

TRANSLATIONS

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Reptiles of the Autonomous Republic of Turkmenistan

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Turtles — Testudines

Caspian Turtle — *Mauremys caspica*

(Gmelin, 1774)

(Suv Pyshdyly, Suv Pyshbagasy)*

Of the three subspecies known, one — *M. c. caspica* — occurs in Turkmenistan (Bannikov et al., 1977).

Mauremys caspica caspica (Gmelin, 1774)

Distribution. — Southern Europe, northwestern Africa, Asia Minor. USSR — central and eastern Transcaucasia, Dagestan, and southwestern Turkmenistan: Atrek, Sumbar, Chandyr (Zarudnii, 1896; Pestinskii, 1939; Filippov, 1949; Samorodov, 1955; Rustamov et al., 1962; Bogdanov, 1962; Bannikov et al., 1971, 1977) and western Uzboi (Rustamov et al., 1962) (Fig. 1).

Habitat. — The Caspian turtle inhabits standing and flowing waters (mountain rivers, shallow streams, waterholes). According to our data, it prefers rivers and streams, in contrast to the swamp turtle [= European pond turtle, *Emys orbicularis*]. Of the 62 Caspian turtles observed in the course of our field work in southwestern Turkmenistan, 51 were found in fast flowing mountain rivers, and 11 in standing water bodies.

Population. — The Caspian turtle populations are more dense than those of the swamp turtle (Rustamov et al., 1962; Bogdanov, 1965). In June – July 1960, Rustamov et al. (1962) encountered 204 turtles in the course of nine field trips to the Atrek River, of which 128 were Caspian and 76 swamp turtles. According to our own investigations, the Caspian turtle is usually abundant in the waters of the southwestern Kopet-Dag. In April – May 1975 and 1976, we found 62 individuals on the banks of a 17 km long stretch of the streams and standing waters investigated (mean density: 9 specimens/km) in the course of 19 field trips. Considerable numbers inhabit the fast flowing mountain rivers and streams. On 29 May 1976, on a 0.5 km long section of Parkhai Stream, 22 turtles were seen. However, other investigators stated that

at the Sumbar River between the settlements of Kara-Kala and Tersakan, no more than three to four specimens could be located during a 1 km walk, whereas the number of turtles observed at the same site in March 1981 was 10–12 per km (Skalon, 1982). In lowland waters, population densities of the Caspian turtle are smaller than those of the swamp turtle. In the course of a 0.5 km excursion to Maloe Delili Lake on 16 April 1976, one Caspian and 35 swamp turtles could be counted.

Daily and Seasonal Activity. — In April, the first active turtles were seen at 0930 hrs, the last at 1745 hrs. In May these times were 0600 and 1800 hrs. In April, May and October 1974 to 1976, 54 specimens were located (14 in April, 40 in May). In Maloe Delili Lake, the first swimming individuals were seen on 15 April 1976. However, spring activity obviously starts earlier, and the Caspian turtle generally ends hibernation in mid-February at such places, as does its relative, the swamp turtle. In the thermal springs of the western Kopet-Dag active specimens may be collected

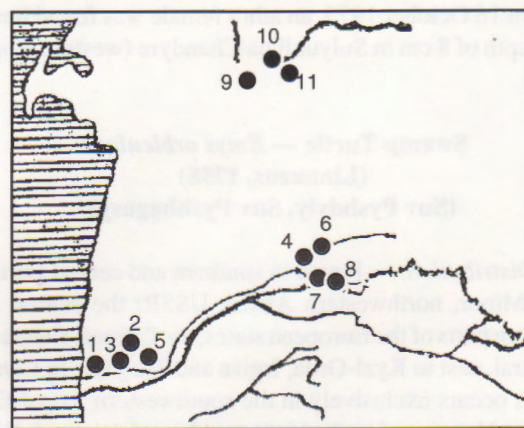


Figure 1. Distribution of *Mauremys caspica* in Turkmenistan. 1. Atrek River (Zarudnii, 1896); 2. Karadegish (Samorodov, 1955; Bogdanov, 1962); 3. Adzhiyab (Samorodov, 1955; Bogdanov, 1962); 4. Sumbar River (Pestinskii, 1939; Skalon, 1982); 5. Maloe Delili Lake (this study); 6. Parkhai Stream (Skalon, 1982; this study); 7. Chandyr River (Filippov, 1949); 8. Sulyukli na Chandyre Stream (this study); 9. Top'yatan Lake (Rustamov et al., 1962); 10. Karategelek Lake (Rustamov et al., 1962); 11. Yaskha Lake (Rustamov et al., 1962).

* Here and elsewhere, Turkmenian names of the species are given in parentheses.

even in December and January. In Parkhai Stream, two to three active individuals were found in the approximately 28°C warm thermal water late in December 1980 and early in January 1981 (Skalon, 1982). In Azerbaidzhan, turtles were active from March to mid-August (Aleperov, 1975).

Reproduction. — Insufficiently known. According to Bannikov et al. (1977), Caspian turtles reach sexual maturity at the age of 10–11 years, at 14–16 cm carapace length (CL). Rustamov et al. (1962) found 12.5–13 cm long specimens to be sexually mature. These authors, while working at the Atrek River in June – July 1960, collected 21 females with eggs developing in their oviducts. The clutches of these individuals consisted of 5 to 10 eggs (mean: 7.4 eggs). In some parts of their range, females lay two to three clutches in a single season, each consisting of 8 to 10 eggs (Bannikov et al., 1977). Eggs laid in April hatch in June. In captivity, embryonic development lasted for 22–27 days (Rustamov et al., 1962). In thermal springs in the western Kopet-Dag (Parkhai Stream), hibernation does not last long, so it is likely that turtles reproduce as early as February or March. In the town of Isfahan, Iran, Anderson (1963) observed two mating specimens on 26 October 1958.

Diet. — All dietary data originate from Rustamov et al. (1962). According to these authors, turtles feed both on water plants (reeds, *Tamarix*) and animal matter. In June – July, plant and animal matter constitute an approximately equal part of the diet (82.1% and 83.3%, respectively). In other months, animal matter predominates. Of the invertebrate elements in the food, the majority consisted of Coleoptera (60%), whereas molluscs and Diptera constituted up to 2.2%. Of the vertebrates, fish were found in 14.7%, amphibians in 4.4%.

Hibernation. — Hibernation starts at the end of September and ends in the middle of March. This inactive period lasts for 150–160 days. In preparation, turtles bury themselves in mud on the bottom of the water to a depth of 8 to 30 cm. On 16 October 1975, an adult female was found buried at a depth of 8 cm in Sulyukli na Chandyre (western Kopet-Dag).

Swamp Turtle — *Emys orbicularis*
(Linnaeus, 1758)
(Suv Pyshdyly, Suv Pyshbagasy)

Distribution. — Found in southern and central Europe, Asia Minor, northwestern Africa, USSR: the central and southern parts of the European states, the Crimea, Caucasus, Pre-Aral, east to Kyzyl-Orda, Irgiza and Turgaya. In Central Asia it occurs exclusively in the southwestern Kopet-Dag, western Uzboi, and in the lower reaches of the Atrek River (Fig. 2).

Habitat. — The swamp turtle inhabits fast flowing rivers, streams, and standing waters (lakes, ponds). However, it prefers the latter. In the course of our field work, 133 specimens were encountered in lakes and ponds, and only 8 were found in fast flowing mountain streams. This species occurs even at altitudes of 1000 m in Azerbaidzhan

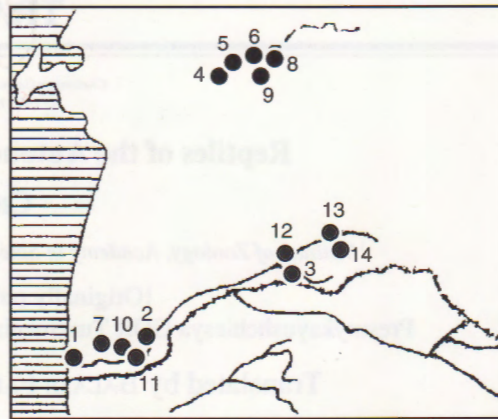


Figure 2. Distribution of *Emys orbicularis* in Turkmenistan. 1. Atrek River mouth (Zarudnii, 1896); 2. Atrek River (Chernov, 1934); 3. Chandyr River (Chernov, 1934); 4. Western Uzboi (Rustamov, 1954); 5. Top'yatan and Yaskha lakes (Filippov, 1949); 6. the same (Kartashev, 1955); 7. Bol'shoe Delili Lake (Dement'ev, 1945); 8. Top'yatan, Karategelek, and Yaskha lakes (Rustamov et al., 1962); 9. Karategelek and Yaskha lakes (this study); 10. Maloe Delili Lake (this study); 11. Ak village at Chandyr River (this study); 12. Parkhai Stream (Skalon, 1982; this study); 13. Koine-Kesir (Laptev, 1934); 14. Daina village (this study).

(Aleperov, 1975), but is found only to 600 m in the Kopet-Dag (Fig. 3).

Population. — For the above reason, swamp turtles are less numerous than Caspian turtles in the Atrek River. While working in the region in June – July 1960, Rustamov et al. (1962) observed 204 turtles, of which only 76 were swamp turtles. This species is decidedly common locally in the waters of southwestern Turkmenistan. In February and April – June 1974 to 1976 in the lakes of western Uzboi, Maloe Delili Lake, and the valleys of Chandyr and Sumbar rivers, 141 individuals were counted during a 15.2 km walk (14 excursions) (mean: 9.2 specimens/km). Along a 2.5 km long reach of rivers in the western Kopet-Dag 8 individuals were found (mean: 3.2 specimens/km), while on the banks of lowland waters 133 turtles were observed on a 12.7 km long tract (mean: 11.1 specimens/km). In the Sumbar River valley in the western Kopet-Dag, 16 individuals were seen on a single excursion on 24 February 1980, while at the same site only 5 were located on 12 March, and 13 and 27 in April

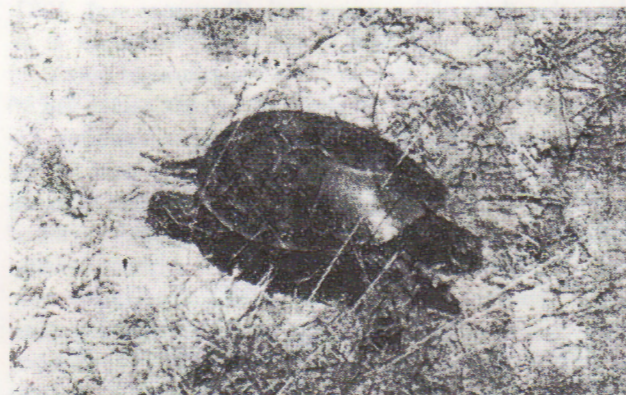


Figure 3. Swamp turtle [*Emys orbicularis*]. Common species. Maloe Delili Lake, May 1974.

1980 (Skalon, 1982). The largest population densities in the republic can be found at places located at lower altitudes. At 400 m at Maloe Delili Lake, 22 specimens were encountered on 13 February 1975, whereas at the same site, on 16 April 1976—at the time of the spring inundation—35 individuals were located along an approximately 2 km long tract.

Daily and Seasonal Activity. — In February – March 1975 and 1976, individuals leaving their hibernation sites could be seen in Maloe Delili Lake and the Chandyr River valley. Their daily activity lasted from 0800 to about 1700–1800 hrs. In May these times were 0600 and 1900 hrs. The first active turtles were observed in the first to second week of February in western Turkmenistan. In Maloe Delili Lake, three adult specimens were encountered on 12 February 1975, actively swimming in 10°C cold water at 1145, 1530, and 1540 hrs. On the subsequent day, 22 turtles were seen in 13°C water and 15°C air temperatures. The last active individual was seen on 16 October 1975 in Sulyukli na Chandyre Stream. As such, the activity season of the swamp turtle lasts for 220–235 days.

Reproduction. — Some females inhabiting the Atrek River reach sexual maturity at 121.8 mm CL. However, most mature at 125–150 mm CL, whereas a very few not until 160–180 mm CL (Rustamov et al., 1962). In other parts of the range, females produce one to three clutches in a season (May – June), each consisting of 5 to 10 eggs (Bannikov, 1954; Terent'ev and Chernov, 1949; Bannikov et al., 1977). The ratio of females ($n = 38$) to males ($n = 33$) was 1.1 to 1 in 1974–1976 in the waters of the Sumbar and Chandyr rivers and Maloe Delili Lake. Follicular development starts in mid-March, early April (majority), or mid-April. Two females collected on 11 and 15 April 1976 contained four to eight yellow follicles of 14–15 mm diameter. The first of such individuals were recovered at the above mentioned places on 15 April 1976 at 21°C air temperature. On the subsequent day, 35 turtles could be counted at the same site, of which nine pairs were mating (51.4%). Mating was observed in December in thermal springs of the western Kopet-Dag. On 3 December 1980, two mating turtles were seen in 27°C warm water (Skalon, 1982). Sexual dimorphism is rather pronounced. Males, as in the case of Central Asian tortoises [= Horsfield's tortoise], are notably smaller than females. They have a longer tail and a concave plastron. Mating occurs under water. During this period, males surface every three to four minutes, exhibit themselves, then leave the females and retreat to deeper parts of the habitat. Females lay 4 to 8 eggs at a time (mean: 5.2; $n = 5$). The first nesting female was observed on 24 May 1974, the next on 16 June. The eggs of these two animals were 34–34.5 mm long, 19–19.5 mm wide, and had a mass of 6.7–7.4 g. According to Rustamov et al. (1962), all females inhabiting the Atrek River lay their 6 to 8 eggs during June and July (mean: 6.7; $n = 4$). According to the literature, hatchlings remain in the eggs until the next spring and live off their yolk (Nikol'skii, 1902; Bannikov et al., 1977). In Turkmenistan, they occasionally emerge be-

fore hibernation. A hatchling measuring 17.5 mm CL and 5.8 g was found on 11 June 1960 in the Atrek River valley (Rustamov et al., 1962). A juvenile (33 mm CL, 32 mm carapace width [CW], 7.9 g mass) was encountered on 25 July 1970 at Daina village in the southwestern Kopet-Dag.

Hibernation. — Hibernation lasts from the middle third of October to the first third of February, for approximately 120 days. This period is spent under water, buried into the muddy bottom to a depth of 10 to 15 cm or more. On 16 October 1975, a hibernating adult was discovered at a depth of 10 cm in Sulyukli na Chandyre Stream.

**Central Asian Tortoise — *Agrionemys horsfieldi*
(Gray, 1844)
(Pyshbaga, Pyshdyl)**

Size, Weight, and Population Structure. — According to their age, Central Asian tortoises can be classified as juveniles (up to 5 years of age), immatures (6 to 9 years old), and adults (10 years or older).

The youngest specimens in their first year of life were found in the months of September and October. These have a rotund and rugose shell, the width of which often exceeds its length. Measurements of the shell are: length 31–37.5 mm, width 26–42.5 mm, weight 9.1–16 g ($n = 2$). Sexual dimorphism is not yet evident in 4 to 5 year-old individuals. Age can easily be estimated by counting the number of growth rings on the scutes. Measurements of the shell of 2 to 4 year-old specimens; length 42–50 mm (mean = 44.2 mm), width 38–52.5 mm (mean = 41.8 mm), weight 18.4–29.9 g (mean = 21.5 g).

From the 5th to 6th year on, sexual dimorphism becomes obvious, and 6 to 9 year-old individuals are thus classified as semi-adults. These have a hard shell. The length of the shell in two males we measured was 94–98 mm, its width 76–81.5 mm, and its weight 184–212 g.

Central Asian tortoises attain maturity by their 10th year of age. Females are significantly larger than males in all aspects. Females originating from the Kopet-Dag reach 286.4 mm CL (Chernov, 1959), those from Kirgizia 198 mm CL (Yakovleva, 1964), Tadzhikistan 202 mm CL (Chernov, 1959), Kazakhstan 197 mm CL (Brushko, 1978). Based on our own data, a 23 year-old female collected 1 June 1969 on Mt. Dushak (central Kopet-Dag) measured 270 mm CL, and had a weight of 3.5 kg. Generally, females weigh almost twice as much as males. In western Turkmenistan, mean weight of females was 1223 g, of males 684.5 g (Shammakov, 1966). The same is the case with a population in South Pribalkhash, Kazakhstan. The mean weight of females from Malaisar, Chingil'da, Akkuduk, and Akkol' was 1577.5 g and males had a mean weight of 780 g, according to Brushko and Kubykin (1977).

Distribution. — Northern and eastern Iran, northwest India, and north Pakistan. In the Soviet Union, this species is found in the Central Asian republics and southern Kazakhstan. It has a widespread occurrence in

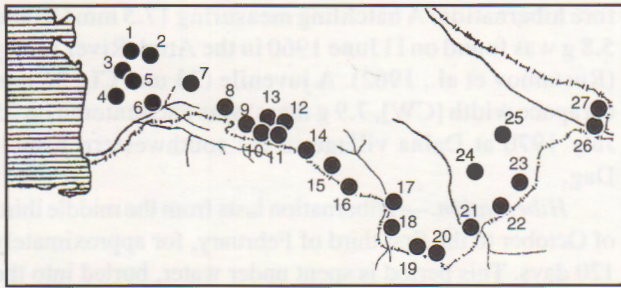


Figure 4. Distribution of *Agrionemys horsfieldi* in Turkmenistan. 1. Greater Balkhan (Vinogradov, 1952); 2. Uzin Akar, Duz Mergen Pass in the Greater Balkhan (Ataev, 1979); 3. Lesser Balkhan (Shammakov, 1966); 4. all of southwestern Turkmenistan (Kartashev, 1955); 5. Danata, Kyurendag, Edzher, and Karagez (Kolesnikov, 1956; Shammakov, 1966; Ataev, pers. obs.); 6. the valleys of Bekibent, Kara-Kala, Sharlauk, Chandyr, and Sumbar, passes of Eldere, Aidere, Shikhimdere, vicinity of Kizyl-Arvat (Mortiz, 1929; Andrushko et al., 1939; Rustamov et al., 1962; Ataev, pers. obs.); 7. region of the Geok-Tepe (Mortiz, 1929); 8. region of Germab and Tretii Birlashik (Ataev, pers. obs.); 9. Chuli and Firyuza (Ataev, 1975, 1977a); 10. Chaek and Mt. Dushak (Ataev, 1979); 11. Alybeg (Ataev, pers. obs.); 12. near Gaudan and Ashgabat (Varentzov, 1894; Fauser, 1906); 13. Bagir, Kalininsk village (Shkaff, 1916; Bogdanov, 1962; Ataev, pers. obs.); 14. Manysh (Ataev, pers. obs.); 15. near Kaakhka (Ataev, pers. obs.); 16. near Dushak station (Ataev, pers. obs.); 17. near Serakhsk (Ataev, pers. obs.); 18. Pul'-i-Khatum and the Gyaz-Gyadik mountains near Akarcheshme (Barei, 1901; Dement'ev et al., 1947; Laptev, 1945); 19. all of the southern Badkhyz and the town of Kushka (Geptner, 1945); 20. Akarcheshme, Er-Oylan-Duz, Kizyl-Dzhar, and the Kongruzly Basin (Korotkov, 1967; Ataev, 1975, 1979); 21. Karabil' (Dement'ev et al., 1951); 22. Lekger and Shikhmoll wells (Ataev, 1979, pers. obs.); 23. Khumly and Darvazkem (Ataev, pers. obs.); 24. Dostybai and Soltanuyuk (Ataev, 1979, pers. obs.); 25. Yaroshevsk Well (Ataev, pers. obs.); 26. Karlyukskii area and Khodzhakaraul (Shukurov, 1976; Ataev, pers. obs.); 27. Svintzovyi Rudnik and Gaurdak villages (Shukurov, 1976; Ataev, pers. obs.).

the Republic of Turkmenistan, from the Lesser and Greater Balkhan and Kyurendag in the west to the Kugitang Range in the east (Fig. 4).

Habitat. — The Central Asian tortoise is found at very different altitudes. It favors flat, steppe-like areas, and avoids steep slopes.

According to our investigations, its favored habitats include the lowermost parts of the mountains, gentle slopes, and passes. On the plateaus lying between mountains, fewer specimens were found (Table 1).

The fact that the habitats favored by this tortoise differ from one area to another is of some interest. In the western Kopet-Dag, they inhabit flat areas between mountains (Chandyr), in Badkhyz (Kongruzly Basin) and at Karabil' Turkmenistan (Shikhmoll Well) they are found in hilly country, and in the Chui Valley of Kirgizia (Yakovleva, 1964) on clay hills. In contrast to the results of other investigations, the species is found in several habitats in the western Kopet-Dag. For instance, on a 2 to 3 hour long trip on 24 April 1976, 35 specimens were seen along the Aldagdan, whereas one day later in the vicinity of Arpaklen, 12 individuals were registered on the montane steppe. On 22 April 1975, in the intermontane Chandyr Valley, 25 specimens were found.

This species also occurs at relatively high altitudes, particularly in the Kopet-Dag. Here it is found at 1900 to

Table 1. Distribution per habitat of Central Asian tortoises in the mountains and hills of Turkmenistan.

Habitat	Total Km covered	No. Spec.	Mean per 6 km
Hills (low mountains)	146.7	1089	7.4
Mountain slopes and dry riverbeds	55	82	1.4
Gorges	40.6	44	1.1
Montane steppe	83	65	0.7
Plains between mountains	226	153	0.6
Irrigation canals	3	2	0.6

2000 m above sea level, at Rengentau, 1300 m (Chernov, 1959), and in the Gissarskii Range, 1200 m (Yakovleva, 1964). However, most of the specimens encountered were found at elevations from 400–500 m to 1000–1200 m. During our study, of the more than 1400 animals observed, almost all (96.4%) were located below 1200 m. From Pagman, Afghanistan, there are reports of specimens from altitudes as high as 2440 m (Anderson and Leviton, 1969).

Population Density. — In spring and early summer months, on a 553.8 km long excursion in the Kopet-Dag, in Badkhyz, Karabil', and the Kugitang, 1451 specimens were seen (accounting for a mean distribution of 2.6 specimens/km). The distribution of tortoises within a given area is not constant. Table 2 reveals that the highest numbers recorded are in the Karabil' Mts. (23 specimens/km) and the Badkhyz Mts. (15.7 specimens/km). In the Badkhyz Mts., 80 specimens/km were found during the most active period (Solomatin, 1973). Korotkov (1967) reported the highest population densities from the Kizyl Dzhar (7.2 specimens/ha) and the mountains of Badkhyz (4.8 specimens/ha) in March and April 1966. In these areas *A. horsfieldi* inhabits hills at lower elevations. Tortoises occur in large numbers in the Chui Valley and the mountains of Kirgizia. Yakovleva (1964) found population densities there of 31 specimens/ha and 12.6 specimens/ha, respectively, while in the sands of Ayak-Agitmy in Uzbekistan, 12 specimens/ha were found (Polyakov, 1946).

The maximum number of individuals recorded on 2–3 hour trips in March were 18, in April, 35, in May, 12, in June, 3, and in July, 1 specimen for the Kopet-Dag, 28 for the Karabil', and 9 for the Kugitang. At Gissar, Tadzhikistan, the maximum number of specimens seen was 25 (Said-Aliev, 1979).

Daily and Seasonal Activity. — The end of the hibernation and the start of the aestivation periods differ by locality. In the Chui (Yakovleva, 1964) and Vakhshkoi valleys

Table 2. Numbers of Central Asian tortoises observed (March–June, 1963–1966, 1969, 1971–1972, 1975–1978).

Location	Km Walked	No. Spec.	Mean per 1 km	1 ha
Karabil'	13	300	23.0	11.5
Badkhyz	42	660	15.7	7.6
Kugitang	14	18	1.3	0.7
Greater Balkhan	10	8	0.8	0.4
Kopet-Dag	455.8	455	1.0	0.5
Gissarskii	19	11	0.6	0.3

(Chernov, 1959), and at lower altitudes in the central Kopet-Dag, tortoises awaken in March from brumation. Around Tashkent (Bogdanov, 1960) and the Murgaba Valley (Bogdanov, 1962), where spring arrives earlier in the year, tortoises emerge in the last third of February from their retreats. Aestivation begins at the end of May or early June, so the activity period lasts for only 100–110 days. According to the results of long term studies in the Kopet-Dag, tortoises end hibernation in the middle third of March and remain active until the middle of June (Ataev, 1979). On 19 March 1964, 7 specimens were found on the Bagir Hills (air temperature 22°C), whereas on 26 March, 18 animals were found (31°C). Tortoises can be observed on the surface from 0800 hrs, they are most active between 1100 and 1600 hrs, and some individuals retreat to their burrows as late as 1730 hrs. In May and June, the number of active specimens decreases markedly, and peak activity is reached twice daily (Fig. 5), once between 0900 and 1100 hrs and again between 1700 and 1800 hrs. After long, cold winters tortoises emerge only very slowly from their retreats. In 1972, following an extremely cold winter, the first specimens were seen on 25 March, while in 1965, when the spring was warm, they could already be observed on 8 March.

Animals from different parts of the species' range do not emerge from hibernation at the same time. On the hills of Bagir, at 300–400 m elevation, tortoises appear in large numbers from 20 March onwards. At Meimil and Arpaklen, at 900–1000 m altitude this occurs in the second half of April. In meteorologically normal years both adults and juveniles end their hibernation at approximately the same time. In montane areas spring vegetation growth greatly affects the activity of animals. In the Kopet-Dag, one part of the tortoise population is active when the desert population hibernates. During our work from July to February, in the valleys of Chandyr and Kurkulaba, on Mt. Dushak, around the Chuli and the Firyuza, and near Bagir village (Kopet-Dag), we have seen 22 specimens in total: 4 in July, 2 in September, 2 in October, 3 in November, 5 in December, 1 in January, and 5 in February. In the summer and autumn months tortoises could be encountered from

1000 until 1800 hrs. Among the specimens observed in summer and autumn, both juveniles and adults were present, whereas in winter only immatures (2 to 9 individuals) were seen (Ataev, 1975).

On flatlands, the activity of tortoises is extremely short due to rapid desiccation of the vegetation. Their number decreases from the middle of March. Bogdanov (1962) reported from the surroundings of the Karayab (Murgaba Valley) that animals started to aestivate in great numbers between 11 and 13 May, whereas Dubinin (1954) found this to occur in mid-May in the Khavast region (Uzbekistan).

In winter, basking individuals were seen from December to February (Ataev, 1975). These awoke at temperatures between 18 and 25°C, and remained in the vicinity of their burrows. In some instances individuals were unable to return to their retreats due to rapid cooling. On 22 January 1972, one specimen was found in a 5 cm deep pit (air temperature 0.4°C, soil temperature –0.6°C). The first active tortoise was seen at 1100 hrs, the last at 1515 hrs. Daily activity therefore lasts from 4 to 4.5 hours.

Longevity. — Rustamov (1956), Chernov (1959), and Yakovleva (1964) stated that the Central Asian tortoise can live for at least 20 years. According to Sergeev (1941) and Brushko (1978), longevity is 23–24 years in this species. Bogdanov (1962) found 25 year old females, and Dubinin (1954) also reported on 22 females older than 25 years. According to our own data, some specimens in the Kopet-Dag reach 30 years (females) and 21 years (males). Of 83 semi-adult individuals (51 females and 32 males), the majority found were 6 to 9 years old (18.1 and 27.1%, respectively). Of the adults, most tortoises were 10 to 17 years old (females, 57.8%) and 10 to 13 years old (males, 58.7%). Much scarcer were males of 14 to 17 years (10.3%), and males older than 20 years were almost never found. Of the 113 females seen, average age was 15.3 years, of the 70 males 11.7 years, so mature females live for about 3.6 years longer than males. The comparatively short life of the males results in a rapid population turnover. For an almost complete turnover of males (97%) in a given population, 14 to 15 years are needed. The same turnover for females (96.8%) is 21 to 23 years. In the Kopet-Dag old males and females inhabit different areas. On Mt. Dushak (central Kopet-Dag) a 30 year old female was found, and on the hills surrounding the Edzher in western Kopet-Dag a 21 year old male was located.

In the Kopet-Dag the mean age of females and males is 19.7 and 12.9 years, respectively. On the Meshed-Messerianski flatland these ages are 13.4 and 12.1 years. Near Ashgabat (central Kopet-Dag) they are 13.2 and 10.7 years, on the sandy dunes between Murgab and Tedzhen rivers 15.2 and 11.4 years, and in the sands near Zakhmet station 12.8 and 11.4 years ($n = 259$). In conclusion, specimens from the Kopet-Dag reach a significantly older age than do those from clay and sand habitats. Longevity is seemingly enhanced by the long hibernation and aestivation periods associated with this area, accounting for 3/4 of the tortoise's lifetime, and by the hard shell and the better ecological conditions available in the Kopet-Dag.

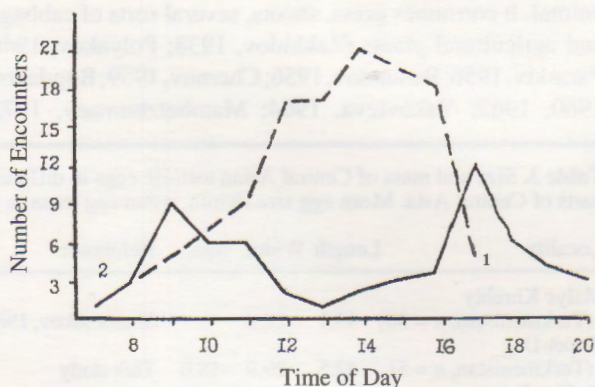


Figure 5. Daily activity of Central Asian tortoises in the mountains of Turkmenistan: 1. [dashed line] March–April; 2. [solid line] May–June.

Reproduction. — In Tadzhikistan and Kirgizia tortoises mate from the end of March until May (Chernov, 1959; Yakovleva, 1964; Said-Aliev, 1979). In Uzbekistan from April to May (Bogdanov, 1960), and on the flatlands of Turkmenistan from the end of March until the first half of May (Shammakov, 1966, 1981). In our republic, eggs are deposited in April and May, twice per annum. They number from 2 to 7, but most commonly only 3 or 4 eggs are laid (Sergeev, 1941; Kartashev, 1955; Rustamov, 1956; Bogdanov, 1962). The first copulating individuals were seen on 28 March in the Kopet-Dag, the last on 25 May. Most copulations were recorded during April. Of the 14 pairs, 1 mated in March, 11 in April, and 2 in May. A 12 year old female collected 4 June 1964 in the central Kopet-Dag contained 2 eggs ready to be laid (45 x 28 mm), and 6 corpora lutea (23 mm diameter) in its ovaries. Females containing eggs can be found later in the year as well. Near Dushak station, two hibernating females (11 and 12 years old, respectively) were collected, and contained 5 to 8 corpora lutea (22 and 23 mm in diameter). Thus, females contain rather large yellow follicles all year round. When the follicles reach 26–31 mm in diameter they can be fertilized. In a 13 year old female found on 7 April 1980, 7 corpora lutea (27.5–31 mm in diameter) were present in the ovaries.

Adult females are usually fertilized by younger males (Ataev, 1979). In April and May 1974 to 1976, the mating individuals observed in the Kopet-Dag consisted of 9 males 10–14 years old (mean = 11.8) and 9 females 12–13 years old (mean = 16.1). On 15 May 1976 on Mt. Dushak (central Kopet-Dag) a 14 year old male was seen copulating with a 30 year old female. This male was 3 to 4 times smaller than the female. The statement of Chernov (1959) that females older than 20 years no longer reproduce is thus incorrect. We have never seen a male mating with a younger female. Obviously, the copulation of individuals of different age positively affects the genetic variance within a population (Shvartz, 1969; Mina and Klevezal, 1976). Only on two occasions (12 April 1974 and 23 April 1976) have individuals of the same age (12–14 years) been recorded.

Oviposition occurs twice annually in the mountains, the first in April and the second in May or early June. One clutch consists of 3 to 4 eggs. The female deposits the eggs in an 8 to 32 cm deep burrow. Two freshly laid eggs measured 49.5–50 x 30–31 mm, and had a weight of 25.5–26.2 g. A 14 year old captive female produced 4 eggs on 5 June 1976, which were incubated at room temperature (28–36°C), and hatched on 18 August (Ataev, 1975). Under similar conditions eggs hatched in 76 days in Afghanistan (Roberts, 1975). It is quite possible that embryonic development lasts for about this long in nature. Hatchlings measure 40 x 31 mm, and weigh 9.1 g. The umbilicus is visible on the plastron, the shell is round and soft, the sexes are indistinguishable.

According to our investigations, sexual maturity is reached by the 12th year in females and 10th year in males in the Kopet-Dag. Sergeev (1941) reported this age to be 10 years for females from the sandy desert near Karabat station.

Similar observations were made in other areas of the region. In Tadzhikistan females mature by their 15th year, males by their 13–14th, in Kirgizia in their 13–14th and 9–11th years, respectively (Yakovleva, 1964). In Kazakhstan, Brushko and Kubykin (1977) and Brushko (1978) reported it to be 13–14 and 11–12 years. In the sandy desert of Turkmenistan, at the Karakumsk Canal (35 km southeast of Zakhmet) an 8 year old male (193 g) fertilized a 13 year old female (892 g) on 4 April 1980. Upon dissection, the female was found to contain 7 yellow follicles with diameters of 27.5, 28, and 31 mm (mass, 93 g). The testes of the male were yellowish brown, the left measured 11 x 7 mm, the right 12.5 x 7 mm, and they weighed 750 mg.

During the breeding period copulatory attempts were also seen between males. At Aldagdan on 23 April 1976 two 9 year old males (98 and 94 mm CL, 81.5 and 76.0 mm CW, 48 and 49 g weight) were observed. Both had enlarged testes which were pinkish in color, and measured 11.5 and 10 mm in length and 8 and 7 mm in width. As can be seen from Table 3, size and mass of eggs differ by locality. The largest eggs are produced by females from Karabat station, Turkmenistan, the smallest by those from the Gassir Valley, Tadzhikistan. In the Alma-Ata region of Kazakhstan, 13–18 year old females laid eggs that averaged 43.6 mm long, 28.8 mm wide, and weighed 21.6 g (Brushko, 1978). For 19–23 year-old females these data are 46.1 mm, 30.0 mm, and 23.3 g. The enlargement of the eggs can cause serious problems in females. In the Khavatsk region of Uzbekistan, females older than 25 years produced eggs 39–48 x 30–36 mm, and had their oviducts inflamed (Dubinin, 1954).

Several authors (Chernov, 1959; Bogdanov, 1962; Bannikov et al., 1977) have noted that hatchlings do not come to the surface until the next spring. In the Kopet-Dag hatchlings are rarely observed in the autumn months. On 9 October 1968 and 24 September 1972, two slightly grown juveniles hatched earlier in the same year were found in the vicinity of Anau and Bagir. In the mountains, mass occurrence of juveniles can be seen only in the spring of the year subsequent to their hatching. During our work, of 13 marked individuals, five (38.4%) were recaptured in March, seven (53.8%) in April, and one (7.8%) in June.

Diet. — The Central Asian tortoise is an herbivorous animal. It consumes grass, shoots, several sorts of cabbage, and agricultural plants (Zakhidov, 1938; Polyakov, 1946; Paraskiv, 1956; Rustamov, 1956; Chernov, 1959; Bogdanov, 1960, 1962; Yakovleva, 1964; Mambetzhumaev, 1972;

Table 3. Size and mass of Central Asian tortoise eggs in different parts of Central Asia. Mean egg size in mm, mean egg mass in g.

Locality	Length	Width	Mass	Reference
Malye Khrebyty (Turkmenistan, n = 30)	45.1	28.8	—	Shammakov, 1966
Kopet-Dag (Turkmenistan, n = 5)	42.5	29.9	18.0	This study
St. Karabat (Turkmenistan, n = 41)	49.2	33.9	29.9	Sergeev, 1941
Kirgizia (n = 56)	44.4	28.5	28.8	Yakovleva, 1941
Tadzhikistan (n = 63)	41.8	28.8	—	Chernov, 1959

Bannikov et al., 1977; Said-Aliev, 1979). Rustamov (1956) found that tortoises feed on 15 different species of plants in the region of Ashgabat, and their stomachs contained 5 to 42 g plant material. Shammakov (1981) reported the diet to consist of 13 plant species. At places where tortoises occur in large numbers, they are regarded as agricultural pests. Mambetzhumayev (1972) at Amudarya and the Kyzylkum, and Solomatin (1973) believed *A. horsfieldi* to be a competitor of wild and domesticated herbivores.

Aside from plant material, tortoises consume invertebrate prey as well. Shammakov (1981) found a mouse in the stomach of one specimen from the Kopet-Dag. Chernov (1959) discovered beetles, locusts, and ants in the stomachs of tortoises from Tadzhikistan. In our study area, we have observed this species to feed on vertebrate prey as well, though only occasionally. On 2 May 1962 at Lekger Well (Karabil') we observed adult tortoises consuming dead Afghan mice. At the same site, one tortoise consumed a dead wheatear thrush a month later.

Hibernation. — In the Central Asian tortoise, aestivation is followed by hibernation. Aestivation starts in the middle of June, and hibernation ends in March. The passive period lasts for 9 to 9.5 months. (Ataev, 1977a, 1977b). In winter, tortoises hibernate in rodent and hedgehog burrows, which are located 20 to 50 cm below the surface (mean = 37.5 cm). They burrow themselves with the head first, and hibernate with their extremities and head retracted. At hibernation sites soil temperature was 5–10°C in winter months, and body temperature 5.6–10.8°C. Tortoises are often associated with lizards in their burrows. On 26 November 1963 at Nis Fort a *Mabuya* and a *Lacerta* were found at 15 cm from the entrance. In the Kenimekhsk Desert (Uzbekistan) Zakhidov (1938) found hibernation burrows as deep as 45–52 cm.

Predation and Mortality. — Several species of raptors including the golden eagle, bearded vulture, kite, black vulture, eagle owl, Egyptian vulture, griffon vulture, and buzzards, ravens, foxes, wolves, and jackals feed on tortoises (M. Bogdanov, 1882; Zarudnii, 1896; Nikol'skii, 1902; Kashkarov, 1932; Dement'ev et al., 1953; Dubinin, 1954; Shcherbina, 1958; O. Bogdanov, 1960). Monitor lizards often prey on juveniles and eggs (Nikol'skii, 1902; Zakhidov, 1938; Sergeev and Isakov, 1941; Laptev, 1945; Polyakov, 1946; Rustamov, 1956; Shammakov, 1966; Said-Aliev, 1979). At Shikhmoll Well (Karabil') we have seen a monitor lizard holding a young female between its jaws (7 May 1962). In Nuratau and Saikhan (Uzbekistan), the cobra and the viper consume tortoises (Bogdanov, 1965).

Specimens hibernating in burrows that are too shallow often awake and die from the cold. An immature female lying at 19 cm depth died just one meter from its burrow on 6 February 1971. Sometimes, heavy storms can kill tortoises. On 3 May 1962 following an icy storm one individual was found dead in an area of 2 ha in the Lekger area, Karabil'. Traffic also decimates tortoises. Between April 1969 and May 1971, 21 tortoises were found dead along 525 km of

asphalt roads in Ashgabat and Badkhyz. It is thus obvious that the carapace of the tortoise does not sufficiently protect it from enemies, though with time the number of individuals dying as a result of enemy attack decreases.

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