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MODERN DISTRIBUTION, LOCATION, AND NUMBER OF PERSIAN LEOPARD (PANTHERA PARDUS) IN TURKMENIA.*

Together with other subspecies of leopards which inhabit the territory of the former USSR, and other species of cats, Persian leopard (P.p. ciscaucasica Satunin, 1914) is still poorly known up to now. The problems of distribution, number, and ecology of Persian leopard are the most extensively discussed by V.G.Geptner and A.A.Sludskii (1972). For the past twenty years a series of papers concerned with various aspects of biology of Persian leopard are published , and now there is the only paper in which the attempt to generalize the whole information on "Turkmen" leopard was made (Lukarevski, 1995). This is first of all associated with the peculiarities of a species and its areal.

Materials, time and methods

Materials, duration, and the methods of the investigations.

The investigations were carried out in 1995-1996 and covered almost all the territory of the Kopetdag, Badhyz, and Kugitang, some territories of both Bol'shoy (Great) Balkhan and Malyi (Little) Balkhan, i.e. practically all the areal of leopards in Turkmenia. Only the Chengurek Mountains where we had found leopards in 1980-ies, were not inspected by us because of a political situation on the boundary. The total duration of the expeditional-field works constituted more than 190 days.

The basins of Sumbar, Chandyr, Tersakan, and Adzhyder rivers in the West Kopetdag were inspected the most carefully. Field investigations were carried out there in March, April, May, June, October, November, and December 1995 and February-March 1996. About 30 routes of approximately 600 km total length were come that enabled us to collect the material

which describes the state of the population of leopards in this region.

The Central Kopetdag was studied in the most optimal period, namely, in April 2-30. The periodicity of rainfall permitted the determination of the freshness of traces with 1-2 days accuracy. The structure of the population of the main victims of leopards, namely mountain sheeps and ¡¥§® p®¢ëå goats was stable and enables the calculation of their number.

The following territories were inspected:

1. the Karagura Mountain , the Hyz canyon, the area of the left mountainside of the Arvaz basin, and the Kyrgyz tract. The total route length was equal to 35 km.

2. The "Babazo" area of the Kopetdag Zapovednik (Reservation) including the territoties:

-from the highway up along the Dugrider canyon to the old hyena lair, about 4 km in all;

- from the Kurtusu well up to the Aselm range along the ridge of the range, about 10 km, down along the canyon and then along the foot of the range back to the border, about 25 km in all;

-the border, on the way to the Dagysh canyon, about 12 km up along the Dagysh canyon, up along the left mountainside to the dividing range with the Dugrider canyon, down along the ridge of the range, down along the bottom of the canyon, about 30 km in all;

-the estuary of the Dashtoy canyon, up along the canyon to the pass till the state boundary with Iran, up along the ridge to the top of the Dashtoy mountain, down along the ridge of the dividing range with the Ogirly canyon, more than 30 km in all;

-the Aselm range and the south-western foothills of Aselm range, the total length of the route is about 17 km;

-"Babazo" canyon from the estuary about 7 km up along the bottom of the canyon, and down along the canyon, about 15 km in all.

3. The Firuza part of the reservation including the following routes:

- the estuary of Firuza canyon, 4-5 km up along the canyon and then down along the canyon;

-up along the left mountainside of the Firuza basin to the top and then down along the whole Damchi canyon (along the bottom and sometimes along the mountainside and the lower terrace), about 25 km in all.

4. The Kalinin Zakaznik (the kind of the territories protected), Kurukhaudan tract, 27 km of the route.

5. A part of Mirzadag mountain , the route length is 40 km.

6. the Dushak mountain, the total length of the routes is about 30 km.

Therefore we inspected a significant part of Central Kopetdag. This enables us to extrapolate our results over the whole mountain country.

As for the East Kopetdag, we had the modern data collected in April-May 1993-1994, therefore we collected only the oral data. We inspected here Zmeinoe, Serazar, Daragbeyt, Zarmi and some other canyons and the upper part of Meana river as well.

Badhyz was studied from May 13 to May 24 1996. Here we came 7 routes of 140 km total length and studied the whole territory of the reservation. We made a cartographic analysis of some territories located behind the engineering and technical buildings where now the Persian leopard yet inhabits.

The materials on the Kugitang were collected during the expeditions to Kugitang reservation from April 24 to May 2 1995 that enabled us to repeat the observations of December 1988. The following territories were inspected:

1. April 24-25 1995, the Deraydara canyon, 25 km;
2. April 27-28 1995, the Kyrgyz tract (Khozhaipil zakaznik), up along the mountainside of the range, the upper border of the canyon to subalpine region, and "dinosaurus" plateau, 45-50 km.
3. April 30 1995, the territory of the reservation, up along the left border of the Khodzhachilgasbab canyon to juniper (juniperus) region, juniper region, down along the left border of the Deraydar canyon, about 30 km.
4. May 1 1995, the territory of the reservation, namely, the low mountains along the rightside of Kugitang river, about 10 km.

We came 2 routes of more than 60 km total length on the Seki-Dag range of the Bolshoy Balkhan.

The base for the primary material on leopards is formed by the results of the registration of the traces of leopard's activity which are collected during more than 190 one-day routes, and the total length of the routes constitutes more than 1200 km.

The imprints of paws of leopards are noticed 63 times, the results of the measurements are used for the refinement and the identification of a sexual, age and individual attribution of the traces. More than 750 scrapings on the ground are registered and more than 188 excretions are collected and analyzed. Ten remains of leopard's food are inspected.

The most reliable signs which indicate the presence of leopards, are the scrapings left by the animals on the ground near their pathway on the ridges of dividing ranges and on the bottoms of canyons. In contrast to the traces, the scrapings remain for a longer time, therefore they may indicate the frequency of the animal's attendance of a place.

For the calculation of leopards in Turkmenia, we took the Abramov (1961) method suggested for the calculation of Amur tigers, the Pikunov and Korkishko (1985; 1992) methods of the calculation of Far-east leopards and some aspects of the Nasimovich (1952) method for the calculation of Persian leopards as a base. A.A.Nasimovich showed that for calculating a number of leopards, one must know and inspect the individual territories which are the base of the space structure of a population. These methods were adapted by us to the conditions of Turkmenia and were used for carrying out field investigations (Lukarevskii, 1995).
We also used some information from irrelevant observers (forresters, hunters, herdsmen and others) and the materials of the Chronicle of nature of the Syunt-Khasardag and Badhyz reservations.

Sexual and age differences in the imprints of paws of leopards are quite essential. The most distinct, reliable and the least changeable element of the trace of a leopard similar to that of a tiger and a snow leopard (Matyushkin, Yudakov, 1974; Matyushkin, Koshkarev, 1990), is the imprint of a large plantar pad or a "heel". In so doing we always considered and measured the imprint of a heel only for forelegs, since the imprints of heels for forelegs and hindlegs essentialy differ both in size and configuration. The imprints of hindlegs are smaller in size and are more

oblong. The width of a heel of grown up males varies within 8-9.5 cm, and only on February 17, 1985 we saw the traces of a male whose heel width of a foreleg was 10.5 cm at a step length of more than 85 cm (usually the step length of a large male does not exceed 60-75 cm). The heel width of grown up female varies within 6.5-8 cm, but the most frequently we met the traces the heel width of which constitutes 7-7.5 cm and the step length varies within 40-60 cm, the average length being 48-55 cm. Young specimens have a heel width from 5 up to 7 cm, the average value is 5.5-6.5 cm at a step length 38-48 cm. The sexual differences are observed for other leopard subspecies, tigers, jaguars and other large cats (Matyushkin, Yudakov, 1974; Pikunov, Korkishko, 1992; Mcdougal, 1977; Schaller, Crawhaw, 1980; Rathore et al, 1983).

One makes the most possible mistake in identifying one or another specimen by its traces when compares the traces of young males and grown up females. The sizes of the traces are overlapped for these kinds of animals though the traces of males are more "spread" and the heel is longer, therefore the whole size of the trace is more than that of a female. This problem is analyzed in detail for a Far-east leopard (Pikunov, Korkishko, 1992). In these cases one had to consider the animal's behaviour. In contrast to grown up females, young males of this age do not mark the territory or their marking activity is weakly pronounced. The mistake is possible only if a resident female has small kittens (her marking activity becomes minimal in this period) or when young males begin to demonstrate the signs of residentiary and the resident female is in the state of heat.

In all cases we considered the character of a substrate, since the same specimen may leave the traces of the paws' imprints of different sizes which vary within 0.5-1 cm depending on a kind of soil and its moisture content. The traces of one or another specimen can be identified the most accurately by examining the chain of the traces. A separate trace is suited for the identification only on plane parts of a pathway with a soft upper layer of the soil.

We registered all the traces of leopard's activity on our route, for example the direction of the animal's motion and the approximate time when the traces and scrapings had been left. The results of the observations were marked in diagrammatic maps. Comparing the results of 2-3 parallel routes we could fully or partially restore a daily route of a leopard and the character of the exploitation of its own territory. It should be noticed that anlagously to a Far-east leopard, a Persian leopard marks the most intesely not the borders of its areal but the central parts of hunting territories which are called by us as a core zone. This is the most pronounced in the location of scrapings on the routes used by a leopard.

For identifying the borders and the configuration of the areal of grown up females, the most reliable sign is the occurence of traces of grown up females with kittens and the traces of kittens who come to an independent life. The females who have large kittens, hunt more frequently on the boundaries of their hunting territories where young specimens migrate in the future.

The studies were carried out in 1995-1996. We also used some our earlier data obtained during the studies in 1984-1994 when we inspected

practically the whole territory of Kopetdag, Badhyz and Kugitang. We also inspected some territories in Malyi (Little) Balkhan and Bolshoy (Great) Balkhan, i.e. practically the whole areal of lepoard in Turkmenia.

Results

Areal and its changes. The distribution of leopards in the Middle Asia.

Persian leopard is found in the following regions of the Central Asia: 1)Bolshoy (Great) Balkhan and Malyi (Little) Balkhan, the whole Kopetdag, Gyaz'-Gyadyk mountains, some regions of Badhyz, Chengurek mountains in the south of Turkmenia; 2) Babatag in the south of Uzbek republic; 3)south-west of Tadzhyk republic (Bil'kevich, 1918, 1924; Laptev, 1934; Ognev, 1935, Flerov, 1935; Bogdanov, 1952; Kolesnikov, 1956; Chernyshev, 1950, 1958; Ishunin, 1961; Geptner, Sludskii, 1972 and others). Basing on the mummified leopard found in a pitfall cave, G.F.Baryshnikov (1987) included also Kugitang-tau mountains on the boundary of Turkmenia and Uzbek prepublic in the areal of Persian leopard.

It is quite probable that leopards still inhabit within the borders of this areal, though it is obvious that their number is very low over the most part of the territories. The modern situation in Tadzhyk and Uzbek republics cannot be evaluated unambiguously for lack of modern data: high variability of the behavior could enable him to survive. According to information of Tadzhyk people, leopards were regularly procured in Khodzha-Kazian and Teke-Kamar mountains. At the same time we did not find any traces of these carnivora when we briefly inspected the south of the territory between Vakhsh and Kafirnigan rivers in October, 1989. Therefore leopard seems to be considered as extinct in this region.

Distribution in Turkmenia.

This region is located on the northern border of a species areal of Persian leopard. Bolshoy and Malyi Balkhan mountains were considered to be a north-western border of the areal of Persian leopard in Turkmenia (Geptner, Sludskii, 1972), and Songudang mountains on the left bank of Nizhni Sumbar (Dementyev, 1945, 1955) river were the south-western one. In 1970-1980 one noticed the stops of leopard at Krasnovodskii peninsula (Gorbunov, 1989; Gorbunov, Lukarevskii, 1991) and even in the West cliffs of Ustyurt where the traces of leopard were noticed in the Kulansay tract in July, 1989 (A.Gorbunov, personal information). Kugitang-tau mountains where a mummified corpse of a leopard was found by G.F.Baryshnikov in a pitfall cave (1987), should be considered as an eastern boundary.

In the middle-end of the 80-ies leopard was met practically in all the regions of earlier defined areal. Thus, the traces of leopard's stay were met by us in the main massives of Malyi and Bolshoy Balkhans in November 1987, March 1988 and May 1989. In November 1989 leopard fell into a trap set for a wolf, near the Galymkuy well in Uzboy (herdsmen said that leopards stayed in this region approximately for a year and regularly fell on camels and small cattle).

The traces of leopard's activity were noticed by us on the south-western mountainside of a range in Ayri-baba mountain and "dinosaurus" plateau (Khodzha-i-pil settlement) in Kugitang-tau mountain country in December 1988. Other territories were not inspected by us, however according

to a personal information of Zh.Rakhmanov, vice-director of Kugitang reservation, a female with two kittens was noticed in the region of
Ayri-baba mountain in June-July 1989.

As for the West Kopetdag, including Kurendag, Karagez, and Aladag, leopard was distributed in a middle-mountain landscape practically everywhere and was met in all the palces where he had been observed by G.P.Dementyev (1945, 1955). According to information of border-guards, leopard was observed in 1982, 1983, and 1986 even near the Atrek river in the region of Kizyl-Atrek settlement, on the plane territory of West Turkmenia, 100-150 km far from t he main habitats. The last data on leopards stay in this region (A.Karavaev, personal information) are attributed to August 26,1991 (leopard killed a large boar near the lake Maloe Delili) and October 10- 15, 1991 (the same region, a foal was killed behind engineering and technical buildings not far from the lake).

As for the eastern part of Turkmenia, leopard inhabited the whole territory of the Central and West Kopetdag, in the mountain and rugged parts of Badhyz (Gyaz-Gyadyk mouintains, Danagermab, Zulfagar, and Keletkay ranges). In Chengurek mountains (the territory between the Kushka and Verkhniy Murgab rivers) the traces of leopards were found by us in 1987 and 1989 in the Agashly tract where we liquidated a trap on the pathway usually used by leopards.

However in the 90-ies a sharp total decrease of a number of animals took place, therefore the northern border of the areal was shifted to the south, to mountain regions which are on one hand relatively inaccessible and on the other hand relatively highly populated by wild ungulata. But in the mountain part the habitability of leopards was disputable in Bolshoy and Malyi Balkhans, in Chengurek mountains and in Kugitang. The most probably leopard's areal in Turkmenia and possibly in the whole Middle Asia drastically decreased by the middle of the 90-ies and is now within the territory of Kopetdag and Badhyz.

Distribution and location of leopards on the territory of Turkmenia.

Up to the end of the 80-ies the leopards of Turkmenia appeared as a complete population (or a part of a wider population which includes the animals inhabiting the territories of Iran and Afganistan) with a free exchange of genetic material within it. The isolation of groups concerned with these or those geographic regions, was of a conditional character.

However from the early 90-ies the processes of population fragmentation, its division into more or less isolated groups with the decrease of a number of animals became significantly more pronounced.

First of all the isolation involved the groups (if are yet) which inhabit separate mountain massives separated from Kopetdag and Badhyz by vast deserts in Maly and Bolshoy Balkhans, in Chengurek mountains, and in Kugitang. The next step was the process of isolation of parcels in the regions with a relatively high density, for example, in West Kopetdag, the group of which was already isolated from the Central Kopetdag one and is divided into small (2-5 specimens) groups practically isolated from one another.

Assuming that the number of leopards will decrease in the near future, we predict the further development of fragmentation of an earlier complete population.

Typical areals of Persian leopard.

On the northern border of a species areal in low and middle mountains of Iran-Afghan upland the habitats of Persian leopard appear as rocky canyons with almost no wood vegetation, plained mountain ¯« ª®pë and juniper thin forests where wild ungulata still inhabit. Thus, leopard inhabits rocky inaccessible mountains fully without trees and bushwood vegetation in Kurendag, Karagez and Aladag. As for Bolshoy and Maly Balkhans, leopard prefers deep rocky canyons with almost no trees, plained mountain ¯« ª®pë and juniper thin forests where wild ungulata still inhabit.

In South-West Kopetdag, i.e. in the basins of the Sumbar and Chandyr rivers leopard inhabits the upper parts of large mountain canyons covered by dense forests with rock detritus and cliffs. His traces are the most frequently observed in freely visible places (dividing ranges and ridges), on the bottoms of canyons and upper terraces. Leopard also inhabits the South -West Kopetdag and low mountains, strongly rugged terrain with a lot of á ª «ì-¨ª and detritus.

In Central Kopetdag leopard inhabits the mountains full of rocks and canyons almost deprived of trees and bushwood vegetation or covered by scarce juniper and pistachio-trees, in the places with a great number of wild ungulata.

In Badhyz leopard inhabits mainly the landscapes with the most rugged relief where there is a lot of mountain sheeps: along the cliffs of Eroylanduz hollow and Kizyldzhar gully, in pistachio-trees thin forests, in deep canyons covered by scarce pistachio-trees.

In Kugitang the leopard's habitats are analogous to his habitats in Bolshoy Balkhan and Central Kopetdag.

The total square of optimal leopard's habitats in West Kopetdag was equal in the past to approximately 5000 sq.km however now the squares of such territories does not exceed 2000 sq.km. In Central Kopetdag the territories with deep canyons and heavily separated mountainsides which are relatively slightly destroyed by human economic activity (the pasturing of domestic cattle and felling are restricted and fires almost do not take place), constitute about 200,000 sq,km. A number of wild ungulata (mountain sheeps) is still relatively high on this territory. In East Kopetdag the square of such territories does not exceed 700-800 sq.km , and 500 sq.km in Badhyz. In Kugitang, in Maly and Bolshoy Balkhan where there are suitable conditions, leopard probably disappeared at all. The distribution of leopards in Turkmen mountain regions is defined not by a character of relief or vegetation, but by the state of feeding sources (Lukarevskii, 1993, 1995).

It is possible that earlier leopard was commonly observed in rugged terrain, tugai (vegetation-covered bottomland) and in the hollows of rivers of west Kopetdag and Uzboy which are now out of his habitats because of the lack of shelters and extremely poor feeding sources that is confirmed by the data on tugai of Tedzhen where leopard was observed (Zarudny, 1889) and is now regularly observed (D.Nepesov, own information; Korshunov, 1986). This is not surprising since this region is characterized by a great number of boars.

Practically all habitats of leopard in Turkmenia and in the whole Central Asia are deteriorated rather quickly under the overpasture of domestic cattle, felling, fires, hunting, and partially recreation charge and also because of bringing new lands into cultivation. One could

assume that human stress would not decrease providing that the tendencies of social-economic development will remain unchanged in the near future. On the contrary, from 1991 the efficiency of the protection of reservations which for a long time had played an important role in supporting the populations of lafge animals, sharply decreased, and these territories lost their nature protection significance. Therefore it becomes necessary to plan the further decrease of both leopard's habitats and a number of animals.

The present number and density of the population of a species in the region.

In the past only S.I.Bilkevich (1924) quantitatively estimated the state of the leopard population in Turkmenia. He estimated the total number of leopards in Turkmenia to be equal to 50 specimens.

West Kopetdag

Territory 1. Syunt-Hasardag chain. The total area is about 500 sq.km including 160 sq.km of protected territories. At the end of the 80-ies one could observe two adult regularly reproducing females, an adult male, and 2-3 young specimens including 1-2 years old kittens. In 1992-1993 one noticed one more reproducing female whose kittens were taken away by a native resident.

In 1995-1996 the traces of only 3 leopards were registered. They were attributed to an adult male, female, and inidentified specimen, but the fire in the Syunt-Hasardag mountainsides in July 1996 the most probably abolished the main habitats of leopard in this territory which are the best ones in the whole West Kopetdag.

Territory 2. The basin of the Aydera river, Nohur and Shalcheklen plateaus.

The total area is about 1200 sq.km including the protected territotries (30 sq.km). In 1985-1988 we saw the traces of three adult females, two adult males and 3-4 young specimens including 1-1.5 years old kittens.

In 1995-1996 the traces of only three leopards, namely two adult females and an adult male were found. The inspectors on reservation protection informed on two large kittens with one of females that seems not to be real since even a year ago three leopards as a minimum had been killed there by poisoned baits, an adult female and two kittens as described.

Territory 3. Mondzhukly range-the interfluve of Sumbar and Chandyr. The total area is approximately 1000 sq.km. In 1984-1989 we found the traces of 3 adult females, 2 adult males and 4-5 young specimens including 1-1.5 years old kittens.

In 1996 the experts evaluated this territory to be inhabited by not more than 3-4 leopards, the traces of young specimens being not observed at all.

Territory 4. Peredovoy range, Gezly mountain and others. The total area is about 500-600 sq.km.

In 1985-1986 we found the traces of an adult male and adult female in the Peredovoy range (Ereush mountain). The native residents (Khodzhakala) saw a female with two kittens there and in the region of Gezly mountain. Thus, our own information and that of native residents enabled us to suggest that this territory had been inhabited by 1-2 adult females, an adult male, and 1-2 young specimens.

In 1995-1996 not more than 2-3 leopards inhabited here.

Territory 5. Aladag, Karagez, and Kurendag ranges (north-west of West

Kopetdag). The total area is more than 2000 sq.km . This region was inspected by us less carefully though our ocassional routes covered all basic mountain systems. The traces of leopard were noticed in the main Kulmach range (Kulmach, Torgoy mountains), in Kurendag and Karagez. In May 1993 the traces of a female and her 1 year old kitten were found together with those of an adult male in the central part of Karagez range (the traces of vital activity show that a female was in íáâpãá). The capacity of the territories for leopard is much lower in this region as compared with the other ones: there are no water sources; boars, mountain sheeps and porcupines are met very seldom, and domestic cattle is pastured not over the whole territory and not every year. All this enables the estimation of leopard to be equal to 5-6 specimens.

In 1995-1996 the situation remained practically unchanged since the traces of leoprad's vital activity were found by us even on such wasteful territories as Torgoy mountains.

Territory 6. Palyzan range on the boundary with Iran. The area of the northern macromountainsides within Turkmenia is about 250-300 sq.km including the protected territories (60sq.km). This territory is behind engineering and technical buildings, therefore we inspected only its separate parts in different years and seasons. Since this part is comparable with the region of Syunt-Hasardag ridge both in area and the state of feeding sources for leopards (a number of boars here is higher than in any other region), one could assume not less than 4-5 specimens to inhabit here and with no doubt in the northern mountainsides of the ridge.

By the beginning of 1996 the situation remained almost unchanged though the tendency for a number decrease was formed because the number of mountain sheeps became two times less, but a relatively high number of boars being unchanged.

Therefore we estimated that approximately 35-40 adult and young leopards inhabited the territory of approx.5000 sq.km in West Kopetdag in the second half of the 80-ies. By the middle of the 90-ies a number of leopards fell down to 23-25 specimens in this part of Turkmenia.

Central Kopetdag.

Central Kopetdag was always characterized by a great number of wild ungulata. It is obvious that the population of leopards was maximal there and according to the report of V.Korshunov (1986), constituted not less than 50 specimens. However by the present time the situation was drastically changed. The analysis of the data obtained during the inspection of 5 various regions in April 1996 showed that the number of leopards became two time lower .

Territory 1. the region of Kalinin zakaznik (protected territory) (Gyaursdag mountains). The total area is more than 200 sq.km. We found the traces of a young specimen (a female as it derives from the imptints of paws) and an adult male who exploits the territories behind engineering and technical barriers (ETB) and in the rear. The results of the inquiry evidence two leopards to be killed only during January-February.

Territory 2. The "Babazo" area of Kopetdag reservation and neighboring territories. The total area is 250-300 sq.km. The traces of 1-2 adult females , a 1-1.2 years old kitten and an adult male were found. The peculiarities of the behavior of an adult female enable the conclusion that she was in the state of heat. We did not manage to identify the traces of paws of the adult females since the sizes, configuration of paws' imprints and the behavior were very

similar. The results of the inquiry showed a young leopard to have been killed here in winter 1995-1996.

Territory 3. The "Firuza" area of Kopetdag reservation. The total area is about 200 sq.km. Here we found the traces of two adult and one young leopards. We also found a relatively fresh corpse of a large adult male the cause of the death of which was not clarified, and the skull of a young leopard killed or perished in autumn-winter 1995. One more young leopard was killed in the rear not far from ETB (oral information).

Territory 4. The "Mirzadag" area of Kopetdag reservation. The area is about 60 sq.km. We found the traces only of one adult female whose territory is probably spread far out of the borders of the reservation.

Territory 5. Dushkeredag mountain the total area of which constitutes more than 400 sq.km. We inspected only a small part of these mountains and found the traces of an adult female and an adult male. The total number of leopards seems to be equal to 4-5 specimens.

Thus the territory of Central Kopetdag of about 1200 sq.km total area inspected by us, was inhabited by 13-15 leopards in April 1996. The total number of leopards in this part of Turkmenia including the territories not expected and those unsuitable for leopards (about 1000 sq.km), should be estimated to be 25-30 specimens.

East Kopetdag.

V.Korshunov reported (1986) that a number of leopards constituted not less than 30 specimens in East Kopetdag including Meanachaacha reservation, though we consider this estimation to be strongly exaggerated. We found the traces of an adult female with two 1 year old kittens and the traces of a young specimen in inspecting some canyons in this region in June 1989 and in May 1993 on the territory of about 300 sq.km.

In 1994 we found the traces of only two females, one adult male and a young independent specimen approximately in the same region (the area is more than 500 sq.km). The number of leopards seems not to exceed 10 specimens with if one takes into account the present tendencies.

Badhyz.

Gyaz-Gyadyk mountains with a lot of wild ungulata were characterized by a greatest number of leopards in Turkmenia in the 40-ies. In 1947-1948 14 specimens were taken on the territory of 500 sq.km (Geptner, 1956). However for the past 30-40 years the state of leopard's population was strongly deteriorated and he became one of the rarest species of large mammals of Badhyz (Gorelov, 1978). The fire of 1983 which was spread over 110 sq.km of pistachio-tree woods, resulted in a sharp deterioration of the conditions of both leopards and mountain sheeps habitats (Sokolov, Gorelov, 1985).

In June 1989 we inspected the whole territory of Badhyz reservation (about 500 sq.km), except the ranges located on the right bank of the Tedzhen river. The traces of leopard were observed practically over the whole territory of the reservation except its plain part, over the whole Eroylanduz hollow and in Kizyldzhar gully, i.e. leopard again occupied all the regions of his former habitat in Badhyz reservation (Lukarevskii, 1991). However one can conclude the number of leopards to be rather low by considering a trace charge (traces, scrapings, excretions, etc).

A number of leopards in Badhyz reservation is estimated by us to be 6-8 specimens and one should consider badhyz population of Persian leopard

together with that of Gyaz-Gyadyk mountains which does not exceed 10-15 specimens (Lukarevskii, 1991), as a part of kopetdag population, considering that leopard easily overcomes engineering barriers.

In 1996 we once more inspected the whole territory of Badhyz reservation. The traces of leopard were observed everywhere, and sexual and age structure of population remained unchanged. This enables the conclusion that Badhyz region is the only in Turkmenia where the state of Persian leopard population is yet stable.

The interfluve of the Kushka and Murgab rivers.

The number of leopards in Chengurek mountains the most part of which is located behind engineering and technical buildings, hardly amounts to 5-10 specimens by expert estimations based on inquiries.

Kugitang-tau mountains.

The inquiry data together with the expert estimations yielded approximately 10 specimens for this region in the 80-ies. However a thorough inspection of this region in 1995 when we did not manage to find the traces of leopard's vital activity results in that this species should be considered as vanished.

Maly and Bolshoy Balkhans.

Maly and Bolshoy Balkhan mountains were the most northern and a relatively isolated region of leopard's habitat. From here the animals reached the Krasnovodsk plateau and even the west cliffs of Ustyurt. In the 80-ies this group was considered by us as a relatively stable one (Gorbunov, Lukarevskii, 1991; Lukarevskii 1993, 1995). However in May 1996 we did not find the traces of leopards on more than 60 km route. A number of wild ungulata was also very small, but the mountains were "strewn" by shot cartridge-cases from rifle. This makes us to have doubts about that leopards still inhabit this region.

Thus, by the present a number of leopards in Turkmenia is estimated to be 78-90 specimens and it gradually decreases over the most part of the territory. The species areal within Turkmenia is broken to 5 parts connected out of the state boundary. This is not the case for Bolshoy and Maly Balkhans which appear as isolates among a desert landscape. It was already mentioned that leopard easily overcomes the lines of boundary engineering and technical buildings and unsuitable territories. Therefore all the groups existing in Turkmenia are considered by us as a united population with an active genetic exchange within it. This is confirmed by Yu.K.Gorelov (1972) and by our own data (A.V.Gorbunov, V.S.Lukarevskii, 1991).

Discussion and conclusions

Thus, if at the end of the 80-ies the leopard's areal in Turkmenia appeared as a complete population, it is now broken to several ones with a tendency to division into smaller groups within every population. Finally the tendency to fragmentation of west kopetdag group may result in its total dying off that seems to have taken place in Maly and Bolshoy Balkhans, Chengurek mountains and Kugitang.

The leopard's areal in Turkmenia and probably in the whole Middle Asia drastically decreased and now exists only in Kopetdag and Badhyz.

The dynamics of leopards number in Turkmenia is not easily observed. S.Bilkevich reported (1924) that in 1920-ies there was no more than one animal per 424 sq.km on the whole territory occupied by leopards in Turkmenia.

Suggested that the total area occupied by leopards, constituted about 20650 sq.km, its total number was equal to 50 specimens that hardly corresponded to reality.

We suggest that such an estimation is very lowered since 14 leopards were killed in Badhyz (Gyaz-Gyadyk) on the 500 sq.km territory during 1947-1948, though this number seems impossible now. In West Turkmenia (West Kopetdag, Bolshoy Balkhan, Krasnovodsk peninsula) ten leopards were killed for 7 years (1935-1941) (Dementyev, 1945) and 336 pelts total were taken in Turkmenia for 34 years (1925-1959) (Sapozhenkov, 1966); in the 60-ies 70 animals were killed for 7 years (Gorelov, Shcherbina, 1971). Our inquiry data evidences that more than 10-11 leopards were killed in the basin of the Sumbar river for 6 years (1979-1985). However all these data do not permit the unambiguous conclusion on dynamics of species number since a part of killed animals was not registered at all and the firing was realized randomly. Besides, all the cases of taking or killing leopards have being hidden during past 20 years after he was announced to to be a protected species.

The tendency to the decrease of species number is obvious. It is also obvious that the number of leopards strongly decreased and is decreasing over the most part of the areal. The situation sharply became worse in 1991-1996 when a severe regime of guards of a right of way (the right of way is sometimes 30-40 km wide) between the state boundary and engineering and technical buildings was in fact eliminated. The right of way was for a long time a reservation and played an important role in protecting the whole natural complex, and first of all large mammals. Sporadic poaching could not essentially affect the state of populations. The elimination of this regime along Turkmen boundaries resulted in that for the past 2-3 years a number of wild ungulata 2-3 or even more times decreased as a result of poaching, and now these territories do not play an important role in supporting leopards number. The dynamics of a number together with the defining factors is easily observed on small and well studied territories, namely, Syunt-Hasardag chain which occupies not more than 500 sq.km and involves the territories protected (160 sq.km) and utilized in agriculture.

Thus, in 1984 this territory was inhabited by 4-5 leopards (2 adult females, an adult male and 1-2 young specimens including 1-1.5 years old kittens). By that time a number of mountain sheeps constituted about 100-120 specimens, that of boars was 150-160 specimens which were the basic objects of leopard's feeding (Lukarevskii, 1988). Mountain sheeps and domestic cattle played a secondary role. By the end of the 80-ies the situation was changed: the number of mountain sheeps grew up to 200-250 specimens and that of boars somewhat lowered down to 120-130 specimens. A number of leopards grew as well. In 1991-1993 it constituted 7-8 leopards, namely, 3 adult females, an adult male and 3-4 young specimens including 1-1.5 years old kittens. There were 3-4 young specimens who played a significant role in leopard's spreading over unsuitable territories appearing as a reserve of the population. Migrating leopards were met far from the basic habitats and for a long time inhabited the territories unsuitable for vital activity falling on domestic cattle, thus their number seemed to be high in this region.

In the 90-ies the situation was changed in such a manner that by the end of 1993 one found the decrease of a number of all wild ungulata in

the Syunt-Hasardag chain and now ungulata are so unique that they cannot be considered as the basic objects of leopard's feeding and the number of leopard itself was reduced to 3 adult specimens. The traces of kittens were not found there neither in 1995 nor in 1996, i.e. the number of leopards was reduced to that of 1979 when the reservation was organized (Chronicles of nature of Syunt-Hasardag reservation of 1979). It implies that if 5 years ago Syunt-Hasardag, Ayder, and Palyzan groups played a key role in keeping the viability of the whole west-kopetdag group, then this significance is lost now. The number of animals was reduced there to a critical one.

The similar and probably a more tragical situation was formed in the Central Kopetdag. On one hand leopards are strongly suppressed by poaching. According to the inquiry data, from 1 to 3 leopards have been killed for the past 5-6 months on every of 5 inspected territories. In Ashgabad one taxidermist prepared 5 leopard pelts only for the past half year. On the other hand, the reduction of feeding objects is of a deeper character since there is no equivalent or close "substitutes" of quickly reducing wild ungulata. The number of the populations of possible "substitutes", i.e. s econdary feeding objects (boars, porcupines, badgers, foxes, hairs, etc) is lower in the Central Kopetdag than in the South-West Kopetdag because of natural conditions, therefore in winter leopards are doomed to starvation under the conditions of a low number of mountain sheeps.

We estimate Persian leopards number to be 130-150 specimens by the end of the 80-ies in Turkmenia. From that time by the end of the 90-ies their number was reduced to 78-90 specimens and this tendency remains unchanged. In so doing, if at the end of the 80-ies leopard appeared as a complete population in Turkmenia, now this population is broken to several groups inside which one also observes the tendency to division into smaller units. Finally the tendency to fragmentation of the groups may result in the total extermination that seems to have taken place with the groups in Maly and Bolshoy Balkhans, Chengurek mountains and Kugitang.

The principal causes for the decrease of density all over the territory of the region are:

a sharp deterioration of feeding sources, practically complete extermination of boars in leopard's habitats. Now boars as objects of feeding, are of importance only on 300-400 sq.km area of the West Kopetdag territories contiguous with those of Iran. Domestic cattle becomes the basic object of feeding for leopards that obviously provokes the cattle owners for firing these carnivora. The inquiry data shows that 2-3 leopards were anually killed in West Kopetdag in the 80-ies. Today this number is minimally two times higher. In addition to the extermination of leopards because of his falling on domestic cattle, a goal-oriented hunting is highly developed for the pelts which are then bought by foreign citizens from Iran and Turkey, and by native businessmen able to pay up to 1000 USD for a pelt. This sum is very large for turkmen. All the factors of human influence on a number of leopards will grow in the near future thus threatening the existence of the species in the region. A number of leopards steadily decreases and if it constituted 130-150 specimens at the end of the 80-ies, it is equal to only 78-90 ones by the middle of the 90-ies and this tendency remains unchanged. It is difficult to believe that by the end of the 20th century fauna of this region will lose one more species of large cats.

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