

TRANSLATIONS

Editorial Introduction

The following paper on tortoises in Bulgaria by Vladimir A. Beshkov was originally published in the Bulgarian Academy of Sciences in 1984. Despite its being nine years old, we have published it for three reasons: because few tortoise biologists are fluent in Bulgarian; because the paper is an important and unusually thorough one; and because the study utilized a technique that may well be applicable to other countries undertaking nation-wide tortoise surveys. The use of widespread standardized questionnaire data with follow-up site visits and transects in a selected sample of localities makes it possible to obtain data, not only on the current relative abundance of tortoises, but also on past abundance, at least within human lifetimes. The methodology would obviously be of more limited applicability in areas where tortoises were highly cryptic or lived in burrows, or where human habitation was scant or absent, or where there was a need to differentiate between very similar species of tortoises.

The translation project derived from a meeting between James R. Buskirk and the author, Vladimir A. Beshkov, in May, 1991, at which Dr. Beshkov expressed interest in bringing his paper before a wider audience. Buskirk arranged for a Bulgarian-English professional translator to prepare a literal translation, and this was then reworked by Buskirk, with input from David Jameson and Peter Pritchard to produce the version published here.

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On the Distribution, Relative Abundance and Protection of Tortoises in Bulgaria

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Translation arranged by JAMES R. BUSKIRK

ABSTRACT. – The present day distribution and relative abundance of tortoises (*Testudo graeca iberica* and *Testudo hermanni*) in Bulgaria are shown in Fig. 1 and the regions where they were exterminated recently in Fig. 4. The ubiquitous reduction in tortoises' abundance is due to intensified agriculture, alterations in low-rise forests that are turned into pastures, coniferous forests, etc., and not so much to the effects of large industries, urbanization and direct consumption by people, the latter occurring mostly in Plovdiv and its vicinity. During 1945 through 1959 tortoises were being collected mostly in the eastern part of the country where they used to be abundant. During 1960 through 1969 deliveries from this part diminished while deliveries from western Bulgaria started growing steadily until 1979. In some areas particularly in northwestern Bulgaria and the Eastern Rhodopes juveniles are being consumed by wild boars, thus reducing the total abundance. The protection of tortoises should be intensified by raising public awareness of their status as protected animals (under ordinance 128/1981 by the State Committee on Environmental Protection) and discontinuing illegal collection by poachers and tourists.

Accelerated economic development in Bulgaria, and in particular the introduction of intensive agriculture in recent decades, has caused substantial alteration of both lowland and upland habitats in the country. This has resulted in negative impacts upon the distribution and abundance of most species of Bulgarian fauna. Among the forms affected are the two tortoise species, *Testudo hermanni* Gmelin and *Testudo graeca iberica* Pallas. The collection of tortoises for food has also contributed to the rapid decline of populations in some areas and their total disappearance in others.

This study was conducted jointly by the National Committee for Nature Conservation and the former National Council of the Fatherland Front. Its aim was to determine the distribution and the past and present status of tortoise popu-

lations throughout the country, to investigate reasons for local decline or disappearance of tortoises, and to propose scientifically sound conservation measures.

METHODS

The data for this study were obtained by means of questionnaires distributed to all communities throughout Bulgaria (with the exception of scattered villages with fewer than 20 inhabitants). The questionnaires, explaining the purpose of the survey and the importance of responding, solicited data pertaining to the tortoises only from the territory surrounding the specific community (town or village) surveyed. The survey was conducted between late

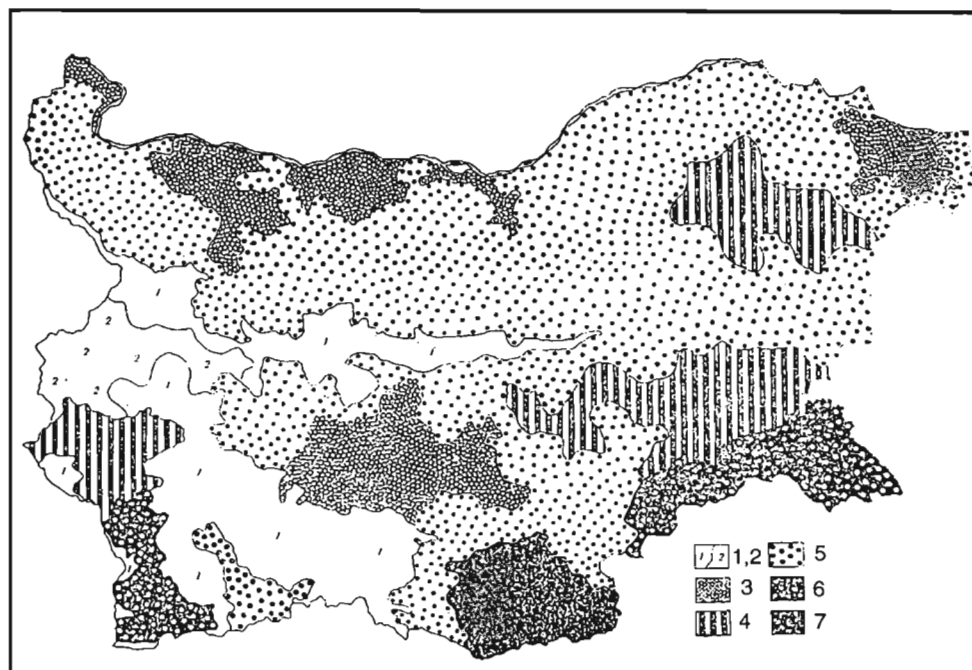


Figure 1. Distribution of tortoises in Bulgaria. Region 1, no tortoises in high mountainous plateaus; 2, small isolated populations up to 15-30 years ago; 3, tortoises completely extirpated; 4, low tortoise densities; 5, moderate tortoise densities; 6, relatively undisturbed tortoise populations; 7, high tortoise densities.

1976 and the end of 1979.

The questionnaire technique was selected after consideration of the following: i) Comprehensive field studies on tortoise population densities were not possible, simply because of the sheer magnitude of the task; and ii) The survey method was the only practical method of gathering information about past distribution and abundance of tortoises, and human use of the tortoises during recent decades, including the use of tortoises for food.

The method employed did not differentiate between the two tortoise species, so the data for both are combined. The following considerations justify this approach: both species chiefly occupy the lowlands and are sympatric almost everywhere they occur (Kovachev, 1912; Buresh and Tsonkov, 1933; Beshkov, 1961), and differences in their biology are minor. Moreover, the factors affecting distribution and numbers apply to both species equally. People gathering tortoises for food expressed no preference for one or the other species, so conservation/preservation problems are identical. These sociological considerations dictated our policy of pooling the data for the two species.

Questionnaires were circulated to 4495 settlements, and a total of 3585 responses were received (79.75%). Of these, a total of 57 gave "no answer", or included contradictory data, or were otherwise unusable.

In 1347 cases (65.46%), respondents confirmed the presence of tortoises; the remaining 1238 (34.53%) reported no tortoises. Responses were allocated to one of eight categories, the first four (A, B, C, D), being the negative ones, and the remainder (E, F, G, H) the positive ones [Ed.—The first 8 English letters, A-H, have been substituted for the first 8 Cyrillic letters actually used, as opposed to direct

translations of the original Cyrillic letters]. Category A ("no tortoises around this settlement, either now or in the past") included 786 of the responses (21.96%). Categories B, C, and D were defined as "no tortoises found presently, but occurred here 30, 15, or 5 years ago, respectively". Category B included 109 responses (3.04%); Category C 265 responses (7.39%), and Category D 78 responses (2.17%). Together, 452 responses (12.60%) alluded to tortoises present in the past, but no longer.

Tortoise density was estimated in a given territory by means of the question "how many tortoises would you find if you went out on a spring day in the best tortoise area?", responses being classified as a) probably none; b) up to 2 specimens (607 responses, 16.93%); c) between 3 and 10 (1038 responses, 28.95%); d) between 11 and 25 (397 responses; 11.07%); and e) more than 25 (305 responses; 8.50%).

The information obtained was plotted on a black and white map of Bulgaria with a scale of 1:300,000, with the rivers, settlements, and boundaries of adjacent territories indicated. All territories giving the same category of response were denoted in the same color. In the resulting mosaic, territories of a given color (i.e., a given range of tortoise densities) were clearly grouped, allowing conclusions to be drawn about the relative density of tortoises over wider areas. Data processing and map preparation were ably assisted by B. Vassilev, L. Stanimirova, B. Grigorov, and G. Petrova, to whom I extend my gratitude.

In order to establish an index to the reliability of the data obtained in the questionnaires, we personally surveyed tortoises in 111 settlement territories - 9 in the Danubian Plain, 18 in the Balkan Range region, 50 in the Thracian

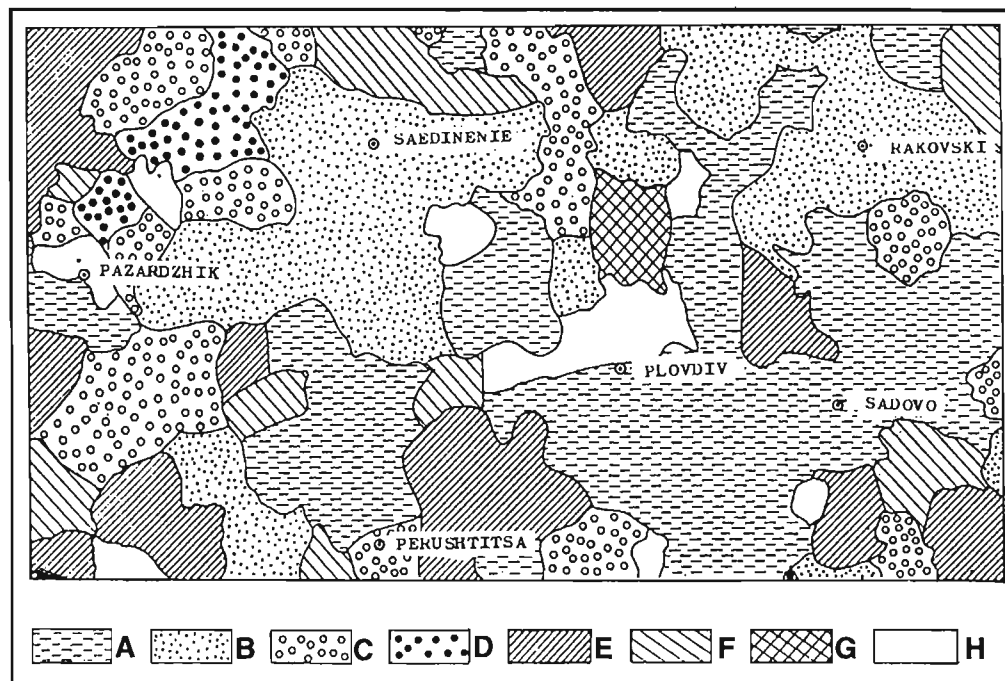


Figure 2. Distribution and relative numbers of tortoises in the central part of the Upper Thracian Plain. A = "No known tortoises at present or before" territories; B = "Tortoises known up to 30 years ago"; C = "Tortoises known up to 15 years ago"; D = "Tortoises known up to 5 years ago"; E = Territories with up to 2 tortoises per day trip; F = Territories where between 3-10 tortoises can be seen per day trip; G = Territories where between 11-25 tortoises observed per day trip; H = Territories with no data on tortoises.

Plain and Sredna Gora region, and 34 in the region of Rila and the Rhodopes.

In the 19 Category A settlements we visited, multiple interviews confirmed the numbers obtained by the survey. In settlements of Categories B, C, and D (12 settlements), we established, through interviews, the time of the disappearance of the last tortoises, as remembered by local people. In 10 of the settlements most of the people interviewed confirmed the survey reports, while in 12 we found the survey findings to be inaccurate. As regards settlements that fell into Category E, we found that the majority of our local interviewees confirmed the survey data in 27 out of 29 settlements visited.

We were not able to obtain such ground truth data in even a sample of communities in all of the categories defined above. Twenty-three settlements in Category F were visited, and transects were walked through ten of these areas, following routes through the areas that the local people considered to have the largest tortoise populations. These field observations and transects were conducted only on warm, sunny days between April and August. The terrain was patrolled for periods of 4-6 hours, at an average speed of 4 km/hr, counting all tortoises seen. The numbers seen were converted to 10-hour equivalents by multiplication by a factor ranging from 2.5 (for a 4-hour count) to 1.66 (for a 6-hour count). In eight cases of Category F (3-10 tortoises reported), the number of tortoises we saw confirmed the questionnaire data. In the other 13 villages in this category, we only interviewed local inhabitants. Most persons interviewed gave figures within the range of Category F. Seventeen settlements of Category G were visited, and field transects were conducted in 10 of these; results generally confirmed the

questionnaire data, although 3 were below the lower end of the range. Some of the interviewees believed that the figures given in the questionnaire overstated the number of tortoises that would actually be encountered.

Twelve settlements in Category H were visited, and field transects were conducted in nine of these. In seven cases over 25 tortoises were counted, with fewer than this in the remaining two. The maximum seen was 19 tortoises in a four hour period (extrapolated to 47-48 tortoises per 10-hour period). Many of those interviewed again felt that the numbers in the questionnaires were either exaggerated or represented past rather than present abundance.

The percentage of confirmed responses was highest in the first five categories (93.34% of responses). The confirmed percentage was smaller (80%) in Category F, and also in Category G (77.77%). Imprecise responses were generally not seriously wrong, and at worst the "right" answer, as established by field transects, fell into a category adjacent to that reported in the questionnaire.

We found that numbers of tortoises tended to be exaggerated in settlements with relatively high numbers of tortoises (Categories G and H). We did not "correct" the data obtained from the questionnaires, but only used our own survey data to get an idea of the overall reliability of the questionnaire responses.

Information on the causes of the decline or disappearance of tortoises in a given region was elucidated by means of questions phrased as follows: 1. If tortoise numbers have decreased around your village, which of the following alternatives is the cause, in your opinion: a) Collection by local people for food; b) Collection by outsiders (vacationers, tourists, soldiers, etc.); c) Mortality as a result of use of

modern agricultural machinery; d) Use of pesticides and herbicides in agriculture; e) Urban expansion and construction of summer cottages; f) Proximity of large industrial plants and construction sites; g) Other. 2. Do local people eat tortoise meat and eggs? a) No; b) Rarely; c) Frequently. 3. Have tortoises been gathered from the area around your village? When? 4. Is tortoise meat served in restaurants in your village?

When positive responses were obtained, a second survey attempted to determine quantities of tortoises collected, who was collecting them, and their destination. Out of 210 questionnaires distributed, 139 responses (60.19%) were obtained. Data about causes of decline and disappearance had to be rejected in 55 cases (1.53%) as a result of clear internal contradictions between the various answers given.

RESULTS

Distribution and relative numbers of tortoises in Bulgaria

Current distribution of tortoises in Bulgaria is given in Fig. 1. The absence of tortoises from the high plateaus and mountains of western Bulgaria (Fig. 1, areas 1-2) is a result of the harsh climate. The outlines of this region coincide with the "Mountainous" climatic region and the "South Bulgarian Moderate Continental" climatic region as defined by Dimitrov (1973). The highest locations are in the southwestern part of the country. *Testudo hermanni* has been reported at altitudes of up to 1400 m on the northern slopes of Belasitsa, and up to 1050 m on the northwest slopes of Slavyanka (Buresh and Tsonkov, 1933). On southwest facing slopes above the village of Vlahi (Blagoevgrad District), both species have been observed at altitudes of up to 1300 m (Beshkov, 1961).

In the areas indicated with the figure "2" in Fig. 1, small, isolated tortoise populations existed up to 15-30 years ago; these include the villages of Chepurlintsi, Kalotina, Tuden, Gradets, Kremikovtsi, Lozen, the Kourilo quarter (Novi Iskar), Sofia District, Vidritsa and Meshtitsa (Pernik District), and others. In regions indicated with a "1" or a "2", there were 572 communities responding to the questionnaire.

Tortoises have reportedly been completely eliminated in the regions indicated with a "3." These are generally low-lying areas with little relief (Daneva, 1973), with intensive agriculture, and with a total of 358 settlements. In the territories corresponding to 288 of these communities, no tortoises remain (Category A - 124 villages; Category B - 45 villages; Category C - 94 villages; Category D - 25 settlements). We assume that tortoises were eliminated on lands in Category A at a time preceding the earliest memories of the current inhabitants.

A case in point is the center of the Upper Thracian Plain, a flat, densely inhabited area with a high percentage of arable land, and intensive agriculture for centuries (Fig. 2). The mosaic of territories includes examples from all four of the

"negative" categories (A to D). We anticipate that, if the rate of destruction of tortoise population continues, territories in categories E, F, and G will progressively become allocable to the negative categories A to D and the latter, as the years pass or memory recedes, will progressively shift from categories B, C, and D to category A.

Tortoises used to be abundant in the plains between the Balkans (Stara Planina) and the Sredna Gora Mountains, as is confirmed by the travelogue of Irchek (1899) that includes the passage "a traveller arriving from the north will be surprised by the great numbers of tortoises (*Testudo graeca*) that will be seen. These have convex shells, with a pattern of black and whitish or yellow squares, and two hands in length. These are rare to the north of the Balkans, but quite common in Thrace." Today tortoises are rare in Thrace, and have disappeared altogether in many areas, while even in areas where tortoises are still common, few if any reach a length of "two hands" (45-48 cm). The situation appears to be similar to that in Upper Thrace in all Category A-D territories in the Bulgarian plains.

We found 43 communities to report tortoise populations that fitted the criteria of Category E, 21 fitted Category F, 4 fitted Category G, and 2 fitted Category H. These are probably doomed populations, being isolated and including so few individuals that it would be unlikely that a given individual could survive, find a mate, and reproduce successfully.

464 responses are indicated on the map (Fig. 1) with the symbol "4". For these, no tortoises were reported by 178 communities, the breakdown by category being 44 from

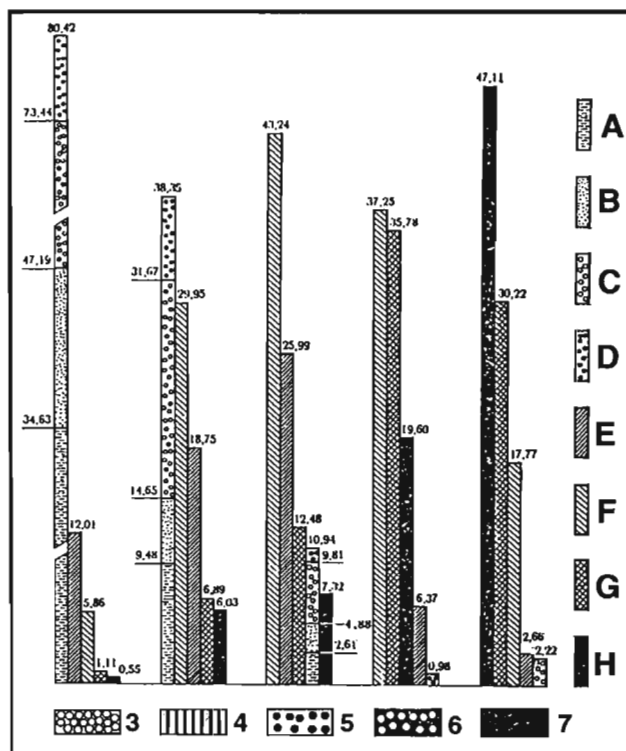


Figure 3. Percentage correlation of survey answers from categories A to H in the regions with tortoises (Fig. 1, areas 3-7).

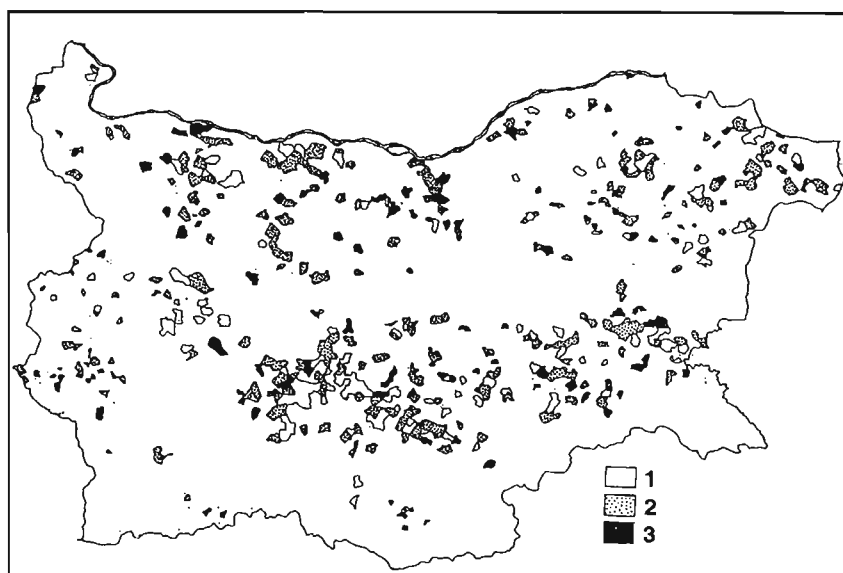


Figure 4. Distribution of territories where tortoise populations were entirely destroyed over the 1946-1949 period (1); ca. 1961-1964 (2); and about 1971-1974 (3).

Category A, 24 from Category B, 79 from Category C, and 31 from Category D. For communities that still reported tortoises, 139 corresponded to Category F, 87 to Category E, 32 to Category G, and 28 to Category H.

Territories denoted by the symbol "5" gave 1962 responses. Today, there are apparently no tortoises in 193 of these territories, distributed as follows: 46 in Category A, 40 in Category B, 87 in Category C, and 20 in Category D. Of the remaining 1569 territories that did report tortoises, most were of Category F (762), followed by Category E (458); Category G (220), and finally Category H (129).

No significant differences were found between the 1254 responses received from north of the Balkan Range (Stara Planina) and the 508 responses from south of the Balkans (Table 1). The low tortoise density in these areas is a cause for concern, in that no fewer than 36.93% of the territories reported no tortoises or only a few (Categories A to E), while high numbers (Categories G and H) were reported by only 19.80%.

Many more tortoises occur in the upland and mountain-foothill regions, indicated with a "6". A total of 204 responses was received from such areas (119 from the Struma River region and 85 from the Strandzha region). Category F included the most responses (76), followed by Category G (73), Category H (40), Category E (13), and Category D (2). Tortoise populations in these areas have been relatively unaffected, in that human alteration of these habitats started late and has not proceeded far.

Areas denoted with a "7" - the eastern Rhodope mountains and certain regions of Thrace - have the largest tortoise populations. Responses were received from 225 communities in these areas, characterized by hills and low mountains, with marked microrelief and transitional vegetation (Bondev et al., 1973). Negative responses (Category C) were received from only 5 communities. Among the positive responses, most (106) corresponded to Category H, with 68 in Category G, 40 in Category F, and 2 in Category E.

The relatively intact tortoise populations here can be attributed to several factors, including the prevailing natural conditions, the low-impact modes of agriculture, and specifically to Ordinance No. 1578 of the General Directorate of Forestry (1970), that prohibits the taking of tortoises in Haskovo and Kardzhali Districts.

Figure 3 shows the percentage of responses in Categories A to H in regions where tortoises occur; the data are arranged in ascending order of numbers of tortoises reported. Negative responses are presented with similar shading. The major differences in the pattern of responses in the various categories reflect the uneven distribution of the populations and the considerable variation in tortoise densities, a result of the complex interplay between the tortoises, alteration of their habitat by man, and other anthropogenic activities, past and present.

It may be seen from Fig. 4 that the areas from which tortoises have been entirely eliminated during the preceding three decades (i.e. Categories B, C, D, and A) are largely located in the intensively farmed plains, but some correspond to open-canopy hilly areas in the high plains of western Bulgaria (Figs. 1 and 2), where isolated small tortoise populations once existed. Exactly why these tortoises have disappeared is unclear, but there is no question that human agency is to blame. It was reported that tortoises disappeared about 30 years earlier (i.e. 1946-49) in 3.04% of the responding territories, about 15 years earlier in 7.39%, and about five years ago in 2.17%. Tortoise populations were reported to have declined (without stated cause) in the territories of 211 responding communities (5.88%) scattered throughout the nation.

Causes of Decline and Disappearance of Tortoises

Overall, reduction or extirpation of tortoise populations in Bulgaria can be attributed to a complex set of causes that fall into the categories of either habitat alteration or direct

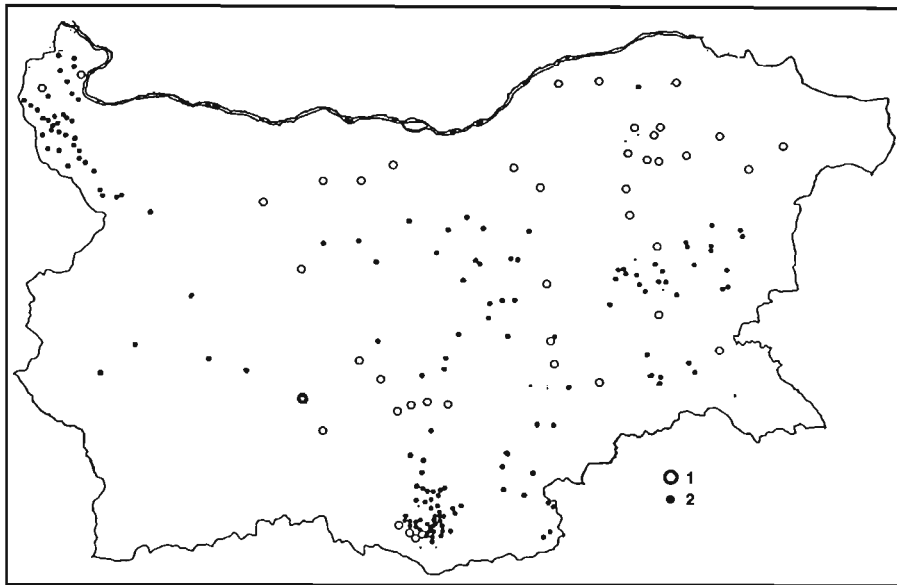


Figure 5. Distribution of answers, giving causes for the fall of numbers of tortoises: (1) the cutting of forests and shrubbery; and (2) being eaten by wild boar.

impact (e.g., by collection).

Various forms of habitat alteration have been implicated. These include the tendency towards large monoculture fields, with the plowing up of the earlier field boundaries; use of heavy agricultural machinery; the plowing of virgin land; and destruction of shrubbery. Only rarely was the creation of an irrigation system cited as a problem. The burning of stubble was also listed on several occasions as a factor that harmed tortoise populations. In 1616 responses, the use of chemical fertilizer was cited as a cause of the decline of tortoise populations, although no concrete examples were given; we visited 73 communities that made this observation, but again found no unequivocal evidence that tortoise populations had been reduced by poisoning. It appears that the impact of pesticides and fertilizers was widely assumed, probably by extension of the known effect upon other animal species, but no data were ever presented to demonstrate the effect of pesticides or herbicides on tortoise fecundity or egg mortality, so we eliminated this factor from further discussion.

Secondary stresses on tortoises, also contributing to their decline or disappearance, were attributed to: i) the clearing of shrubbery or scrub vegetation in favor of clear monocultural sites (coniferous tree plantations, agricultural land, and pastures), as indicated in Figure 5; ii) the proximity of major construction projects or industrial undertakings (cited by 55 respondents, especially those close to Zlatna Panega, Eliseina, Devnya, Dimitrovgrad, Radnevo, the Madan mining basin in the Rhodopes, and elsewhere); and iii) the establishment of holiday villages and the expansion of existing settlements and communities (33 responses listed these factors, 20 of which also cited factors listed under ii), above. The remainder came from villages close to district centers).

Among the direct causes of reduction of tortoises, the greatest problem was the gathering of tortoises for human

consumption. Up to the time of World War I, cheloniophagy in Bulgaria was largely restricted to the city of Plovdiv and surrounding communities. Collection of tortoises subsequently became especially intensive during 1941-44, when they were exported to Germany, and with large numbers also sent to private restaurants in the interior of Bulgaria. The Mayor of the town of Chukarevo (Yambol District), estimated that 90% of all tortoises in the vicinity of this community were collected between 1941 and 1944, while the Mayor of Drama, Yambol District reported that, in 1942-43, traders from Plovdiv gathered tortoises in the area so intensively that they reduced populations from a level where 30 to 50 could be found in one day to the current level of perhaps 2-3 per day.

The distribution of cheloniophagy in Bulgaria today is illustrated in Fig. 6. The territory of the country is divided into squares measuring 20' by 20' of longitude and latitude. In each square the intensity of cheloniophagy is indicated by a pie diagram divided into sections corresponding to the three possible responses "no tortoise consumption", "rare tortoise consumption", and "frequent tortoise consumption".

Tortoise eating was found to be affected both by local availability of tortoises and by community traditions. Cheloniophagy was generally unknown or rare in those areas where no tortoises were found. It was rare in the plains of northern Bulgaria, where the local tortoise populations have been eliminated. A correlation was found between areas of high tortoise populations and the practice of cheloniophagy, e.g., in the eastern part of the Balkan foothills, Stara Planina, the eastern Rhodope Mountains, Svilengrad, and Strandzha. On the other hand, in the Thracian plain (Pasardzik, Plovdiv, and Stara Zagora Districts), cheloniophagy was made possible by tortoise supplies from distant areas of Bulgaria. Fig. 7 shows the centers of both collection and consumption of tortoises during the period

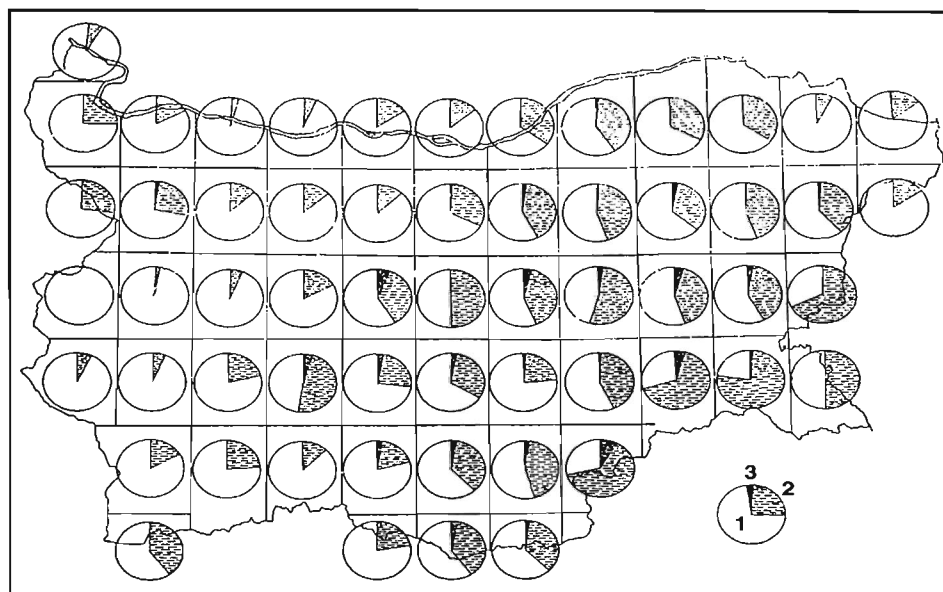


Figure 6. Distribution of cheloniophagy in Bulgaria. Percentage of correlation to answers to the question "Do the inhabitants of your village or town consume tortoise meat and eggs? 1 - No; 2 - some, rarely; 3 - frequently.

1945-1959.

A major center for tortoise consumption was the city of Plovdiv, including neighboring towns such as Rakovsky, where up to 98% of the inhabitants consumed tortoises quite frequently, according to information received by the Mayor in 1977. Tortoises were also brought to restaurants in Sofia, Varna, Burgas, and Pazardzhik, etc. These were collected primarily in eastern Bulgaria, where tortoises were still abundant during the period in question. During the 1960's, tortoise populations were greatly reduced by over-collecting in eastern Bulgaria, and collection pressure shifted to the southwest and northwest of the country (Fig. 8).

During the 1970's, most tortoises were gathered in the Districts of Vidin, Michailovgrad, and Blagoevgrad - the least accessible regions, still with good numbers of tortoises. Interestingly, there was a negative correlation between tortoise abundance and cheloniophagy in the districts of Kjustendil and Blagoevgrad (with the exception of the extreme southwest of the latter). Tortoises were still abundant in these areas, but there was no local tradition of cheloniophagy, and indeed there was considerable prejudice against the practice.

Interviews conducted with several hundred random Bulgarian citizens indicated that about 35-40% of Bulgarians have consumed tortoises, the commonest positive response being from males who had tasted tortoise meat on a single occasion during their national service.

Tortoises collected are usually the larger ones (14-18 cm in carapace length, usually 14-15 cm), these being easier to spot. Thus, in areas that have been heavily collected over the past 5-10 years, most of the surviving tortoises are small (5-10 cm) with only a few of medium size (10-18 cm). Such tortoises are either immature or in their first years of maturity. Bannikov (1951) found that maturity in Caucasus *Testudo graeca* occurs at 12-14 years of age, when the carapace is 16-18 cm in length.

Thus, in Petrich and the Sandanski Plain and the foothills of the Malashevsk Mountains, the Ograzhden Mountains, Pirin, and Belasitsa, intensive tortoise gathering during the 1970's has resulted in there being no tortoises left with carapace lengths over 20 cm, although tortoises of this size do still occur near the altitudinal limit of the species in the mountains listed, i.e., along the forested and shrub belts between 900 and 1300-1400 m, where tortoises have not been gathered because of their remoteness and intrinsically low population density. In such localities in the Malashevsk Mountains we found *Testudo hermanni* up to 34.6 cm in length, and *Testudo graeca* up to 28.5 cm [Transl.—The sizes indicated appear to be erroneously transposed].

During the past two decades, there has been increasing use of the blood, meat, eggs, and other tortoise products for supposed "cures" for cancer and leukemia. In many cases, tens or even hundreds of tortoises were gathered by the relatives of patients or by their "doctors." In addition, along the Black Sea coast and in some interior areas (including Melnik), tortoises have declined as a result of the subadults being gathered for sale as pets to both national and foreign tourists and vacationers. Elsewhere (for example at the village of Kran, in Kardzhali District), tortoises have been utilized for such souvenirs as lamps and ash trays, a practice that continues. Furthermore, military units continue to utilize tortoises as food, especially during summer camp operations.

Another factor constituting an increasing stress upon tortoises in Bulgaria is their predation by wild boar, whose numbers have been increasing throughout the country in recent decades (Fig. 5). For example, we have heard from the villages of Rabisha (Vidin District) and Daskotna (Burgas District) that tortoises have become scarce through boar predation in these areas, and may be on their way to extirpation. In conversations with local people in these villages, we learned that tortoise predation by boars had been observed

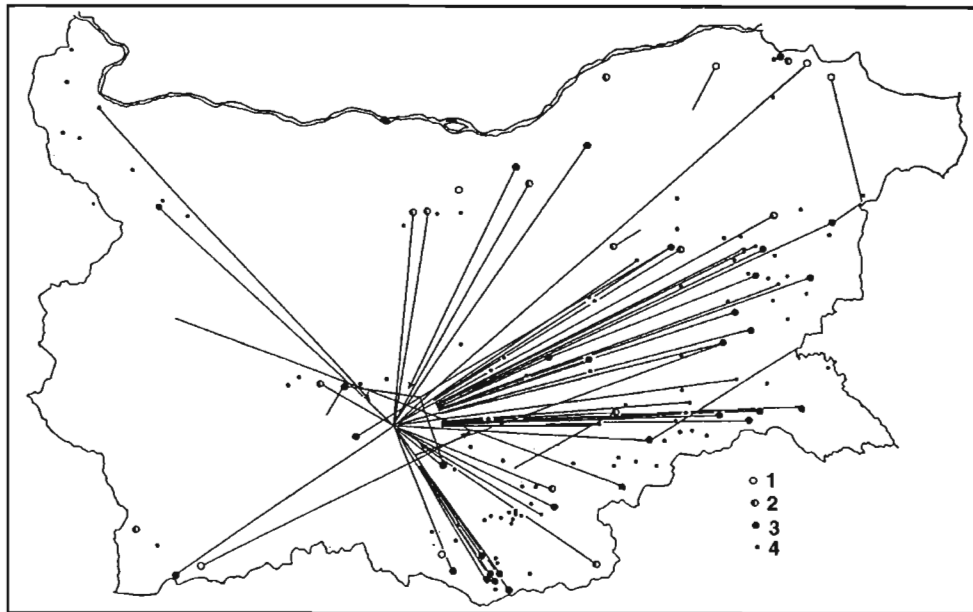


Figure 7. Locations where tortoises were gathered, direction and transportation to consumption centers, 1945-1959. 1 - up to 200 specimens; 2 - between 200 and 2000 specimens; 3 - above 2000; 4 - unknown quantities.

on many occasions, the predation being most intense upon tortoises in the 10-12 cm range. Tortoise predation by boar in winter (especially late winter) has also been reported from the village of Gorna Louka (Michailovgrad District). It occurs typically in areas with high populations of both boar and tortoises, and sets in when there is an overall shortage of other kinds of food.

Other natural predators are probably insignificant, according to both the questionnaire data and our own field work. Eagles and vultures may take some tortoises, but both are rare in Bulgaria, and their impact is probably limited to tortoises in the immediate vicinity of the nests. We did observe the remains of 95 tortoises, some obviously eaten

only 1-2 days earlier, on 10 June and 22 July 1982 on rocks below or adjacent to the nest of an eagle (*Aquila chrysaetos*) in the southern part of the Kresna Gorge. Only seven respondents implicated eagles and vultures as a factor in the reduction of tortoise populations (four from Burgas, two from Blagoevgrad, one from Gabrovo District). Others (13 respondents, 0.36% of the total) mentioned crows, ravens, weasels, foxes, and jackals as predators upon tortoise eggs and small tortoises.

Figure 10 represents, in histogram form, the frequency of the different reported causes of tortoise decline and disappearance, in areas of different overall tortoise population density. Percentages are referred to the total number

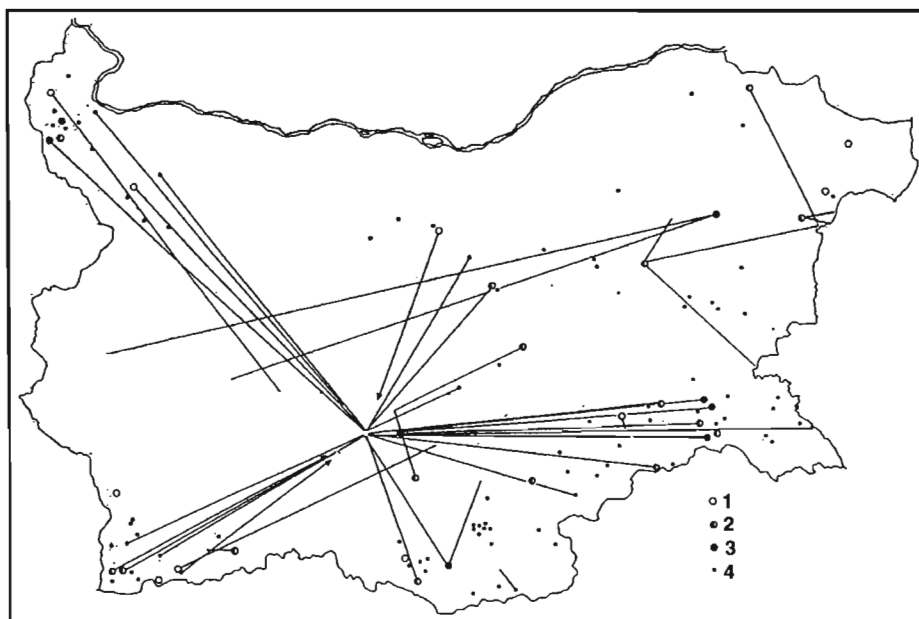


Figure 8. Locations where tortoises were gathered, direction and transportation to consumption centers, 1960-1969. 1 - up to 200 specimens; 2 - between 200 and 2000 specimens; 3 - above 2000; 4 - unknown quantities.

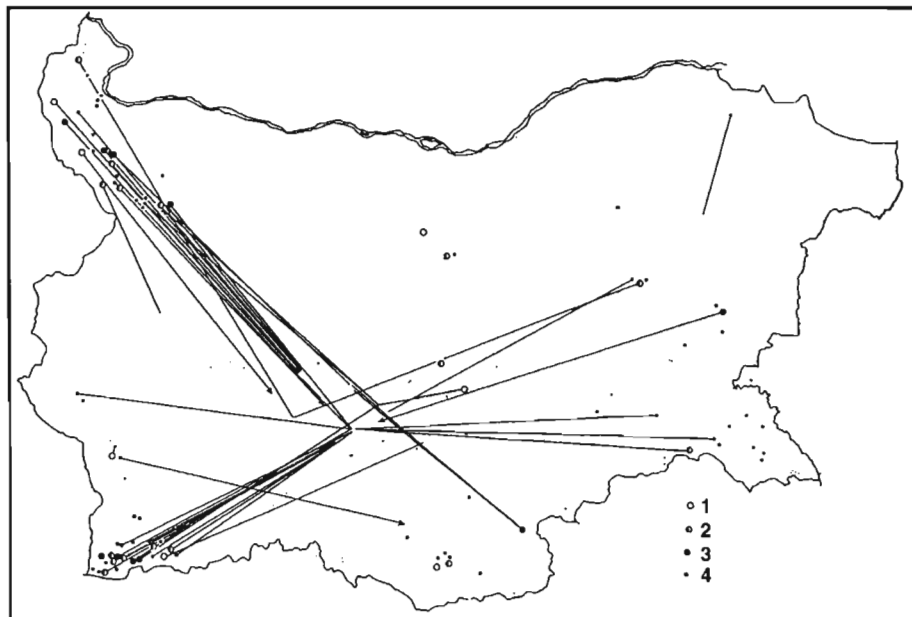


Figure 9. Locations where tortoises were gathered, direction and transportation to consumption centers, 1970-1979. 1 - up to 200 specimens; 2 - between 200 and 2000 specimens; 3 - above 2000; 4 - unknown quantities.

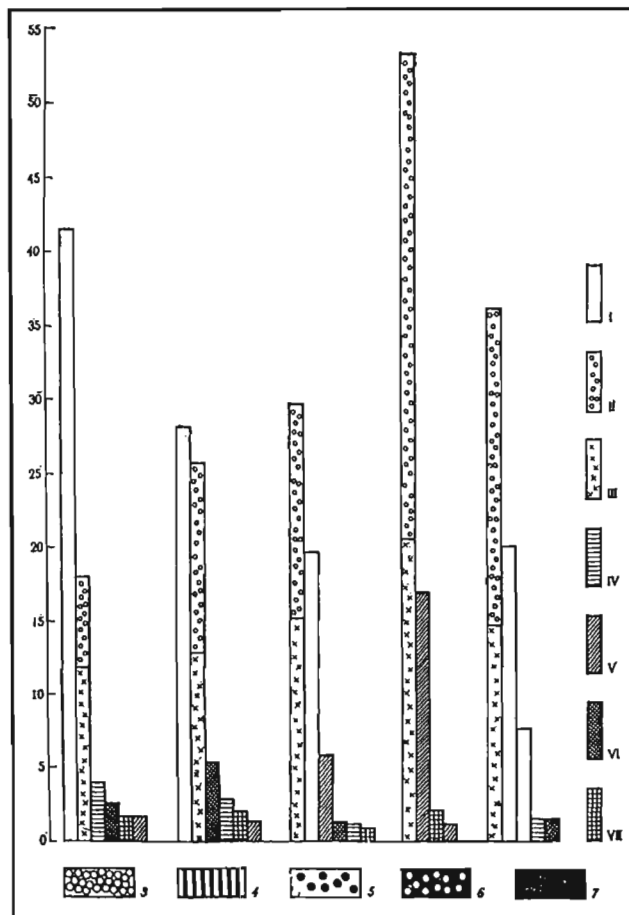


Figure 10. Frequency of survey answers on the causes for decline and disappearance of tortoises in regions with different population densities. I - Introduction of modern methods; II - Gathering from people not from area; III - Gathering from local people; IV - felling of forests and shrubbery; V - Eaten by wild boars; VI - Proximity of major industrial sites; VII - Expansion of settlement areas, cottage zones; see also Fig. 1.

of responding communities that indicated that tortoises are or were present in their territories. Figure 10 yields the following conclusions: 1) In the plains and low-lying areas with little vertical relief, tortoises have been severely reduced by contemporary agricultural practices and habitat alteration. This impact declines gradually as one ascends into the foothills, and is least in the low mountains of the eastern Rhodope, where the rugged terrain, limited arable land, and restricted variety of crops (mainly tobacco) combine to reduce the utilization of modern, intensive agriculture practices.

The surviving tortoise populations in the plains and lowlands are small, isolated, and often almost extirpated, and this has now reduced the numbers of tortoises gathered in these areas to a very low level; tortoise collectors, particularly from distant areas, would have little reason to visit these locations. On the other hand, in those areas where tortoises survive in moderate to high density (such as the Struma Valley and the slopes of adjacent mountains; the eastern Rhodopes; Strandzha; and neighboring regions), tortoise collecting continues to be a significant factor in their decline. Such gathering is conducted by collectors from other areas of the country, drawn by the relative abundance of tortoises. Fewer tortoises are collected in the eastern Rhodopes than in Strandzha and the Struma Valley as a result of the above mentioned ban on collecting tortoises in the region of Kardzhali and Haskovo, in force since 1970.

Protection Measures for Bulgarian Tortoises

The rapid declines in the numbers of tortoises and the almost complete extirpation in many places led to the instigation of the year-round prohibition on collection, capture, or destruction of tortoises anywhere in the country, with a fine of 25 leva for each tortoise taken (Ordinance No. 128 of

the Committee for the Protection of the Environment of the Council of Ministers, State Gazette Issue No. 20/10, dated March 1981). This ordinance provides a sound basis for the conservation of tortoises in upland or mountain terrain in that it provides a ban on directed "take." It is much less effective in the plains and lowlands, where the problem is much more one of habitat destruction as a result of the introduction of intensive agriculture. As a result of the ordinance, tortoises are no longer served in restaurants, and large-scale tortoise collection has now ceased in Bulgaria. Action priorities now center upon wide-scale environmental education, with explanation both of the protected status of tortoises and also of the useless and potentially dangerous nature of the utilization of tortoises for folk medicines. Tortoises are known to be hosts for *Salmonella* (Dimov, 1966; Koen and Mateva, 1962), although serious doubts have been expressed regarding their serving as hosts for leptospirosis (Mateev et al., 1961, 1962).

Attention should also be directed towards sanctions for poachers. Frequently, motorists from Plovdiv, Pazardzhik, and the Stara Zagora Region, visiting regions where local people still gather tortoises for medicinal purposes, are guilty of buying tortoises. Customs officials also need to stop the export of live tortoises from Bulgaria.

Finally, predation on tortoises by the increasing wild boar populations in Vidin District, in the western part of Michailovgrad District, the eastern part of Smolyan District, the western part of Kardzhali District, and the eastern Balkans needs to be addressed, and taken into account when quotas for boar culling operations are drawn up.

CONCLUSIONS

Anthropogenic factors have caused decreases in tortoise populations in Bulgaria; especially serious have been the introduction of modern agricultural practices and the collection of tortoises for human consumption. Tortoise populations are most threatened in low-lying and hilly terrain, while they remain closest to primordial population levels in low mountainous terrain with well-developed microrelief, a transitional Mediterranean climatic influence, and the vegetative communities associated with these factors.

The progressive disappearance of tortoises from lowland and plains commences with the formation of a mosaic of areas from which the tortoises have been extirpated. These regions gradually grow and merge, producing ever-larger blocks of vacated territory. Destruction reached its peak during the early 1960's, and the regions of widespread cheloniophagy generally coincide with the regions of highest tortoise numbers. Major centers of tortoise consumption included Plovdiv and adjacent towns. During the second half of the 1940's and the 1950's tortoises were supplied for consumption chiefly from the eastern part of the country. When these resources were depleted or exhausted in the 1970's, supplies came mainly from northwestern and southwestern Bulgaria. Such tortoise collection impacted most

heavily upon medium to large specimens, and now, in such areas, the surviving population is still composed mostly of small tortoises. The restoration of a normal age distribution in such populations will take several decades. Of the natural enemies of tortoises, only wild boar constitute a serious threat, and chiefly in northwestern Bulgaria and the eastern Rhodopes.

Urgent measures are necessary for the protection of Bulgarian tortoises. Such measures must include widespread promulgation of information about Ordinance No. 128/1981 of the Committee for Environmental Protection of the Council of Ministers, with its complete, year-round prohibition on the gathering of tortoises throughout Bulgaria; strict enforcement of anti-poaching legislation; education of the public about the ineffectiveness of folk medicines derived from tortoises; control of export of tortoises by foreigners; and culling wild boar populations in areas where their predation upon tortoises is intense.

We envisage no effective means of restoring tortoises to the plains areas, where habitat alteration by conversion to agricultural lands has resulted in the destruction of tortoise populations.

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