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The golden jackal (*Canis aureus* L., 1758) as a new species in the fauna of Ukraine

Key words: golden jackal, *Canis aureus*, area, steppe zone, Ukraine, mammals, population, dynamics, structure, biotopes, hunting

Introduction

The golden jackal (Fig. 1) has appeared in Ukraine in recent years being a new species for our fauna. Due to the fact that its distribution goes very rapidly we decided to study characteristics of the jackal ecology in the period of expansion and characteristics of the range spreading.

Material and methods

Over the period from 1998 to 2009 on the territories of Zaporizhja, Odessa and Kherson regions of Ukraine and the Autonomous Republic of Crimea the authors managed to collect data about observations of the jackal ($n = 574$) in various habitats. Of them 531 relate to the Dniester-Danube population, and 43 to the Eastern Ukrainian population.

A scatological method was used to investigate the diet ($n = 16$). Besides, we specially investigated a gastrointestinal tract of animals got during hunting, and also of those died due to various reasons ($n = 31$). It gave an opportunity to analyze the content of a great number of samples.

The numbers were counted by a transect method on two study plots located in different areas of the Dniester river delta. The data obtained with this method were transformed in qualitative indices using the formula:

$$P = \frac{1,57 S}{md}$$
, where P – density of animal population (number of individuals per 1 km²), S – number of cases when a researcher crossed a track of animals; m – length of the transect, km; d – average length of animal movements during 1 day, km (FORMOZOV 1932).



Fig. 1 Jackal on Biryuchy Island (the Sea of Azov). Photo by V. Kolomyichuk

It allowed to discover main trends of number dynamics of the Eastern European population of the golden jackal in Ukraine.

Discussion

Range

In prehistoric times the golden jackal never inhabited Ukraine that is proved by absence of its paleozoological remains in this area. The species supposedly formed in the territory of the North Africa or Western Asia, and from these geographic areas penetrated to Europe in late Pleistocene or even in early Holocene (SPASSOV 1989). According to other researchers (KÜHN 1935) European populations of the golden jackal were developed artificially by introduction of animals from African continent already in 15th century.

In 1950s–1960s the range and numbers of this species in the Caucasus considerably shrank. the possible explanation was drying of the Caspian Sea and reduction of the reedbed area (GEPTNER et al. 1967). However, in 1970s this process was changed for a rather rapid growth of the population inducing the range expansion, though already in 1948–1960 single animals occurred in the Kuban river delta near the Sea of Azov

(BAKEEV 1978). After 1965 the jackal began distributing from the coastline of the Caspian Sea to the west, and also from the Black Sea coast of the Caucasus across Krasnodar Territory – to the east (KUDAKTIN 1979). In the Western Caucasus this species from 1970 to 1977 expanded by more than 150 km to the south-east (VITOVICH 1979). In 1972 the jackal was recorded in the Kuban Delta near the city of Timashevsk and also in the Don river delta (pers. comm. by A.M. GINEEV).

By the end of 20th century the species inhabited all the vast delta of the Kuban where the conditions were favourable. From this area in winter 2001/02 the jackals went on ice across Kerchensky Strait and penetrated to Tuzla Spit in the Crimea (VOLOKH 2004). Since the first days when they appeared they began making attacks on poultry, and in April 2002 smothered over 20 lambs in a sheep fold. Later, one jackal was caught: it was an adult, normal-fed male. Very soon this species occupied the western coast of the Sea of Azov (Lake Sivash) and during 2002–2008 formed a small population there. Hereof the jackals began to penetrate to inland area of Ukraine, and in 2008 reached the city of Zaporizhja.

From the Don river delta and the Manych river delta (Russia) migrants in 2003–2007 started to

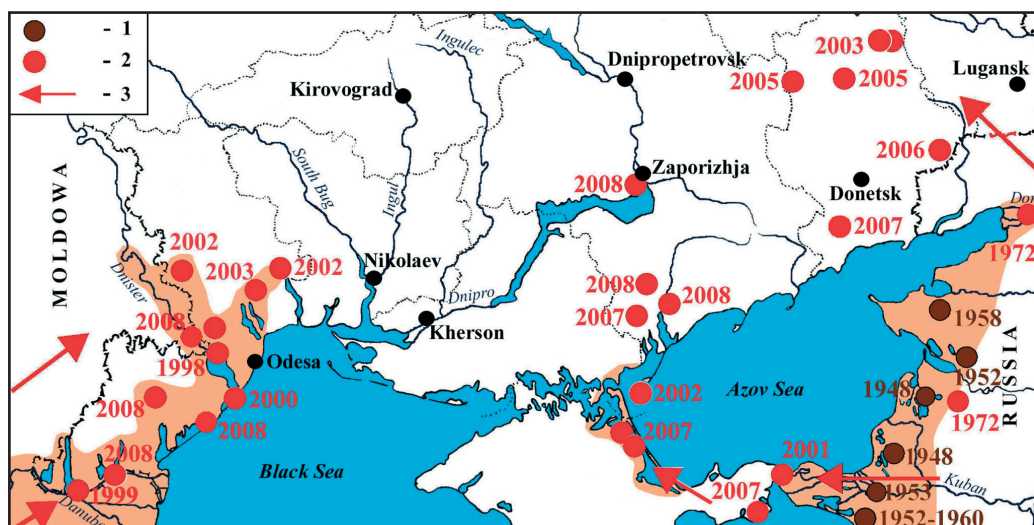


Fig. 2 Dynamics of the range of the golden jackal in Ukraine: 1 – distribution of animals before 1960s; 2 – discoveries of animals in 1970–2008; 3 – direction of migrations

appear in the territory of Donetsk region (Ukraine); there some of them were killed by hunters or observed by accidental people. The Caucasian migrants still did not manage to form a population in the south-east of Ukraine but this opportunity cannot be excluded.

The wolf is suggested to be a serious competitor of the jackal and even its enemy, which drives away the latter from its individual plot (GEPTNER et al. 1967). However, in Ukraine the distribution of the jackal coincided in time with increased numbers of the wolf and with formation of its new populations in South Ukraine (WOLOCH 2007).

Real reasons of the jackal expansion are unknown. However, this process is characterized by large scale and synchronism in different parts of the area. From 1950s to 1980s the jackal range expanded to the north from the lower reaches to upper reaches of the Syrdarya River, coming out to the Aral Sea eastern coast. In Turkmenia the dispersion of this species from the foothills of Kopet-Dag in the direction of Ashgabat was recorded since 1968 (NURGELDI-EV et al. 1974). Earlier, the distant penetration of the jackal to the north (until $\sim 49^\circ$ N) was recorded in Kazakhstan in some years which were characterized by mass murrain (GEPTNER et al. 1967).

Now the jackal penetrated to the interfluvium of the Volga and Ural (until $48^\circ 45'$ N) and in Western Kazakhstan region ($\sim 49^\circ 30'$ N). Since 1989 the jackal began occurring in Saratov region of Russia, since 2000 there are registered the breeding cases of this species which is new for the region (OPARIN 2005).

Mechanisms of the jackal invasion are poorly studied. The existing hypotheses are based on the fact of permanent reactions of animals to changes in ecosystems structure. At this, typical phenomena are diffusion of the species into a new area which induce broadening of the range and appearance of new populations (ARNOLDI 1957).

However, it doesn't explain the reasons of expansion of this species which was still rare in Europe in the middle of 20th century.

We only suppose that it maybe connected with natural cyclicity of populations, though we still do not know starting mechanisms of animal dispersion. Possibly there were various reasons:

on Balkan Peninsula and in the Caucasus it was because of decreasing hunting pressure on groupings of predators.

A very important prerequisite for the species expansion was simultaneous improvement of protection conditions on a vast area of southern regions of Europe and Asia (a consequence of planting artificial forests with lakes and reedbeds), and also reduction of the area of agrocoenoses. As the jackal is a thermophilic species, the global warming is also considered as an essential reason of its range expansion (BAKEEV 1958).

Use of biotopes

In south Ukraine the jackal inhabits different biotopes (Fig. 3) but mostly prefers wetlands (Fig. 4). They are liman shores (Dniestrovsky, Utyutsky Limans), lakes (Sivash) and seas (the Sea of Azov and Black Sea) where it was recorded 188 observations (32.7 %). Probably this index is even higher because in the south-west of Ukraine the beasts were recorded many times ($n = 133$) on the highways which lie in river floodplains or in the vicinity of large water bodies.

Generally, the jackals like investigating roads where they eat animals died under car wheels. These predators prefer reedbeds but can be seen in them only by accident as in the south of Ukraine the reedbeds occupy a huge area. In the south-west of Ukraine out of 531 records of animals 14 (2.6 %) are in reedbeds, and in the south-east Ukraine there are 12 of 49 (24.5 %). However, in these biotopes there are well visible numerous tracks of jackals in coastal sites and shallows.

Important biotopes for the jackal are also maritime and liman meadows, characterized by high numbers of voles and mice.

Sometimes predators come into settlements where they harm domestic animals. For instance, 21.5.2008 in Dzhanhoy district of the Crimea a jackal attacked a tethered dog, but was shot by the dog's master. In autumn 2008 another beast came into the village on Biryuchy Island but was also killed; it was suspected to be ill with rabies though the preliminary diagnosis was not proved.

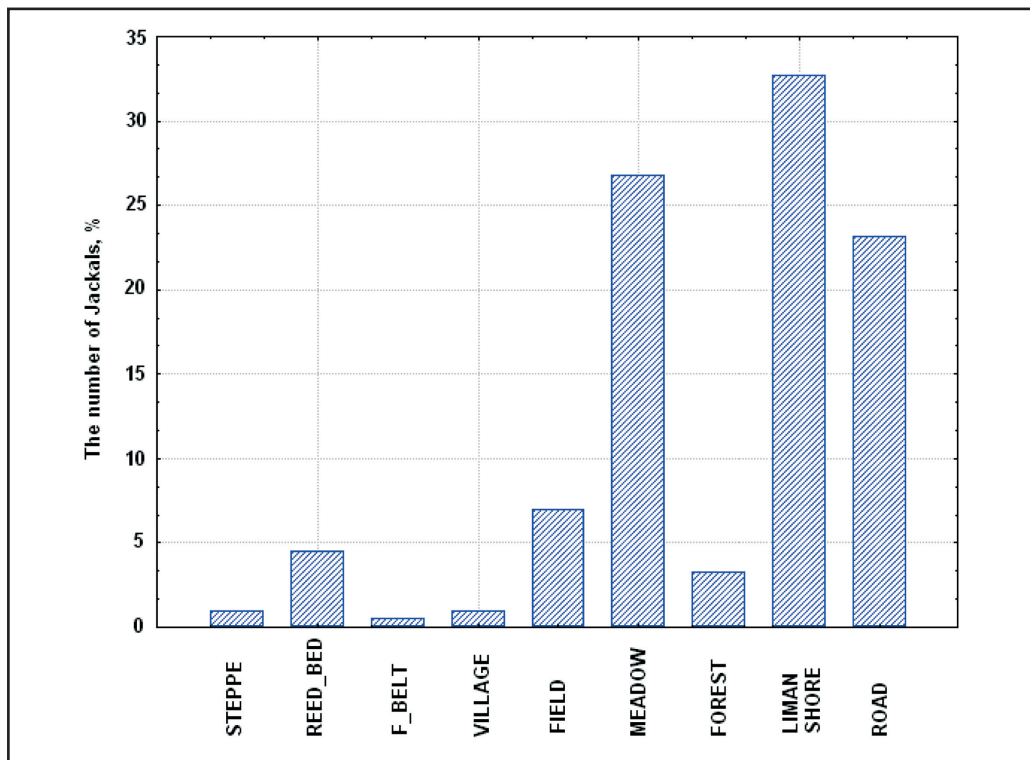


Fig. 3 Habitat distribution of the jackal ($n = 574$)



Fig. 4 Wetlands are main biotopes of the jackal in Ukraine.

The diet of the jackal in South Ukraine

As for its diet the jackal is both a predator and active collector. In areas where it is not hunted the beast doesn't afraid of people and often steals into hen houses, comes into stock-farms and attacks domestic animals. At the same time this

predator likes fruit, vegetables, melons, water-melons and other plants. All year round the jackals readily eat the carrion, and thus they are transmitters of various dangerous diseases.

As for the content of jackal stomachs in the region of our study (occurrence of components) different food waste was dominated (73.3 %);

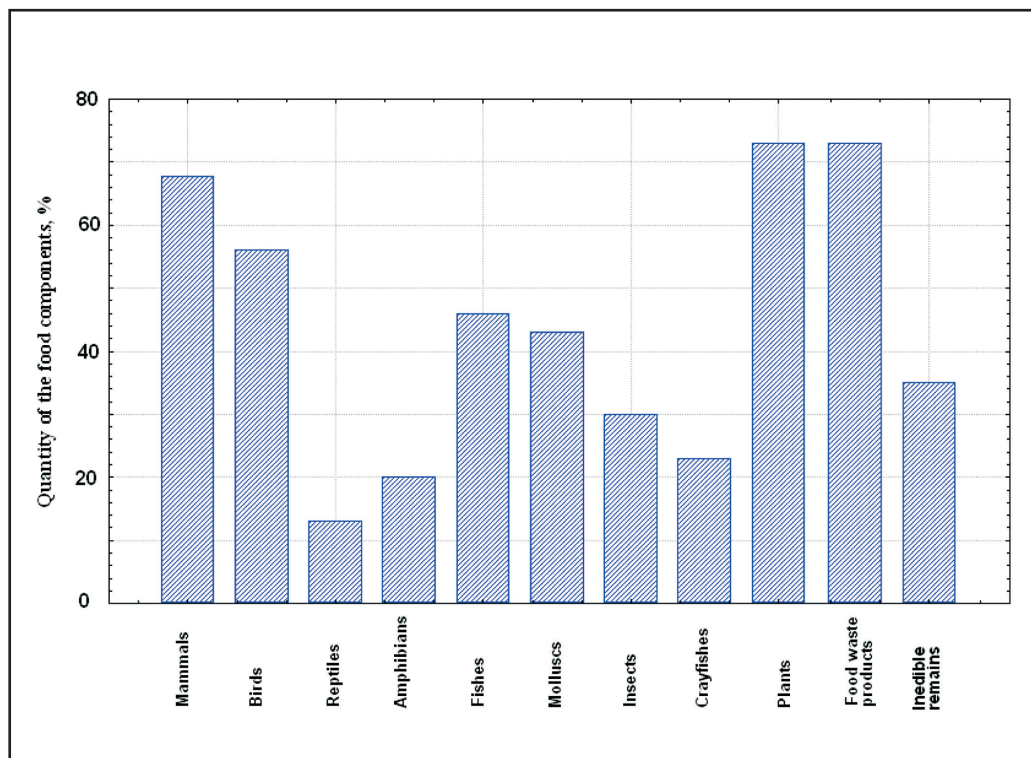


Fig. 5 Percentage volumes (% v) of principal food components of the jackal stomachs ($n = 31$)

the second place was occupied by mammals (67.7 %), birds (56.7 %), fish, mollusks and other components (Fig. 5). Inedible remains (35.5 %) or garbage (paper, ropes, polyethylene, parts of fishing nets) were quite frequent.

Comprehensive analysis of the content of 16 stomachs has showed (Table 1) that the carrion dominated according in terms of mass, and as for occurrence – birds and small rodents (*Apodemus sylvaticus*, *Cricetulus migratorius*, *Micromys minutus*) dominated. The European water vole in spite of low occurrence ranks the second in stomachs in terms of its mass (13.6 %) which proves its importance in the jackal's diet.

As for birds the jackals the most frequently eat the Coot and rarer the Moorhen, which are the most numerous in coastal wetlands. It was occurred one individual of Greylag Goose, once it was Mallard and teals probably wounded during hunting.

Fish is rather important in the jackal's diet (25.0 %), and as for secondary forage – plants

contain a significant part. Of the components which are rarely eaten it should be mentioned water beetles and amphibians. But as for the mass, main forage of the jackal is nevertheless carcasses of died animals and rodents.

In spring-summer period mammals still dominate in the jackal diet. It can be seen from the results of scatological studies (Table 2). At this the predator readily hunts on European water voles and picks up chicks of passerines fallen out of their nests (mostly black bird, carrion crow, warblers). On their individual plots the jackals catch, if possible, all available warm-blood animals, firstly juveniles of coots and also ducklings. The same as in other seasons, in spring and summer a high importance for them have remains of animals died under car wheels as a result of collision. In winter (and sometimes early spring) the jackals frequently visit places where large animals died (deer, fallow deer, roe deer, wild boar, domestic animals) and gnaw round even their skeletons. However,

Table 1 Analysis of the content of the jackal stomachs in Odesa region ($n = 16$)

Food components	Weight		Quantity	
	g	%	cases	%
Carrion (cows, pigs)	5983	71.9	6	37.5
Small rodents (<i>Muridae</i>)	457	5.5	7	43.6
European water vole (<i>Arvicola terrestris</i>)	1132	13.6	3	18.8
Birds (<i>Passeridae</i> , <i>Gallinula chloropus</i> , <i>Fulica atra</i> , <i>Anser anser</i> , <i>Anas platyrhynchos</i> , <i>A. crecca</i> , <i>A. querquedula</i>)	378	4.5	9	56.3
Amphibians (<i>Rana ridibunda</i>)	28	0.3	1	6.3
Fishes (<i>Carassius auratus</i>)	19	0.2	4	25.0
Insects (<i>Hydrous piceus</i>)	7	0.1	1	6.3
Plants (<i>Poaceae</i> , <i>Viburnum opulus</i> , <i>Elaeagnus angustifolia</i> , <i>E. argentea</i>)	117	1.4	5	31.3
Inedible remains	205	2.5	5	31.3
Total:	8326	100.0	—	—

they also can be serious predators. In December 2000 we were witnesses of an attack of two adult jackals on a wild piglet about 30 kg by weight, which was lucky to tear itself from the jackals and run away. In the Dniester floodplain there are known cases when a pack of jackals of 5–7 specimen attacked a dog which survived only due to the protection of its master.

Plants are of certain value in the jackal diet. Frequency of eating them depends on their concentration and availability in nature. In mid-summer the jackal readily eats fruit of the mulberry tree (*Morus nigra*, *M. alba*) – 14.7 %, blackberry (*Rubus* sp.) – 6.0 %, grapes (*Vitis vinifera*) – 5.2 %, and also blackthorn (*Prunus spinosa*), dog rose (*Rosa canina*) and houndsberry (*Solanum nigrum*). Generally, quantity of plants eaten by the jackal in Ukraine is still small if compared to areas of the permanent inhabitation of this beast (GEPNER et al. 1967).

Number dynamics of the jackals

Number dynamics of the jackal in Ukraine is not studied as this species is a recent invader in the country. However, the investigations carried out in the Dniester Delta during 10 years have showed that the Eastern European jackal population develops like an S-shaped curve (Fig. 6).

At first its increase had a swift rate, and due to this animals relatively rapidly (in 6 years) occupied the Dniester Delta and filled all available habitats. During this time the numbers of the jackal increased since 4 individuals to 59; it was conditioned by high fertility of females (3–10 puppies) and their early sexual maturity (10 months). Later, with increased number of family groups it also increased the frequency of contacts among animals as well as trophic and territorial competition. It induced the destruction of buffer zones between families and packs. Usually on reaching high density by a population, their groups are fragmented and also low-rank individuals and sometimes particular families are pushed outside the main area. It is one of the mechanisms to stabilize numbers in the population, dynamics of which depends on the density (ERRINGTON 1946).

That is why in spring 2005 in a coupling period and right after it, there took place a significant emigration of animals from the delta, and, as a result, numbers of the jackal declined by 57.6 % (Table 3). It was followed by the increased mortality of animals because of different reasons but mostly because of collision with cars. However, the population restored very quickly and in 2008 it reached the second peak. After that it reduced again. Thus, number dynamics of the jackal in the area of our investigations has

Table 2 The diet composition of the jackal in spring and summer period according to the data of scatological analysis ($n = 116$)*

Organisms or groups	Food components	Occurrence of records	
		Abs.	%
Mammals	—	83	71,6
	Small rodents (Rodentia)	49	42,2
	European water vole (<i>Arvicola terrestris</i>)	28	32,2
	Brown rat (<i>Rattus norvegicus</i>)	4	3,4
	Shrews (Soricidae)	2	1,7
Birds	—	46	39,7
	Passerines (Passeriformes)	23	19,8
	Coot (<i>Fulica atra</i> L.)	10	8,6
	Carrion crow (<i>Corvus corone</i>)	7	6,0
	Wild ducks (Anatidae)	6	5,2
Reptiles	—	2	1,7
	Grass snake (<i>Natrix natrix</i>)	2	1,7
Amphibians	—	5	4,3
	Frog (<i>Rana</i> sp.)	5	4,3
Fishes	—	7	6,0
	Bream (<i>Abramis brama</i>)	2	1,7
	Silver porgy (<i>Carassius auratus</i>)	5	4,3
Insects	—	4	3,4
	Beatles (<i>Carabidae</i>)	4	3,4
Plants	—	37	31,9
Carrion	—	16	13,8
	Dog (<i>Canis familiaris</i>)	8	6,9
	Cat (<i>Felis silvestris</i>)	6	5,2
	Wild boar (<i>Sus scrofa</i>)	2	1,7
Inedible remains	—	16	22,3
	Polyethylene	10	17,2
	Paper	4	3,4
	Trash	2	1,7

* In: ROZENKO, 2006

a wave-like type. Apparently, for the Dniester Delta covering the area about 20,000 ha 50–60 individuals are the maximum safe load. Taking into account that the factual area of habitats available for the species inhabitation is about 12,000 ha, the density of predator amounts to 4.2–5.0 individuals per 1,000 ha. Apart from

the jackal there are another 12 predators in the delta (ROZENKO 2004) which intensify trophic and topical competition and in many aspects determine regular emigration of the jackals and other animals outside the delta borders. Moreover, the jackals are characterized by considerable conservatism in behaviour and antagonism

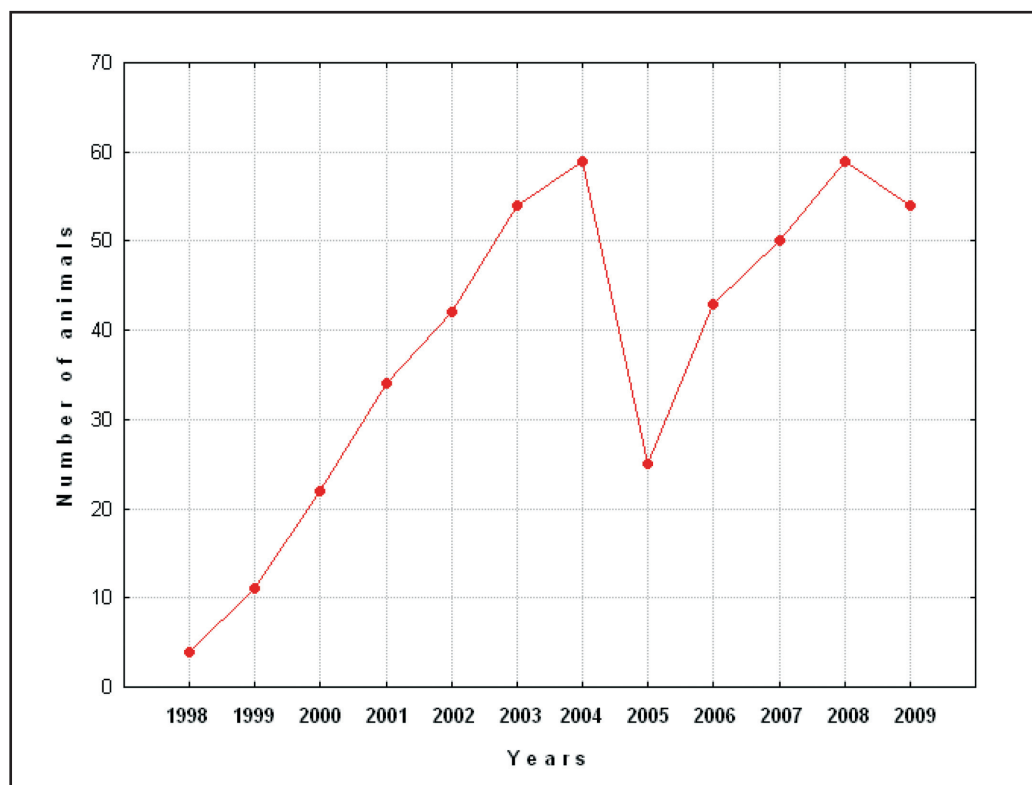


Fig. 6 Dynamics of the jackal population in the Dniester Delta

Table 3 Number dynamics of the jackals in Dniester Delta

Character	Years											
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of animals	4	11	22	34	42	54	59	25	43	50	59	54
Dynamics of animals, abs.	—	7	11	8	8	12	5	-34	18	7	9	-5
Dynamics of animals, %	—	175.0	100.0	36.4	23.5	28.6	9.3	-57.6	72.0	16.3	18.0	8.5

toward some of other predators. During the day these animals obligatory inspect their individual plot along the borders, the length of which is 8–10 km. At this they evict the raccoon dogs and foxes. When the jackal appeared in the Dniester Delta the above-mentioned predators stopped to occur at all. For example, at the study plot in 2002–2005, in addition to 4 jackals, it

lived also 2 European weasels, 1 stone marten, 1 European mink and never (neither in winter not summer) occurred other species of predator mammals.

The process of the jackal dispersion is an interesting zoogeographical and faunistic phenomenon, which needs a special investigation within the whole range. The attention should be paid

not only to the fact of appearance of this new species in fauna of many European countries but also to the fact that the dispersion of the jackal from Balkan, Caucasian and Turkmen cores of inhabitation started simultaneously.

Summary

Golden jackal (*Canis aureus* L., 1758) – new species in the Fauna of Ukraine

The golden jackal penetrated to Ukraine in 1997 and formed a population in the south-west of the country. Since 2001 this species is registered in the Transcarpathians and Crimea, since 2003 – in Donetsk region. In the west of Ukraine the range was formed by the animals come from Romania, in the east – from Russia. Now the distribution rate of the jackal is very intensive which is possibly explained by improvement of protection conditions such as planting of artificial forests, irrigation systems with lakes and reedbeds, reduced area of agrocoenoses and global warming.

In Ukraine the golden jackal mostly inhabits wetlands though frequently occurs in meadows and on roads. The stomach content of the jackal is dominated by food waste (73.3%), plants (73.3 %), also mammals (67.7%), birds (56.7 %), fishes, mollusks and other components.

Populations of this predator develop as an S-shaped curve of wave type, a period length amounts to 3-6 years. When the population reaches the density of 4.2 individuals per 1,000 ha then it happens emigration of large numbers of animals followed by their high mortality.

The process of simultaneous dispersion of the jackal from the Balkan, Caucasian and Turkmen core areas is an interesting zoogeographical and faunistic phenomenon which needs to be specially studied within the whole range.

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