34)
T9	2.0±0.0 (24)	NS	2.1±0.3 (34)
B10	31.3±12.2 (24)	NS	20.5±12.9 (33)
B9	79.5±8.8 (23)	0.005	67.7±14.7 (34)
B8	60.4±7.9 (24)	0.007	54.5±5.8 (34)
B7	36.9±4.5 (24)	0.03	34.3±3.2 (34)
W10	66.3±4.1 (23)	0.02	63.4±4.2 (34)
W9	52.6±4.2 (22)	NS	50.2±4.3 (33)
Z	1.1±0.3 (24)	NS	1.1±0.4 (34)

Note: explanation of abbreviations is given above in the text.

Примечания:

W1 - длина крыла; DL-длина между кончиком 1-го и 10-го первостепенных маховых при максимальном размахе крыла; HE-общая длина головы; В1 - длина клюва; НВ1G - высота клюва в районе гонидиального угла; НВ1N-минимальная высота клюва между гонидиальным углом и челюстью; Bill ratio - пропорции клюва; TR-длина цевки; МТ-длина среднего пальца; IR colour- цвет зрачка; ER colour- цвет окологлазного кольца; Legs colour-цвет ног; М- оперение; NB-число первостепенных маховых с черными кончиками; TI - тип окраски черного участка на внутренних первостепенных маховых; T10 - тип окраски P10 (десятого первостепенного махового пера); T9 - тип окраски P9; B10 - минимальная длина черного участка на P10; B7, B8, B9 - длина черного участка на P7, P8, P9, измеренная от дистального конца серого/белого языка до конца черного участка; W10 - максимальная длина белого участка на кончике P10; W9 - длина белого участка на P9, измеренная от начала белого пятна до кончика пера; P1, P2, P3, P... - номер первостепенных маховых перьев.

Bill colour. The bill colour was usually pale yellow. It is worth to notice, that only females (5 of 32) have an amount of reddish tinge on upper mandible, in all males the reddish spot was restricted to the lower one. Out of 55 otherwise fully adults, 24 had various dark signs on the bill, which varied from a single dark grey spot to a complete black bill band. Recorded in the same proportion in both sexes, it was present also in 11- and 12-years old birds.

Legs. Legs colour varied strongly. 68% of trapped gulls (n=56) had legs with “cadaverous” colour. The second big group consists of birds with some yellow on the legs (32%), the most numerous were pale yellow- or yellowish-legged birds. No birds with intensive, deep yellow legs were trapped. There are no difference in colour between tarsus, toes and a swimming web in general. The only bird (a male) with very intensively coloured tarsus and toes (pale yellow, 4 on the scale), had the swimming web flesh yellow (5 on the scale, the same as in *nichahellis*). Two birds (female and male) had also more intensive colour on the swimming web (pinkish) than on the rest of leg (cadaverous).

To check how the colour depends on the light, we took a sample of birds seen from the distance. In the group of 104 adults, 58 had “cadaverous” legs and 46 had more or less yellowish tinge, sometimes very deep yellow. It is need to notice, that in strong sunlight “cadaverous”, wet legs (with a slight yellowish tone) seen from a distance can look quite yellow.



Mantle colour. The grey mantle colour varies strongly within *cachimans* gulls. The lightest individuals were about 5.0 on the Kodak scale, while the darkest were at about 7.0 (medium neutral grey), with the mean for all examined birds ($n=56$) placed at 6.22, without differences between males and females (Table).

Wing-tip pattern. Black-and-white primary patterns are known to be diagnostic in identification of these gulls (Cramp & Simmons, 1983, Mierauskas et al., 1991, Garner, Quinn, 1997; Jonsson, 1998).

Number of black-tipped primaries. Varies from 5 to 7, and most frequent are birds with six or seven primaries with black. Commonest pattern is a complete or near-complete bar on P5, but on P4 only single dark spots in 24% of individuals (outer web) were noted. Exceptionally one female had only 5 black-tipped primaries. Females evidently tend to have more white on the primaries, what results also in having more restricted black parts of the feathers in all examined features (P9 & P10 patterns, black and white dimensions, number of primaries with black). Differences between sexes are marked and statistically significant (Table 1): 82% of females and 63% of males had 6 black-tipped primaries, against only 15% of females and 37% of males with 7 black-tipped primaries.

Outermost primary (P10). On P10 the connection of grey tongue and white primary tip and the extension of subterminal black bar developing were noted (see Material and methods). The one extreme is the lightest variant - a "thayeri"-pattern (very pale, usually white tongue connected with white primary tip, regardless of developing extension of subterminal black bar), the darkest one - fully developed subterminal bar, crossing the feather transversally (with the black bar separating the pale tongue from the white primary tip).

Variability was found within population (figure 2). Most numerous, together giving over 70% were types 2 and 3 (all-white P10 tip or white with traces of black). "Thayeri"-pattern was present in about 8% of birds, all of them were females. P10 patterns of females differed from that of males, having more white in general (highly significant, χ^2 test, $p<0.001$). The black bar (B10), separating the end of the inner web tongue from the white primary tip was narrow.

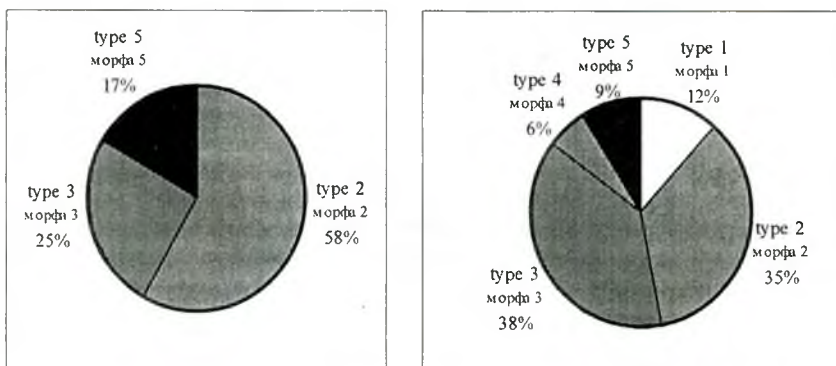


Fig. 2. Percentage of particular P10 patterns in Yelow-legged Gull males (left) and females (right).

Рис.2. Процентное соотношение разных морф P10 у самцов (слева) и самок (справа) чайки-хохотуньи.



Very pale with a white or whitish inner web tongue strongly contrasting with black, and only in 4 of 55 individuals the border between white and black was a bit diffused. All of them were males, with significantly more black on P10 (41.2 mm) than the mean for males (31 mm). The white tongue of *cachinnans* is the deepest among all European gulls, ending 58-115 mm from the primary tip, and often has a specific shape. The white primary tip (W10) is long, with a mean of 65 mm (Table).

Second outermost primary (P9). The P9 pattern was very stable (the reverse of P10 patterns). A huge white mirror, reaching both feather's edges was present in all males and in the most females (figure 3). Only 5 females showed it reduced reaching one of primary edges, but it still was present on both webs. One bird, a female, had "thayeri"-pattern. The black bar is strongly broader than on the outermost primary (Table). The white was shorter than on P10. The inner web tongue was still very pale, although it can be darker grey than on P10; the typical shape and sharp delineation from black was present in almost all cases.

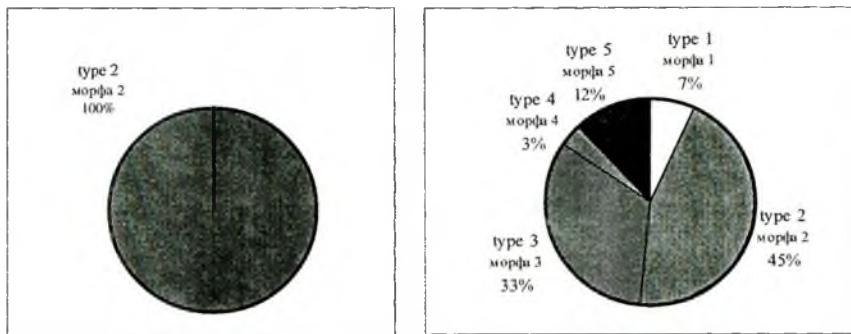


Fig. 3. Percentage of particular P9 patterns in Yellow-legged Gull males (left) and females (right).

Рис.3. Процентное соотношение отдельных морф P9 у самцов (слева) и самок (справа) чайки-хохотульки.

Discussion

Обсуждение

Identification of large gulls require a combination of multiple field marks (Klein & Gruber, 1997; Jonsson, 1998). Variability within the Azov population seems to be more pointed for females. There are also some features, mainly in basic measurements (Cramp & Simmons, 1983), giving a possibility to distinguish sexes. It is evident from the measurements, that the males are larger than the females (Harris & Hope Jones, 1962).

The difference between minimal and maximal (at gonydeal angle) bill height is obviously small within *cachinnans* gulls (0.4-2.1, mean 1.3 mm), smaller than in the two other European populations (*michahellis* and *argentatus*, t-test, $p=0.001$; Zagalska & Neubauer, in prep.). Presence of dark spots on the bill were in the same proportion as presented by Liebers & Dierschke



(1997). It seems to be specific at least for part of the population. There is no evidence to determine age of the birds by of the presence a dark rings on the bill.

The iris colour in *cachinnans* group is variable, but often more or less dark coloured (Garner, Quinn, 1997; Klein & Gruber, 1997), and it is a good feature to distinguish *cachinnans* from other European populations, among which dark-eyed gulls are extremely rare. No pale irises without any dark spots were noted in the examined birds. Gulls observed from the distance seem to be "pale-eyed" but in hand iris in most cases has dark spots with different intensity. Liebers & Dierschke (1997) suggest that over 60% of the birds have pale iris. It is very possible that to this group birds with iris signed in our classification as a type 2 and probably sometimes type 3 were pooled. Classification suggested by these authors are based on the impression which could depend on light intensity and can not be treated as a fact. Furthermore, a very weak correlation was found between colour of iris and eye-ring, in opposite to Liebers & Dierschke (1997).

We agree that from the distance legs in many birds are deep yellow (Liebers & Dierschke, 1997) especially under specific light condition (e.g. sun set). In-hand no birds had deep yellow legs (such as *michahellis*), but admixed yellow or yellowish tones.

Females evidently tend to have more white on the primaries, resulting also in having more restricted black parts of the feathers in all examined features (P9 & P10 patterns, black and white dimensions, number of primaries with black). According to Mierauskas et al. (1991) the number of the black-tipped primaries was 6 or 7, but in our analysis we found differences between sexes to be significant (Table). While comparing our data referring types of black on P10 and P9 and data by Mierauskas et al. (1991) we found some new aspects. Interesting is that "thayeri" type appeared on the P10 (not recorded by Mierauskas et al. 1991) and/or on the P9, but only in females. Additionally on the P9 in males only type 2 was noticed. It seems to be very stable feature although there no statistically significant difference (Table) between sexes.

In summary, the morphometric variation of *cachinnans* could be very wide, but knowing the biometrical range of variability it is possible to distinguish sexes on alive birds. Within the defined, there exist variation typical and unique characters for *cachinnans* (Jonsson, 1998).

References

Литература

- Кошелев А.И. Миграционные перемещения северо-азовской чайки-хохотуньи (*Larus cachinnans*) // Птицы Азово-Черноморского региона на рубеже тысячелетий. - Мат. конф. 10-14 февр. - Одесса: АстроПринт, 2000. - С.25-26.
- Chernichko I.I., Siokhin V.D., Koshelev A.I., Diadicheva E.A., Kirikova T.A. Molochnyi liman // Numbers and distribution of Breeding waterbirds in the Wetlands of Azov-Black Sea Region of Ukraine. - Kiev, 2000. - PP. 339-372. (In Russian)
- Cramp S. & Simmons K.E.L. (eds). The Birds of the Western Palearctic. - Vol. 3. - New York: Oxford University Press, 1983. - 620 p.
- Filchagov A.V. State of knowledge of characteristic features in *argentatus-cachinnans-fuscus* complex from the Eastern Europe and Northern Asia // The Herring Gull and Related Forms: distribution, systematics, ecology / Zubakin V.A., Panov E.N.- Stavropol, 1992. - PP.3-8.
- Garner M., Quinn D. Identification of Yellow-legged Gulls in Britain. - Brit. Birds. - №90. - 1997. - PP.369-383.
- Griffiths R., Double M.C., Orr K., Dawson R.J.G. A DNA test to sex most birds // Molecular Ecology. №7. - 1998. - PP.1071- 1075.
- Backer A.J. (eds.) Molecular methods in ecology. - London, Blackwell Science: 2000. - 420p.



- Gruber D. Die Kennzeichen und das Vorkommen der Weißkopfmöwe *Larus cachinnans* in Europa // *Limicola* - №9. - 1995. - SS.121-165.
- Harris M.P. & Hope Jones P. Sexual differences in measurements of Herring and Lesser Black-backed Gulls // *Br. Birds.* - №62. - 1962. - PP.129-133.
- Heidrich P., Ristow D. & Wink M. Differenzierung von Gelb- und Schwarzschnabelsturmtauchern (*Calonectris diomedea*, *Puffinus puffinus*, *P. yelkouan*) und Großmöwen des Silbermöwenkomplexes (*Larus argentatus*, *L. fuscus*, *L. cachinnans*) // *J. Orn.* - №137. - 1996. - PP.281-294.
- Helbig A. Genetische Differenzierung von Möwen und Sturmtauchern: Ein Kommentar // *J. Orn.* №135.- 1994. - PP.609-615.
- Johnson C. Biochemical genetic variation in populations of *Larus argentatus* and *Larus fuscus* in northwestern Europe // *Biological Journal of the Linnean Society.* - №24. - 1985. - PP.349-363.
- Jonsson L. Yellow-legged gulls and yellow-legged Herring Gulls in the Baltic // *Alula.* - №3. - 1998. - PP.74-90.
- Kahn N.W., John J.S., Quinn T.W. Chromosome-specific Intron Size Differences in the Avian CHD Gene Provide an Efficient Method for Sex Identification in Birds // *The Auk.* - №155. - 1998. - PP.1074-1078.
- Klein R. Silbermöwen *Larus argentatus* und Weißkopfmöwen *Larus cachinnans* auf Móldeponien in Mecklenburg – erste Ergebnisse einer Ringfundanalyse // *Vogelwelt.* - №115. - 1994. - PP.267-286.
- Klein R. & Gruber D. Die Bestimmung und taxonomische Stellung der in Mitteleuropa auftretenden Weißkopfmöwen *Larus cachinnans* // *Limicola.* - №11. - 1997. - SS.49-75.
- de Knijf P., Denkers F., van Swelm N.D. & Kuiper M. Genetic Affinities Within the Herring Gull *Larus argentatus* Assemblage Revealed by AFLP Genotyping // *J. Mol. Evol.* - №52. - 2001. - PP.85-93.
- Liebers D. & Dierschke V. Variability of field characters in adult Pontic Yellow-legged Gulls // *Dutch Birding.* - №19. - 1997. - PP.277-280.
- Micrauskas P., Greimas E. & Buzun V. A comparison of morphometrics, wing-tip pattern and vocalisations between Yellow-legged Herring Gulls (*Larus argentatus*) from eastern Baltic and *Larus cachinnans* / *Acta Orn. Lituania.* - №4. - 1991. - PP.3-26.
- Wink M., Kahl U. & Heidrich P. Lassen sich Silber-, Weißkopf- und Heringsmöwe (*Larus argentatus*, *L. cachinnans*, *L. fuscus*) molekulargenetisch unterscheiden? // *J. Orn.* - №135. - 1994. - SS.73-80.