

MIGRATION OF THE WATER-WADING OF BIRDS FROM THE REPUBLIC OF MOLDOVA

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Introduction.

The avifauna of Moldova is represented by 119 species of aquatic birds and waders from nine orders – Podicipediformes - 5, Gaviiformes - 2, Pelecaniformes - 4, Ciconiiformes - 12, Anseriformes -28, Gruiformes - 6, Charadriiformes - 47, Coraciiformes – 1 (105 species) and Passeriformes (the rest of 14 species). All the bird species of this group are migratory species, except the passage birds that can visit in various seasons and with various success the territory of the republic. As a rule, the visits of such species are irregular and their individual number is always moderate. There are only 9 species of them, of which 6 species are representatives of Mongolian or Mediterranean fauna types.

The fauna of the republic is represented by many species that don't breed on our territory, but can be met only on migration. From 42 species the majority belong to the Siberian (15) and Arctic (13) fauna types. These are various species of curlew, geese, ducks, gulls.

The geographic position of the Republic of Moldova at the Prut – Nistru interfluvium determines in a great measure the seasonal character of bird migration. The bird migration in this region occurs in extended front. However, the Prut and Nistru river bed gather the migratory species, particularly the aquatic birds and waders complex, creating strong migratory streams directed in autumn period to the Black Sea coast and further directed to the African continent, to the Middle East and to the northern coast of Mediterranean Sea. In spring the birds migrate approximately by the same ways in backward direction over the territory that extends from Carpathians at the west and East Scandinavia at the north till Ural Mountains at the east. The Prut valley is used as migratory way by the birds flying from East Europe, including the Eastern district of Russia, the Baltic Countries, Belarus, Ukraine and the boundary territories of Western Europe. The inhabiting area of these populations broadens in northern latitude direction. As advancing to the Black Sea coast the species composition of the migrants increases at the account of the birds flying from north-east and east directions. The duration of migratory period in spring and autumn depend on many factors and is connected mostly with the weather and with the ecological situation in the places of aquatic birds and waders migration. Usually the migration streams pass in undulatory mode and the whole period lasts 1,5-2 months.

Material and methods of study.

The main observations on visible bird migrations were accomplished in spring and autumn according to the methods [1,4,20,21 and others]. In spring systematic observations were performed from March 15 to April 15, in autumn from September

20 till October 20. At the same time special studies were made to specify the species composition and the ratio of various bird species number during the seasonal migrations in a narrower period of time. Furthermore, simultaneous visual and radar observations were accomplished to emphasize the proportion of night and day bird migration, as well as to determine the belonging of radar echo. On the territory of Prut-Nistru interfluvium the first visual observations were made at the end of the XIXth century, but the systematic studies of bird migrations started in the second half of the past century, on which data were edited thematic collected articles and separate scientific papers. We have to mention in particular that among the instrumental methods of bird migration study, Moldova was one of the first former USSR republic where the radiolocation method began to be used [7]. As result of visual and radiolocation studies on the territory of former south-western USSR the main bird migration ways through the territory of Moldova were established. The most important places of study accomplishing in this direction were the lower Nistru and Prut (Ciciurgan aquatic reservoir and Manta-Beleu). Starting with 2000, the study of seasonal bird migrations was performed on Middle Nistru (from Naslavcea village till Dubasari town), on Prut (Costesti aquatic reservoir and on the sector Balatina – Cuhnesti villages), as well as on the aquatic basins from the central zone (Ghidighici aquatic reservoir, Gura-Bacului fishery farm, Costesti and Rezeni aquatic basins). The daily observations began at 30 minutes before the sunrise and lasted 4 hours. In the days of mass bird passage the studies were accomplished during all the day-light period of 24 hours. During the observations all the birds seen by the naked eye in a line of about 1000 m wide were registered. The bird species, the individual number, the high and the fly directions were registered. In this paper the results of observation on visible migration of aquatic birds and waders are analyzed. But in the general characteristics the data of ornithological state radar evaluation are used in the whole republic, as well as in some particular study points.

Results and discussions.

The analysis of bird number changing in Europe, generalized for the last decades, confirm the fact that about half of all the species inhabiting this continent territory (278) need special protection measures, of which 195 species have the status of unfavourable – are rare species or have negative tendencies in number dynamics [48]. The absolute majorities of these species inhabit various aquatic – marsh lands or are migratory species. Furthermore, with the aquatic birds and waders migrations is connected in the last years the spreading of the bird flu virus. Therefore the detailed study of seasonal bird migrations on our territory comprises two components: the habitat protection to preserve the diversity of common, rare and threatened species and the monitoring of seasonal bird accumulation for the emphasizing and prophylaxis of bird flu outbreaks.

The main places of west-European biogeographical populations of aquatic birds and waders nesting and wintering are rather well studied [22,40,45 and others]. The ways of these birds migrations in different regions of Europe are also well studied, for instance in Baltic Countries, in Ukraine and partially in Belarus [1,2,11,12,13,25,26 and others]. But the location of the main ways of passage and of the most important stopping places during the migration period in the central continental part of East Europe, including Moldova remain poorly studied.

During the elucidation of bird migration regularities in any region the following

questions appear: how the passage occurs – in wide front or in thin migration flows, which is not only of theoretical importance, but also is of purely practical importance. This problem was discussed during many years starting with the middle of the past century [8,17,18,20,21,28,29,30,39 and others). At the present the majority of scientists have an “integrated” position that it is the bird migration as a whole occurs in a wide front, in which limits there exists migrant accumulation in narrow directed passageway with subsequent ramification. On each concrete territory the regularities of bird migrations are determined by the ecological conditions of the terrain that include different biotopic complexes, suitable for stopping and feeding of various ecological bird groups. The territory of Moldova in this sense must be examined in the context of migration ways passing to the Black Sea, East Europe and particularly to Ukraine.

The second important moment in migrations is considered the presence on the territory of the transit and stopping bird passage. In the process of bird migration study it was emphasized that out of 280 bird species recorded in Moldova during spring and autumn passages, through its territory migrate about 190 bird species from almost all taxonomic orders, the main quantity of which are the representatives of order Passeriformes (38%), Anseriformes (15%), Haradriiformes (14%) (fig. 1).

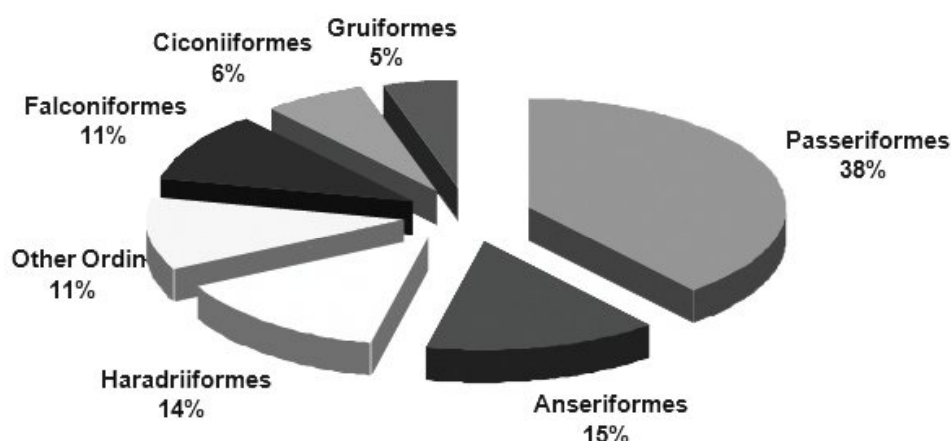


Fig. 1. The proportion of migratory birds from different orders during the seasonal migrations on the Republic of Moldova territory.

Through the territory of Moldova, which, in ornithologists opinion, occupies a unique geographical position pass the transcontinental migratory ways of the wild birds that connect the territories from Finland to Ural at north and from North Africa to Little Asia in the south.

Furthermore, it was established that through the territory of Moldova the bird migration pass in wide front, as well as along the directional lines. Among the migratory birds the aquatic ones and the waders group occupy one of the first places, sometimes they even dominate. The main direction of their movements during the spring and autumn migrations is determined by the location of large aquatic basins on the territory of South-East Europe. The splitting of the spring migratory flow in north-eastern

and eastern directions can be probably explained by the existence on Nistru river of large aquatic reservoirs. The great proportion of aquatic birds and waders migrating in eastern direction is conditioned by the dense net of river estuaries, falling into the Black Sea, favourable for feeding and resting. A part of the birds pass by transit through the territory of Moldova in north-eastern direction, starting from Lower Danube, from the adjoining lakes Bratesh, Cahul, Yalpuh, Sasyk and other, dividing in two flows: a part flies in north-eastern direction over the northern regions of the country, another part flies to the north along Prut valley, turning to the north-east in the central zone of the country.

The main ways of bird passage through the territory of Moldova are connected to the valleys of Nistru and Prut rivers, as well as to the large internal aquatic basins and woodland. The period, the directions, the altitudes, the velocity and the intensity of bird migrations are conditioned by different factors, the main of which are the weather and the synoptic ones. Until the present the visual and radiolocation observations on the seasonal bird migrations in Moldova were accomplished in different points of southern and central zones of the republic, starting with 1962 till now periodically.

On the territory of Prut-Nistru interfluvium the first visual observations on bird migrations were performed at the end of XIX century, but the systematic study of bird migrations started in the second half of the past century. The results of these studies were published in several volumes and scientific articles. In 1960's such studies were accomplished on the basis of visual observations that were accomplished mainly in the southern regions of the country (Lower Prut-Manta-Beleu, Lower and Middle Nistru – Cuciurgan and Dubasari aquatic reservoirs [6,10,15,29,30 and others]). As result of visual and radiolocation studies on the territory of former South-West USSR the main bird migration ways through the territory of Moldova were established (fig. 2).

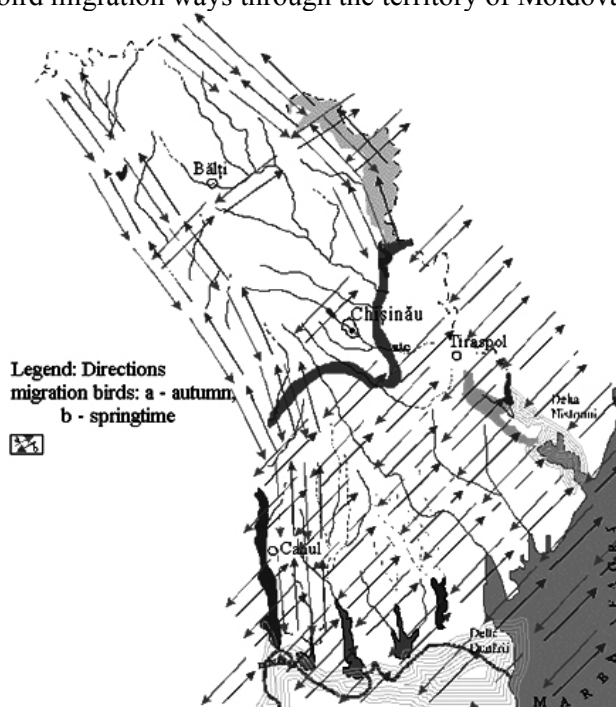


Fig. 2. The main directions of seasonal bird migrations on the territory of Moldova

The huge quantity of information accumulated as a result of radiolocation researches, offer to the professionals the possibility to widely use the meteorological data to emphasize certain regularities of bird migrations. This is of particular importance in the prognosis of bird and aircraft collisions probability.

To elucidate the influence of meteorological conditions upon the bird migration the multifactorial analysis was used, as a rule, that allowed to compare large data bases on many parameters of meteorological and synoptic situations. Many scientists from USA, Great Britain, Switsetland, Denmark and other countries established that various factors influence upon the bird migration intensity such as the cloudiness, the cloud height, the air temperature, the humidity, the velocity and the wind direction and other. It was established that in spring and in autumn the influence of meteorological factors manifests itself in different ways. It can be explained not only by the weather influence, but also by the adaptive strategy of the birds to modify their behaviour under the influence of different ecological factors. It was established that a significant connection was revealed against the temperature increasing, dense cloudiness, absence of the rain, and a nonsignificant connection against the wind direction. Furthermore, it was established that at high air temperature, low humidity and southern or eastern wind in autumn an increasing of migration intensity occurred, while during the rain it was suppressed.

But, with the accumulation of large information quantity from different geographical zones some conflicting data about the influence of the weather upon the bird migration were emphasized, which is probably connected, to the modifications of the migration tableau under the influence of the local factors. It was revealed that upon the local bird migrations the weather has a lower influence than upon the transit bird migrations.

In Denmark for example, for the prognosis of bird migration the data on 29 weather factors were used. The qualitative evaluation of migration intensity was accomplished according to the density of radar screen illumination on a 9-point system. As result it was revealed that in springtime the bird migration depends on wind direction, its velocity lower than 10 km / hour, on day temperature by 2 degrees higher than the normal, and in autumn depends on the first two mentioned factors, on day temperature by 2 degrees lower than the normal, cloudiness under 50% and pressure more than 1020 mbar.

In Leningrad district and in Baltic countries to appreciate the influence of the weather factors and to working up a dynamic model of bird migration, 10 factors were emphasized, but the prognosis according to the mean multiannual data of precedent migration wave passing was reliable, while the prognosis of the migration waves only according to the weather data proved to be invalid. The analysis of bibliographic data allow to conclude that the most important weather factors, which considerably determine the bird migration, have a geographical aspect, therefore the models of seasonal bird migrations reflect the concrete conditions of each region where the researches were accomplished. But the principles and the approaching to the modeling and prognosis of bird migrations based on the interaction of their intensity with the weather and synoptic situation can be perfectly used in any region.

According to some researchers, during the spring migration one of the stimulating

synoptic processes is the warm cyclone sector, the western anticyclone periphery, the low-gradient zone between the cyclone and the anticyclone [31]. The atmospheric fronts of the cyclones and the zones with thunderstorms, rains, hail, ice formation, snow and mist block up the migration.

In autumn the migration is stimulated by the eastern anticyclone periphery, the cyclone type, the low-gradient zone between the cyclone and the anticyclone, as well as the processes leading to the early fall of temperature, while the cyclones, the atmospheric fronts, the zones of turbulences and heavy winds etc. block up the migration. All these processes become apparent in concrete meteorological conditions that represent an obstacle, suppress or make more active the bird migration. In our opinion the most reliable prognosis of bird migration, based on the character as well as on the degree of this interaction, expressed in concrete models of ornithological situation and corresponding equations of dependence based on mathematical statistics with use of visual and radar observation. Such researches were also accomplished on the territory of Moldova in the laboratory of Ornithology, Institute of Zoology.

The radiolocation information was obtained from the survey radar П-37 placed on the territory of Chisinau airport, while the meteorological data were obtained from the Chisinau meteorological station. The researches performed in 1994-1997 allow to obtain not only various data on bird migration period, directions, heights and intensity of flight, but also to compare this data with some parameters of weather conditions. It was revealed that during the spring and autumn the migration intensity changes strongly, at the same time several activity peaks can be observed (fig.3).

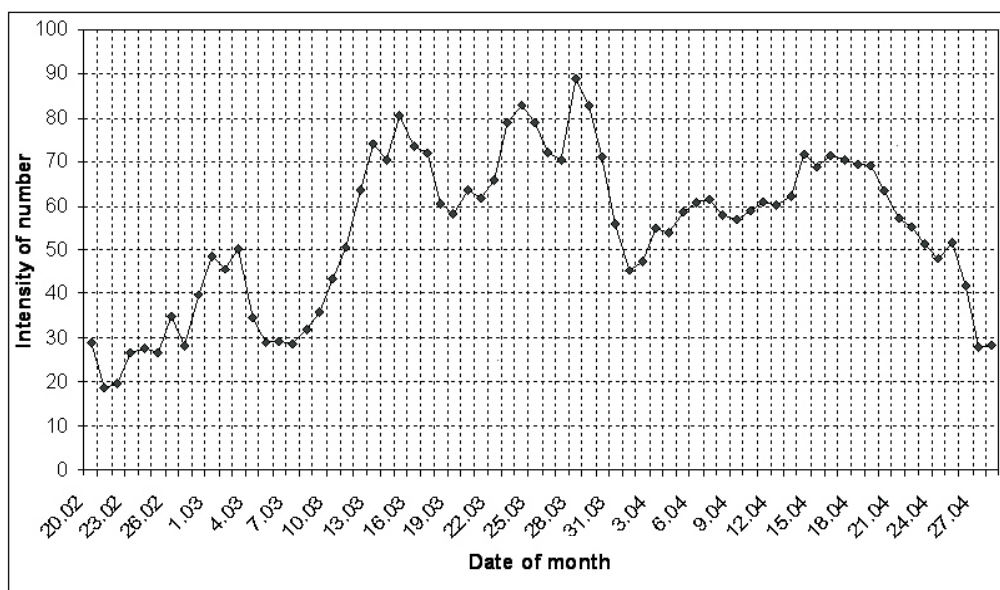


Fig. 3. Dynamics of bird migration intensity in springtime (according to mean annual radar data).

These activity peaks, or how the ornithologists call them the migration waves, are connected with the migration of certain bird groups. The first migration waves are

determined by such bird groups like sand pipers (pewit, godwit, little plover), gulls (black-headed gull and herring gull), ducks (garganey teal, wild duck), passerine birds (starling, buntings, greenfinch, wagtail), rails (bald-coot, water-hen), ciconiiformes (common heron, night heron, great white and egret, white stork) predatory birds (black kite, buzzard, marsh harrier, kestrel).

During the spring migration 4-5 migration waves can be recorded, the flight heights are of 500 – 2200 m. But the most of small passerine birds fly at the altitude of less than 500 m. In autumn the number of migration waves can be higher than in springtime (fig. 4).

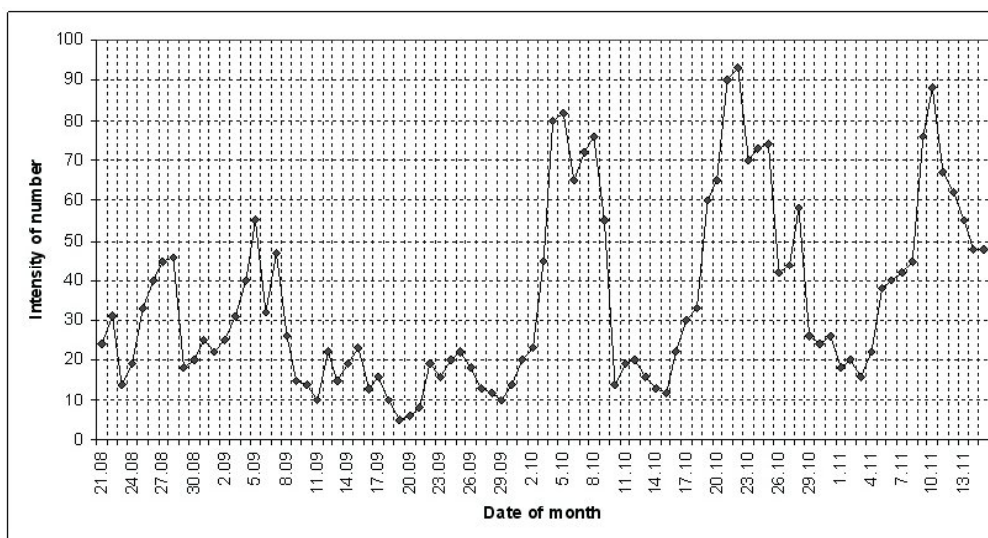


Fig. 4. Dynamics of bird migration intensity in autumn (according to mean annual radar data).

The birds started the autumn migration in reverse direction by comparing with the spring period – the insectivorous species from different bird groups migrate the first, than follow the other species. The minimum flight altitude is of 350 m, the maximum altitude is of 2300 – 2500 m. The comparison between the bird migration intensity and air temperature, atmospheric pressure, direction and velocity of the wind allowed to emphasize several regularities. During the spring migration the increasing of air temperature provoke the increasing of bird migration intensity (fig. 5).

The increasing of the atmospheric pressure leads in most of cases to the decreasing of bird migration intensity (fig. 6).

The wind velocity also had a great inverse influence upon the bird migration intensity: with the increasing of wind velocity the bird migration slowed down (fig.7).

The bird migration intensity depended also on the wind direction. It was determined that in spring the north-eastern, northern and seldom the north-western winds favored the bird migration, while in autumn the south-wester, southern and less south-eastern winds favored the migration (fig. 8).

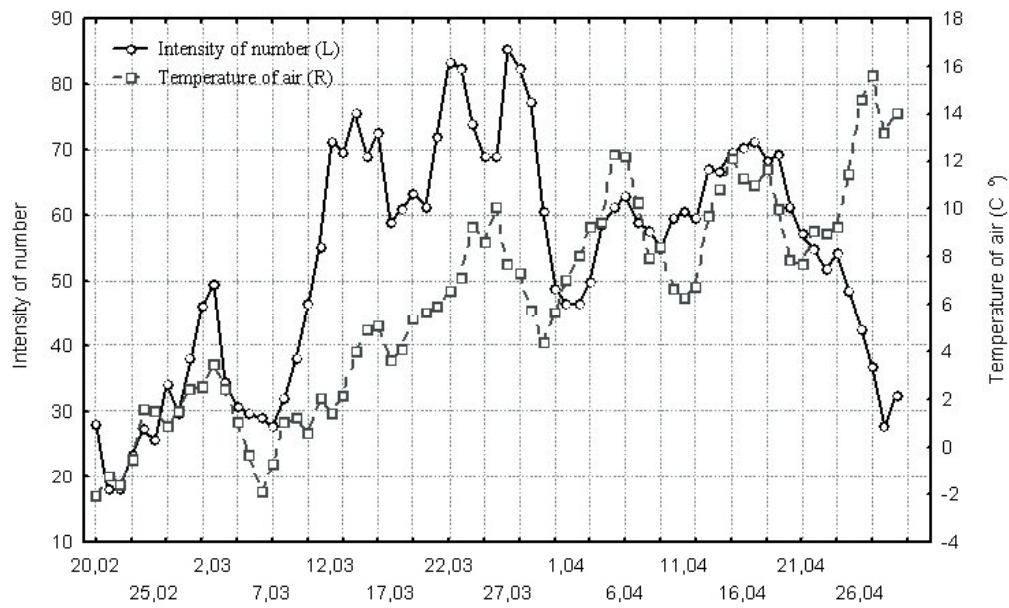


Fig. 5. Dependence of bird migration intensity in spring on air temperature (according to radar data).

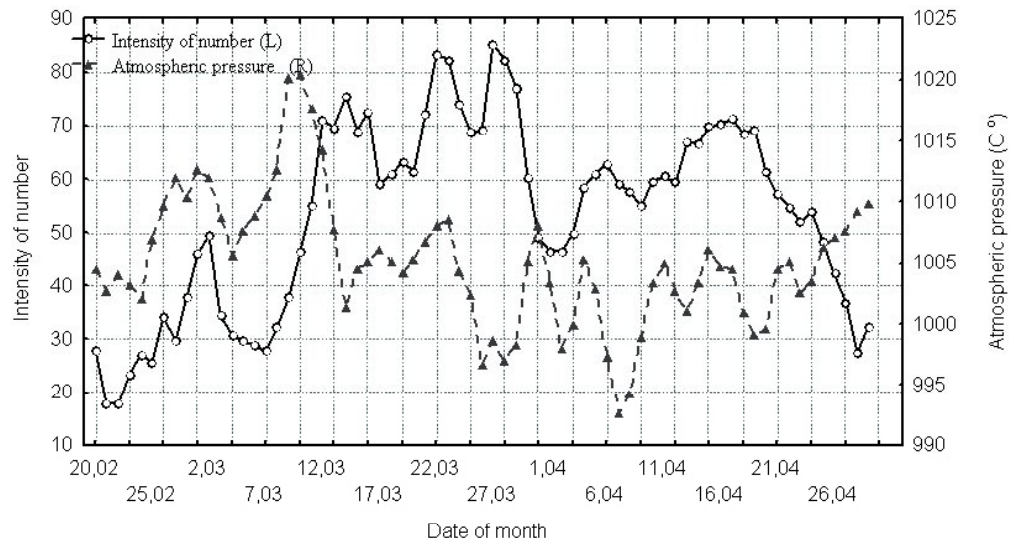


Fig. 6. Dependence of bird migration intensity on atmospheric pressure (according to radar data).

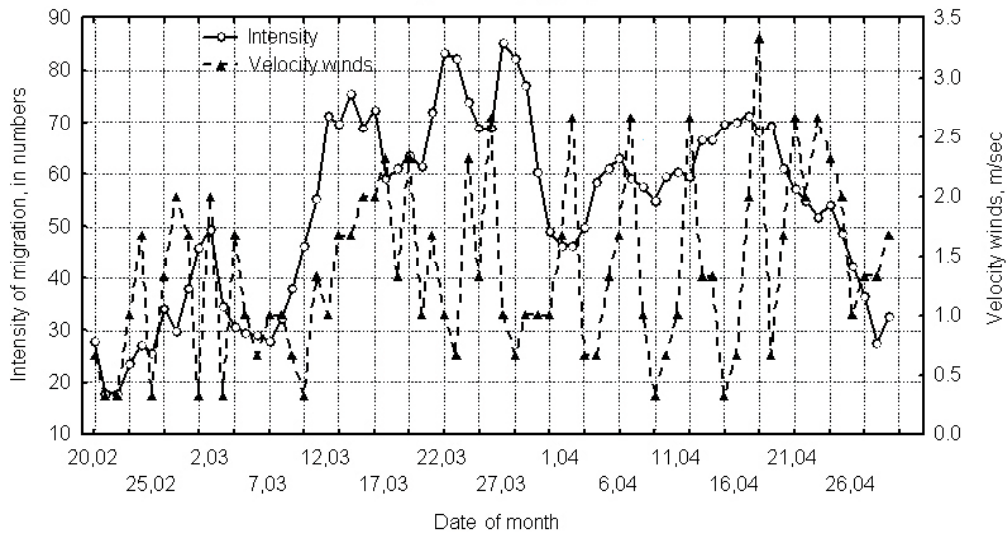


Fig. 7. Dependence of bird migration intensity in spring on wind velocity (according to radar data).

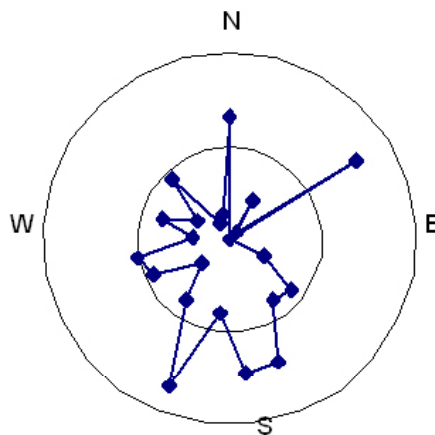


Fig. 8. Dependence of bird migration intensity on wind direction (according to radar data).

It has to be mentioned that the meteorological situation can hardly change from year to year, which reflects on the reliability of ornithological situation prognosis in each particular season. As an illustrative example was the winter of 2002-2003, such winter wasn't registered since the XIX century. For the purposes mentioned above, there are necessary multiannual observations and the use for the prognosis of combined dynamic models with multifactorial analysis of interactions between the bird migrations and the weather conditions. Furthermore, it must be taken into account the specific peculiarities of bird migration, the weight characteristics of different species.

In spite of the obtained in the past years results within the area of bird migration study on the territory of Moldova, we can't use them in full measure at the present. This is impossible because in the last 20 years the migration ways of some bird species

have changed, especially of those from the group of aquatic birds and waders (for instance, *Branta ruficollis*, *Anser albifrons* and other), which migration ways switched to south-eastern direction and the quantitative proportion of the migrating birds has modified. Moreover, some bird species migrate in spring by one route, while in autumn by another route. Therefore, in view of appeared at present infection focus of domestic birds by the bird flu in Russia, we can't completely exclude the possible flight of the birds from this region on our territory during the autumn migration, since a part of birds can move in latitudinal direction to the west. It has to be mentioned that the aquatic birds and waders fauna composition increased by 7 species in the last years, 33 more species (by comparing with the 50-70's of the past century) became to spent the winter on the republic territory and 4 new species were recorded on migrations. These breeding area birds are situated mainly in the regions of East Europe, including the zones of tundra, elfin woodlands, coniferous, mixed and deciduous forests. A small part of species entered in the fauna from the south.

In the last decades occurred some changes in the species composition of the migrating birds and their number, as well as in the character of their territorial distribution. The occasional observations on bird migrations accomplished in the last years on our territory concerned only 4 points on Nistru and Prut rivers. On Prut river the points were Costeshti aquatic reservoir in the middle part of the river and Manta-Beleu aquatic basins in lower Prut. On Nistru river the observations were performed on the sector between Otaci and Holoshnitsa villages (middle Nistru), as well as near Talmaz and Crocmaz villages. Furthermore, separate non systematic observations were accomplished on water basins in valley of Ialpuh river (Congaz and Taraclia aquatic reservoirs) and in lower Nistru (Gura-Bacului fishery farm).

In the last years (2001-2006) the studies on bird migrations were accomplished by visual methods, by mean of observations in several stations, the most important from point of view of bird concentration during the spring and autumn migrations. The stations were the lower Prut (Manta – Beleu complex), the middle sector of Prut valley (Costeshti aquatic reservoir), lower Nistru and middle Nistru on the sector Otaci – Holoshnitsa. The observations concerned mostly to the complex of aquatic birds and waders because first of all with their representatives the bird flu spreading is connected. During the researches the traditional ornithological methods of bird migration study were used. The studies were performed in spring from 15 of March to 15 of April and in autumn from 20 of September to 20 of October. Within the studies special observations on species composition definition and on number ratio of different bird species were performed during the seasonal migrations, as well as the proportion of night and day bird migrations in shorter period of time was emphasized. The bird species, the individual number, the flight altitude and direction were registered. The data on quantitative evaluation of the species are rounded till tens and hundreds of individuals. Besides, available literature was used on the avifaune valleys of the Prut [42].

Within the research period during the spring migrations in lower Prut 72 bird species were registered among which the most abundant were the representatives of aquatic birds and waders species: wild duck – *Anas platyrhynchos* (6500 individuals), common coot – *Fulica atra* (2500 individuals), pochard – *Aythya ferina* (1800 individuals), gadwall – *Anas strepera* (1700 individuals), pintail – *Anas acuta* (750

individuals). Among the geese there were recorded the gray goose – *Anser anser* (160 individuals), white-fronted goose – *Anser albifrons* (140), lesser white-fronted goose – *Anser erythropus* (90), as well as the swans: mute swan – *Cygnus olor* (150 individuals) and whooper swan – *Cygnus cygnus* (120). The proportion of various ecological bird groups during the migrations in lower Prut is shown in table 1.

Table 1. Proportion of various groups of aquatic birds and waders during the migrations in lower Prut (min-max) (72 spec).

	Spring migration			Autumn migration		
	beginning	Intense	end	beginning	Intense	end
	II dec.of febr.-1 dec. of march	2-3 dec. of march	1-2 dec. of april	3 dec.of august - 1 dec.of sept.	2 dec.of sept. -1 dec. of oct.	2 dec.of oct. -1 dec. of nov.
Divers (1 spec.)	1-3					1-3
Grebes (4 spec)	22-45	55-110	10-20	42-73	120-180	35-65
Cormorants (2spec.)	8-15	160-320		80-140	600-1200	50-100
Pelicans (2 spec.)	50-100	210-320		800-1200	500-1000	100-200
Hérons (8 spec.)	60-120	290-450	250-330	250-380	530-780	110-210
Storks (2 spec.)	20-30	80-160	80-130	40-70	80-170	
Ibises (2 spec)	5-15	325-65		15-30	25-60	
Swans (2 spec.)	80-130	220-300	35-60	60-120	200-300	160-240
Geese (5 spec.)	85-135	235-465	95-180		310-520 (>3-4 thous.)	330-470 (>5 thous.)
Duks (17 spec.)	1110-1790	4580-9550	680-4800	530-940	5760-9600	8320-12480
Rails (6 spec.)	50-100	2030-3560	10-20	+	2540-3570	2020-3030
Plovers (16 spec.)	35-60	740-1330	170-310	210-340	1065-1650	5-10
Gulls (3 spec.)	70-130	260-400	40-60	80-130	320-500	
Terns (3 spec.)	75-120	290-520	50-90	60-100	400-700	

Among the registered species the majorities are night migrants (almost all the species of river and diving ducks, the majority of sandpiper species), therefore the visual observation data allow to speak only about the time of their migration. We can judge about its intensity only after the bird number on the places of day stopping.

On middle Prut (Costeshti aquatic reservoir) during the spring migration in the observation period 67 species were recorded, among which the most numerous were the wild duck (2500 individuals), the common coot (1800), European teal (1300), gadwall (1100), dunbird (800). The goose number in this station was lower than in lower Prut. The white fronted goose (150 individuals) and the gray goose (120) were dominant, Lesser White-fronted Goose were few (up to 70 individuals), while the swans were rather numerous – the mute swan - 250 individuals, whooper swan – 120) (tab. 2).

In lower Nistru during the spring migration 45 bird species were registered. The most numerous were the wild duck (1500 individuals), the common coot (1000), the dunbird (800), the garganey teal (800), the gadwall (500).

Table 2. Characteristics of seasonal bird migrations on Costeshti-Stanca aquatic reservoir (Middle Prut) (2003-2005). (74 spec).

	Spring migration			Autumn migration		
	beginning	Intense	end	beginning	Intense	end
	2 dec.of febr.-1 dec. of march	2-3 dec. of march	1-2 dec. of april	3 dec.of august - 1 dec.of sept.	2 dec.of sept. -1 dec. of oct.	2 dec.of oct. -1 dec.of nov.
Divers (2 spec.)	+					+
Grebes (5 spec.)	+	+	+	+	+	+
Cormorants (2 spec.)	10-20	50-100		10-20	70-150	30-50
Hérons (8 spec.)	70-90	135-250	60-120	100-210	190-510	50-80
Storks (2 spec.)	90-180	60-120	60-90	80-130	50-90	
Ibises (2 spec.)		+	+	+	+	
Swans (2 spec.)	70-120	220-370	30-50	70-140	260-400	80-150
Geese (4 spec.)	80-140	180-340	80-120		300-500 (>3thous.)	400-600 (>4thous.)
Ducks (15 spec.)	930-1450	3890-7090	1980-3340	440-700	4250-7880	6790-10000
Rails (7 spec.)	60-90	1500-1800	10-20	+	2000-3000	1000-2000
Plovers (18 spec.)	20-40	185-410	30-55	55-140	330-580	
Gulls, Terns (7 spec.)	90-170	235-450	50-150	80-135	365-580	

Among the geese the grey goose (500 individuals) and the white fronted goose (100) were dominant, Lesser White-fronted Goose was in low number (50), among the swans the mute swan was absolute dominant (200) (tab. 3).

Table 3. Characteristics of seasonal bird migrations in lower Nistru (2003-2006) (76 species).

	Spring migration			Autumn migration		
	beginning	Intense	end	beginning	Intense	end
	II dec.of febr.-1 dec. of march	2-3 dec. of march	1-2 dec. of april	3 dec.of august - 1 dec.of sept.	2 dec.of sept. -1 dec. of oct.	2 dec.of oct. -1 dec.of nov.
Divers (1 spec.)	+					+
Grebes (3 spec.)	+	+	+	+	+	+
Cormorants (2 spec.)	<50	100-200		100-200	500-1200	50-80
Pelicans (1 spec.)				20-150	20-100	
Hérons (6 spec.)	+	+	+	+	+	+
Storks (2 spec.)	10-50	50-100	10-20	40-100	40-100	
Ibises (2 spec.)				10-120	10-100	
Swans (2 spec.)	<50	50-200	<50	50-100	100-200	50-150
Geese (5 spec.)	200-300	300-600	110-160		60-200	260-550
Ducks (17 spec.)	760-1220	1720-4250	650-1250	390-650	1800-4250	1650-3560
Rails (6 spec.)	10-20	800-1000	+	+	800-1500	800-2000
Plovers (19 spec.)	+	+	+	+	+	+
Gulls (2 spec.)	+	+		+	+	+
Terns (4 spec.)	+	+	+	+	+	+

On middle Nistru (Otaci – Holoshitsa) during the spring migration only 19 bird species were recorded. The number of all the registered species was low. The wild duck (1100 individuals) and the dunbird (500) were the dominant species (tab. 4). Among the swans the whooper one (25 individuals) dominated. The number of other duck species constituted several tens of individuals. The obtained data about the ratio of goose species individual number in spring migration demonstrate that in this station the

gray and the white fronted geese are absolute dominant, the number of the bean goose and Lesser White-fronted Goose on migration was very low.

The majority of aquatic bird and wader species migrate in spring on the 2nd - 3rd decades of March and in April. In spring the majority of the geese migrate in eastern (E) and north-eastern (NE) directions. Meanwhile, certain regularity in flight direction can be observed. Thus, in the south region the eastern direction prevail, to north – the north-eastern direction. The Prut river valley represents the main way of water bird spring migration in our country, especially of the ducks. Among the migratory ducks the dominant species was the wild duck, the number of other duck species, registered by visual methods was insignificant. Among sandpipers the pewits were the most numerous from all the registered migrants in the Prut valley, as well as on Nistru, but here their number is not too high and constitutes about 200 individuals. The main part of this species in spring migration follows the riverbeds of small rivers with many ponds in the central part of the republic. Unlike the water birds that follow the riverbeds of the rivers on migration, the pewit migrates in wide front. Just for this reason the migration density of this species in riverbeds is not very high. The dynamics of pewit migration during a day don't represent a clear pattern. Probably the pewits start the migration flight in different periods of the day, mostly in the first hours after the sunrise. Another typical representative migratory bird among sandpipers is the ruff. The number of the migrating ruffs is rather low, lower than the pewit number. Probably the main part of the ruffs migrates in the night, especially at the beginning of the migration period. In the period of mass migration a significant part of ruffs migrate in the daytime too, mainly in the first hours after the sunrise. Among other sandpiper species in lower Prut the migration of the godwit is rather well expressed, the number of which constituted up to 300 individuals. The other sandpiper species were recorded in small number.

The autumn migration of water birds and waders is more intense than the spring one. The total number of registered water birds and waders in all the study points is much higher than in spring. The number of the most abundant duck species, especially of the wild duck on autumn migration in lower Prut constitute 3500-4500 individuals (end of migration period), the number of other species is slightly lower: dunbird – 1500-2000 individuals, gadwall – 1500 – 2500, pintail – 800-1200, garganey teal – 600-1200. The common coot number is also high on the autumn migration – 2500-3500 individuals. Altogether in the period of autumn migration 65 bird species were registered in this station. We can judge about the character of water birds autumn migration after the observation data on goose migration. At the end of migration period more than 9000 individuals were registered, among which the absolute dominant species was the white fronted goose – >5000 individuals and the grey goose – about 4000 individuals. The Bean Goose and Lesser White-fronted Goose number was much lower – several tens of individuals. During the observation period on autumn migration the geese appeared usually in the second decade of September. The terms of the autumn migration are less varying in different years than those of the spring migration. Usually the mass goose migration takes place at the end of October – first half of November.

In the middle sector of Prut river (Costeshti water reservoir) the number of water birds during the autumn migration also was higher than in spring. Altogether during the autumn migration 67 bird species were registered (Fig. 9).

Table 4. Characteristics of seasonal bird migrations on Middle Nistru Otaci-Holoshnitsa) (2003-2005).(31 spec)

	Spring migration			Autumn migration		
	beginning	Intense	end	beginning	Intense	end
	II dec.of febr.-1 dec. of march	2-3 dec. of march	1-2 dec. of april	3 dec.of august - 1 dec.of sept.	2 dec.of sept. -1 dec. of oct.	2 dec.of oct. -1 dec.of nov.
Grebes (2 spec.)		<5	5-8	<5	10-20	10-20
Cormorants (2 spec.)				30-50	50-200	
Hérons (5 spec.)		30-50	20-40	45-110	100-210	30-60
Storks (2 spec.)		5-20	15-25	10-20	<10	
Swans (2 spec.)	20-35	2-3		10-30	10-30	10-20
Ducks (10 spec.)	70-120 (>1mii)	130-280	<10	60-320	920-2750	600-1230
Plovers (6 spec.)	<15	25-50	20-40	30-70	45-120	10-20
Gulls (2 spec.)	<10	20-50		10-30	20-50	30-50

Like in the lower Prut here was recorded a high number of ducks and geese. The wild duck was the dominant species (3000-4000 individuals) at the end of migration, as well as the Gadwall (1000-2500), the European teal (1300-2300), the dunbird (900-1200 individuals). The common coot also was numerous in the period of intense migration (2000-3000 individuals). The goose number was lower than in lower Prut and constituted in white fronted goose over 4000 individuals at the end of migration, in gray goose – over 3000 individuals in the period of intense migration. Lesser White-fronted Goose constituted only several tens of individuals. Among the swans the mute one was dominant with 200-300 individuals, while the whooper swan was less numerous – 60-100 individuals.

In lower Nistru in autumn period 65 bird species were registered (Fig.9). But the number of the majority of the species was rather low and constituted tens and hundreds of individuals. The most numerous were the wild duck (1000-2000 individuals) and the dunbird (500-1000 individuals), followed by the garganey teal (300-800 individuals) and the European teal (200-400). The common coot was also rather numerous (800-2000 individuals).

In middle sector of Nistru river (Otaci - Holoshnitsa) the duck number was higher than in spring and constituted in wild duck 1000-2500 individuals. Here the wild duck were the absolute dominant species at the autumn migration. The swans were recorded in small groups by 5-10 individuals. The sandpiper number during the autumn migration is slightly higher than in spring. For example, the pewit was recorded in lower Prut in a number of about 240 individuals, the godwit – no more than 250

individuals, while the ruff – 140 individuals. As in the spring, the sandpiper migration pass through the territory of the republic by wide front, with stopping in small groups on almost all the internal water basins where shoals and sandbanks exist.

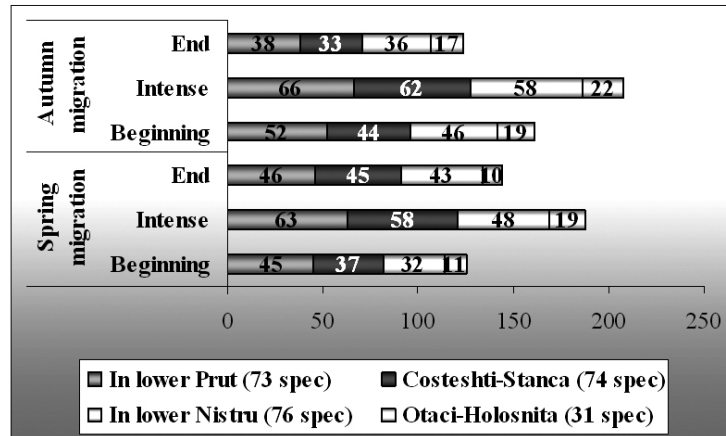


Fig. 9. The Correlation of the number species of water-wading birds during spring and autumn migration on some pools in Moldova.

As during the spring migration, in autumn the main migration way of the water birds is the Prut valley. Furthermore, the large aquatic basins at the south of the republic are of great interest – Congaz and Taraclia aquatic reservoirs, where accumulations of white fronted goose and of brand goose up to 10000 individuals. The last species was recorded in separate groups (tens of individuals) and solitary in the white fronted goose flocks.

The bibliography analysis shows that the migrations of water birds in East Europe pass by wide front from Leningrad district at the north till Carpathians in Ukraine [3,23,29,30,35,37,40 and others]. The modification of migration ways in autumn and spring can be explained by the trophic conditions on the ways of migrations. The main goose foods on the autumn migration are not only the grains of cultivated plants on the gathered fields, but also the young growth of winter crops. Therefore the goose migration occurs at the end of October – beginning of November, when the winter crops are already raised and the geese find a lot of trophic places. In spring the main food of geese and ducks constitute the winter crops too [44] and the green grass shoots in the river valleys. However the mentioned food resource in this period is probably limited for the water birds, therefore the main part of their population migrates by transit through our territory. Furthermore, the absence of strong flood waters in spring because of Nistru and Prut river regulated stream doesn't insure the safe resting and feeding, except the large aquatic reservoirs. From the quantitative analysis of water bird migration (ducks) on the territory of Moldova results that the most important for this bird group is the Prut migration way. The majority of the birds migrate along Prut way in spring to northern and north-eastern directions. But the most marked migration way must be considered the south north-eastern and the south-western one. In our region there are well known several large places of water bird accumulation for feeding and resting: Prut river valley with aquatic reservoirs and water basins in lower course, Nistru river valley (Dubasari

aquatic reservoir and the lower course of the river), the valleys of small rivers with water reservoirs (Taraclia, Congaz, Ghidighici) and small ponds and water basins. In autumn the birds from this group migrate to the wintering places basically by the same ways, as in the spring. The similar places of goose accumulation in spring and autumn allow to speak about this fact, as well as the migration directions. It is possible that this group is represented by the birds wintering in south-western Europe and breeding in the western part of European tundra. The result of data processing and analysis allow to express the supposition that the Prut and Nistru rivers valleys represent the extension of the well known Dniepr [16,36 and others]. In spring along this way the birds that are wintering on the sea coast of the Black Sea and are breeding in the eastern part of the European tundra migrate. On the very same way, but only by wider front, the birds fly in autumn to the wintering places. In spring the main direction of the migration are the northern one, and in autumn the southern one.

During the migration passage the bird with various success visit the wide net of internal, large and small water basins, located on the way of their flight. The migration way junction, passing through the territory of the republic, is located in Danube Delta. The flooded plain sectors of Prut and Nistru rivers, some of their shallow zones and gulfs, formed and the confluence of these rivers with the small ones, the large water reservoirs like Costeshti, Congaz, Ghidighici, the basins of fishery farms can be actually referred to the main base stations of the migrating birds on the territory of the republic.

During the migration the birds can pass by transit, intersecting large areas without stops, or can fly using the stepped method - make a series of stops to replenish their energetic reserves. The migration character has a species and group peculiarity, which depend on ecological features of the birds. As a rule the species from the northern latitude populations that migrate over the territory of Moldova more often use the transit way of moving. способ перемещения. This way concerns mostly the species from Arctic and Siberian fauna types. In the last years the tendency toward the diminishing of their number and species diversity can be observed; the populations of many species fly to spent the winter in Western Europe or remain on the territory located closer to their breeding area.

One of the important migration aspects are its seasonal and daily rhythm. The general terms of water bird and wader complex migration activity include the period between February – middle of April in spring and September – November in autumn. The limits of migration time continuum are generally undistinct and depend a lot on the weather conditions and trophic resources status. At the same time within the duck camp in autumn the herbivorous species arrive earlier and continue their migration way. The species using for food animal poop arrive, as usual, the last. In spring the inverse situation can be observed. The ducks with mixed way of feeding appear in various terms, depending on the trophic resources conditions.

The terms of autumn migration in bird species positively correlate with the terms of spring arrival. In the last years many species started to arrive and fly away earlier than the usual terms. This fact can be referred to some populations inhabiting in middle latitudes, to the representatives of European, Transpalearctic and partial Siberian fauna types. The autumn migration terms are delayed at the birds from the northern populations. At the same time their arrival in spring can be rather early. In this entire

dynamic process many things depend on the latitudes where the birds are breeding and where they spent the winter, to which ecological group the birds belong. On the whole in the last years the migration process (especially the spring one) of the majority of the species decreased hardly in temporal aspect and much more birds began to migrate by-passing the republic territory in transit. The pessimum of the ecological conditions created in the last decades within the ecotopes of shallow zones rather negatively influenced upon the river duck fauna. The indexes of their diversity, of their general number and especially of the number of certain species decreased drastically. These species became rare and low numbered not only in the breeding period, but also on migrations. They migrate mainly by transit and stop only on several water basins for a short time period, forming groups of small number individuals. These conclusions are valuable in many aspects for the sandpipers too.

The majority of water birds and waders complex refers to the category of near migrants, which fact is particularly characteristic for the group of water birds. For these birds the wandering type of flying is characteristic, when they can visit the water basins located on their migration way, sometimes living these basins, sometimes turning back. In this connection the temporal features of their staying on the water basins within the visited territory it is rather difficult to determine.

The species compositions of the migrating birds changes significantly, as well as the number of each group. In actual conditions within the water birds the diving ducks became to be more numerous than the river ones. A high stabile number can be observed only in wild duck. The number and the inhabiting area of the cormorants, pelicans, herons, gulls and terns increased. The number and the diversity of the sandpipers on the contrary decreased, except a small series of species. At the same time the staying duration of some species during the year increased, many solitary species appeared that are feeding on different according to their type water basins.

In connection with the changing geophysical, climatic and ecological conditions the state of migration bird activity distinctly changes. The displacement of the migration beginning and end terms can be observed, the modification of the migration character to the wintering places and forward, can be recorded, in particular the routes are changing, the wave structure of the migrations become smooth, recombination in the mixture of the population composition occurs and many others.

In the last decades the indexes of species and number composition of wintering birds increased significantly, especially of the fauna from the north latitudes. This fact testifies in the favor of the appearance of some optimum conditions in the inhabiting environment for a given year period. The wintering sectors in great measure are visited also by the migrants, but their composition doesn't show a high northern population species diversity.

In the last years, due to the soft winters, the number and the diversity of the wintering water birds and waders increased considerably, especially on the non-freezing sectors of large rivers and on aquatic reservoirs. A significant place among these water basins is occupied by middle Nistru and the river sector located immediately after the Dubasari HES barrage. In winter period thousands of birds from about 20 species and all 9 orders inhabit here, of which the dominant species are *Anas platyrhynchos*, *Larus argentatus*, different species of diving ducks. There are many swans, herons, Бывает

много лебедей. Are present Grebe, Heron, Cormorants. The birds stay in these places all winter, with the decreasing tendency in number and in bird diversity, as well as in number of inhabiting places toward the end of the cold period. In this season the bird population is formed by the populations from the north latitudes, among which the representatives of European, Transpalearctic, Siberian and Arctic fauna types occupy an important place. The birds from the southern fauna types can be met isolated and rarely.

The wintering fauna is represented by 49 species of which 2 species are sedentary. From the Siberian, Arctic, Transpalearctic, Mongolian, Mediterranean, European and Chinese fauna types there can be met respectively 10, 6, 9, 6, 4, 11 and 1 species. Thus, the spectrum of population belonging of the birds is rather wide within the scale of their inhabiting area and the bird species composition is rather diverse. The sandpipers, the pelicans and many other groups are absent in the winter period. The majority of the birds belong to the ducks, namely to diving ones and to wild ducks. Sometimes the geese (grey goose and white fronted goose) remain for a long time period and are feeding on the winter crops fields. Lesser White-fronted Goose, Bean Goose and the brand goose stay for wintering irregularly and in low number. The common coot, the Great Crested Grebe, the gray heron, the cormorant and some other species are wide spread but in low number. As a rule, the birds using for food mainly or exclusively the trophic resources of animal origin stay for wintering. They obtain the food from the water basin bottom at the coast or in depth and in water column. Several wintering species use the water basins only for resting and partial for feeding, while the main trophic resources they find on dry land (in fields, on food waste dump).

Importance of the bird migration study results for the prophylaxis of the bird flu.

The study of seasonal bird migrations aspects and their wintering in the republic are of huge actuality. This study components are the conservation of bird habitats and diversity, including the birds of wet biotopes, the rare and threatened species and the monitoring of the seasonal bird accumulations, the flight activity and dynamics of seasonal bird migrations. One of the monitoring tasks is the revealing and the prophylaxis of bird fly infections. The well-known role migrating birds in carrying and spreading the incitants bird fly infection [24].

There is a reason to believe that the places of traditional bird accumulations are mostly subjected to the risk of bird flu spreading, existing for a long period of time, the population composition of which is permanently renewed by the birds of different species and from different latitudes and geographical regions populations. These are the zones of population mixing and contacts of great bird diversity, gathered from huge territories of East Europe and partial Western Europe, which in spring contact with each other again, flying from the southern districts of Europe, from Africa and from the Middle East. These are, as usual, the delta of large rivers, the big water reservoirs, the ponds of fishery farms. At the same time many bird species visit regularly the net of small water basins. At present a particular place in this context is occupied by middle Nistru, in connection with the decreasing of the river water drainage, its general shallowing and overgrowing with water vegetation. On this entire river sector the

species of water birds and waders are breeding and the seasonal bird accumulations are forming. Here during the whole year the water birds and waders are present, their species composition and number are changing seasonally.

With the purpose of wild and domestic bird prophylaxis against the bird flu infection there are necessary informations about the fauna composition of the water birds and waders group, about the dynamics of the species and number composition, about the spatial-temporal aspects of their seasonal life. At the same time is of special importance the data concerning the species composition and the bird population in general at the particular moment of time and their belonging to the geographic population they represent. In this case the chance appears to competently judge about what species and from what territory can be carrier of the infection. For this it is necessary to have preliminary data on the initial infection focuses.

The water birds and waders can breed, rest and feed directly in the zone of water basin area, or can use for this purpose the islands, the coasts and even the territories located at the distance (for instance the herons, the cormorants, the storks). In the cases when the birds during a certain time period live outside the water basin limits, their faeces and food remains from the long-inhabited sectors can reach them, being washed by the inundations or by the rain waters. Anyway the secondary products of bird vital activity directly or indirectly fall or can fall in any aquatic basin, lake, river or even puddle.

Before the flight or during the flight start the birds usually defecate with the purpose to decrease their weight. At the same time this procedure is often repeated during the flight. In this connection their faeces can spread within the limits of the visited territory. This territory can be rather wide and can include the biotopes and the landscapes situated far away from the wet zones, which is characteristic for the migration period and after the breeding local migrations.

Thus, it is rather difficult and complicate to isolate the domestic birds and other animals, as well as the people from the indirect contact with the wild birds.

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