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RESEARCHES ON THE POPULATION DENSITY AND STRUCTURE IN TRITURUS MONTANDONI (BOUL.) DURING THE PERIOD OF REPRODUCTIVE AGGREGATION IN THE EASTERN AND NORTHERN CARPATHIANS MOUNTAINS.

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HISTORY. The Carpathian newt *(Triturus montandoni)* is generally considered by the herpetologists as a Carpathian endemism.

There are poor references about its ecology: Fuhn (1939, 1960), Gulicka (1954), Mehély (1893).

The population density and structure were not so far investigated in the Carpathian newt.

This paper has the purpose to contribute to the knowledge of some ecological aspects concerning the population density and structure, following a three years study of an abundant material.

MATERIAL AND METHOD

a. *Material*

The investigated material was collected from 7 biotopes in the Eastern Carpathians and one in the northern Carpathians (Kürov) during the 1968-1970 period (Fig. 1).

All the specimens were collected in swamps. The following material was examined.

3350 individuals were used for histogram performing.

723 individuals labelled in mai 1970 in five different places were tracked in Iune and July of the same year.

b. *Method*

The collected specimens were preserved in a 70^0 alcohol solution supplemented by 5 cm/l formol.

Since a morphological method for the age determination is lacking, we made histograms representing the body lenght (Fig. 2, a, b).

The measurements were made after 1 to 3 months of preservation.

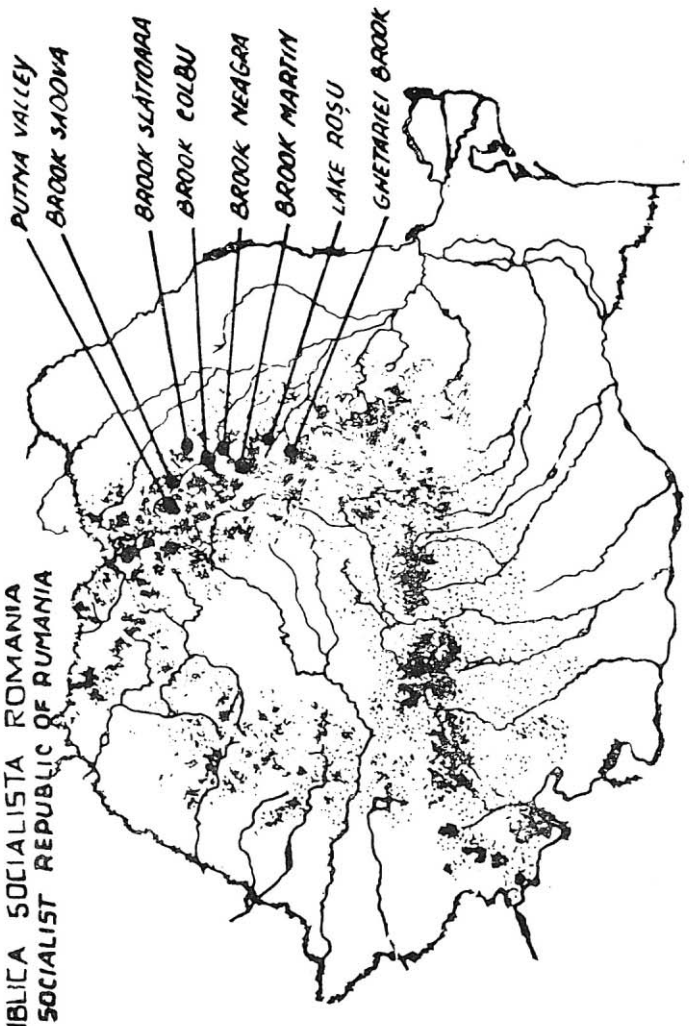

Fig. 1. The collecting biotopes of *Triturus montandoni* in the Easten Carpathians.

The data obtained from the labelled and recaptured animals were marked up according to a formula developed and verified by Dreux (1963) :

$$N = \frac{nP}{a}$$

where :

N = the population strenght
n = the number of labelled individuals
P = the number of individuals which were recaptured after being recaptured.

POPULATION STRENGHT AND DENSITY

In the herpetological literature there is very little knowledge on the Carpathian newt population strenght.

Gulicka (1954) found in a swamp of Belanska Tatra (1500 m height) having a lenght of 20 m, a width of 8 m and a depth of 40-50 cm, a number of 1000 newts, among which 2/3 were Alpine *(T. alpestris)* and 1/3 Carpathian *(T. montandoni).* The population strenght of the Carpathian newt may vary also depending on ecological and anthropological factors.

The observations made by Gulicka during 16 years also show that „the numerical dynamics of the Carpathian newts in varions years is balanced, withont showing any conspicuous increase or decrease" (p. 553). The author states hoewer that certain numerical diminutions may occur in the droughty years when snow is scarce and „many newts do migrate in moist forest places".

Urban (1935) found a population of *T. montandoni* near Odergebirge (Germany), which at the beginning of the century had a very high strength, but after three decades the same population was extremely small. Urban gives no additional data on the precise strength of this population.

The swamp size cannot be a true indication for a density evaluation, since the newts prefer areas of stagnant water and rich vegetation.

During Mai the mountain swamp vegetation is poorly developed. The Carpathian newts often perform their pairing plays in the puddles generated by the snow melting. By measuring up the water depth where the newt population takes place, we could demonstrate that they prefer both in permanent and transitory swamps depths between 5 and 40 cm, which is in agreement with Gulicka s data. The pairing takes place however with the same intensity also in marshes, particularly by raining weather.

Since the biotope description may give a rough indication of the individual density, we should calculate only the surface area and indicate the water depth were the newts are grouping themselves, reporting then these data to the number of captured individuals.

The table No. 1 shows that the calculated density per sq. m. varies between 1 to 1,5 individuals in the century-old forest of Slătioara

and 79 individuals per sq. m. in the brook of Neagra. We may see in the same table that higher densities occur in the Neagra and Colbu brooks, and in the Putna and Sadova valleys.

The data obtained by collecting newts during two successive years in the Lake Roşu (Suhard and Păstrăvărie), are in complete agrement with those of Gulicka as to the density and the preservation of the numerical balance.

The data for greater lakes are however only relative, since the areas which are empty during one year may be populated the following year by neighbour animals.

In order to prevent this source of error, we choosed in the biotopes of Neagra and Colbu brooks and Putna Valley, small swamps or marshes which are 3 to 5 km. away from all other sources of migration for the following years.

In three succesive years (1968, 1969, 1970) we performed there during the same period (10-20. V.) a collection of all individuals, obtaining very high densities.

The table No. 1 shows that in 1969 the density in the area mentioned above has increased as compared to 1968, a conspicuous decrease taking place only in 1970.

For preventing annual collecting errors we totalized the captures made during the three successive years (Table No. 2), finding that during the aquatic life period a great many individuals are assembled on small areas for pairing purposes.

The annual density or that calculated for three years is extremely high as compared to the Gulicka s data, who found 1000 individuals ia a 160 sq. m. swamp (20x8 m) i. e. a density of 6 individuals per one sq. m.

The density stated by Gulicka in the Tatra Mountains is consistent with the lowest densities, observed in the newly developed lakes of the Eastern Carpathians (Lake Roşu-Suhard and Păstrăvărie).

The individuals labelled in 1970 were tracked only in one biotope — the water meadow of Prelunci, Cîmpulung Moldovenesc. *)

A number of 109 individuals (n) were labelled at 12. V. 1970, from which 45 (P) were recaptured at 7. V., 14. VI., and 25. VI. of the same year; 19 among the recaptured animals were labelled (a). According to the formula $N = \frac{nP}{a}$ this population i comprises 258 members, i. e. 32 per sq. m; the relying interval (95%) of this density is situated between 26 and 38 individuals.

This figure indicates an even higher density than that resulting from the Table No. 1, where for the water meadow Prelunci a density of 19 individuals per sq. m. is mentioned.

In the Tatra Montains 2/3 of the population (Gulicka 1954) is composed by *T. alpestris* while in the Eastern Carpathians *T. montandoni* prevails with 80 to 100 per cent in various biotopes.

*) We express on this occasion our gratitnde to Prof. N. Caziuc for his aid in the animal recaptures.

Table No. 1

THE RELATIVE FREQUENCY AND DENSITY OF THE CARPATHIAN NEWT (TRITURUS MONTANDONI) IN THE INVESTIGATED BIOTOPES OF THE EASTERN CARPATHIANS (1968—1970)

No.	Place	Date of the collection	Investigated water area in sq. m.	Water depth in cm.	Nombre of collected specimens			Relative frequency of the species T. montandoni	Nombre of labelled specimens in 1970	Density per. sq. m.	Notes
					T. montandoni	T. cristatus	T. alpestris				
1	L. Roşu (Suhard)	13-V-1969	18	5-80	132	—	16	100%	—	8	Barrage lake
	L. Roşu (Suhard)	9-V-1970	3	5-35	14	—	3	95%	—	6	Barrage lake
2	L. Roşu (Păstrăvărie)	13-V-1969	8	5-40	55	—	14	93%	—	9	Barrage lake
	L. Roşu (Păstrăvărie)	9-V-1970	5	5-45	18	—	25	97%	15	9	Barrage lake
3	Brook Martin (Durău)	17-V-1968	18	5-20	71	—	4	97%	—	4	Swamp and marsh
	Brook Martin (Durău)	9-V-1970	26	5-15	195	—	5	96%	156	8	Swamp and marsh
	Brook Neagra	18-V-1968	6	5-52	289	5	—	100%	—	49	Swamp under a stump
4	Brook Neagra	17-V-1969	5	5-40	393	—	—	100%	—	79	Swamp under a stump
	Brook Neagra	10-V-1970	9	5-10	182	—	—	100%	156	22	Dryed, swamp, marsh
	Brook Colbu	19-V-1968	12	5-40	335	—	24	99%	—	30	Swamp with sawdust
5	Brook Colbu	17-V-1969	10	5-40	418	—	25	87%	—	44	Light polluted sawmp
	Brook Colbu	10-V-1970	5	5-15	120	—	—	100%	12	24	Completely polluted swamp
	Putna Valley	21-V-1968	7	5-30	142	—	5	100%	—	29	Steady swamp
6	Putna Valley	15-V-1969	7	5-30	308	—	8	82%	—	45	Steady swamp
	Putna Valley	11-V-1970	7	5-30	163	—	7	89%	72	24	Steady swamp
	Century old forest Slătioara	22-V-1968	36	5-10	45	—	—	80%	—	1,5	Slow flowing ditch
7	Century old forest Slătioara	15-V-1969	36	3- 8	35	—	—	95%	—	1	Ditch with stagnant water
8	Slătioara swamp 1	17-V-1969	10	5-40	145	—	—	42%	—	14	Transitony swamp
9	Slătioara swamp 2	12-V-1970	12	5-40	190	—	1	97%	100	16	Steady swamp
10	Sadova	12-V-1970	10	5-70	277	6	34	98%	103	19	Barrage lake
11	Water meadow C. Lung Moldovenesc	12-V-1970	8	5-35	149	—	—	100%	109	32	Transitony swamp
	Total				3676	11	172		723		

POPULATION STRUCTURE

For knowing the age structure of the Carpathian newt we made pairs of histograms of seven Eastern Carpathian populations and one population of the Northern Carpathian Mountains (Fig. 22a, b).

Three populations in the Colbu and Neagra brooks and the Putna Valley were studied during three successive years, and other populations in the Lake Roşu, the century-old forest of Slătioara and the Martin (Durău) brook only two successive years.

The material was collected in Mai of each year.

Fig. 2 a, b, shows the age structure depending on a single size character: the body length. The histograms demonstrate that the Carpathian newts are reaching their sexual maturity at various sizes, the females at 71 to 81 mm length and the males at 63 to 75 mm length. On the other hand, the last reproductive individuals disappear at ages varying from one population to another: the females between 90 and 110 mm and the males between 80 and 100 mm.

However, every population maintains invariably the limits of sexual maturity and disappearence from the pairing place in both sexes.

The similarity of the histogram width indicating closely similar frequencies during 1968 and 1969 in Colbu and Neagra brooks and Putna Valley demonstrates that the selective factors have a similar activity in each biotope. The graphs for 1970 are a little modified.

However, the age structure as resulting from the whole length examination show a number of interesting differences in the various populations. These differences did not vary during three successive years in the investigated populations and represent a characteristic feature of these population (e. g. Colbu and Neagra books, Putna Valley).

The differences shown by the histograms (Fig. 2 a, b) are concerning:

1. The reaching of the sexual maturity at different ages. For example, the Neagra brook population reaches the reproduction age at the length of 72 to 75 mm., and the population of the century — old forest Slătioara at 82 to 85 mm. (Fig. 2 a). These differences are present in both sexes (Fig. 2 a, b) as well in nearly situated populations as in those geographically separated.

2. The mean values of the body length are different even in populations of the same hydrographic basin and hence geographically close together e. g. Neagra (88, 10), Colbu (95, 60) see —. Table No. 2.

Such age (length) differences, as well as the reaching of the sexual maturity at different ages (sizes) and the various frequencies of individuals having different sizes, are distinctive characteristics among

populations, since they proceed from the interaction between the environmental and genetic factors, which are different from one population to another and are referred to by Schwartz (1965) as „biotopic variability", The body mean differences and their statistical reliability were demonstrated for *T. montandoni* by Şova (1970).

Selective factors may operate in a similar manner also in biotopes which are geographically very remote. For instance, both sexes in the populations of Kürov (North Carpathian), Gheţăriei brook (Trotuş Valley) and the century-old forest Slătioara (Moldova Valley) have similar histogram forms, a maximum frequency at the same size ranges, and are reaching their sexual maturity at roughly similar sizes.

The individual annual age is not known in any *Triturus* species. The only available information is reported by Wolterstroff and Freytag (1951) who have grown in captivity a *T. montandoni* specimen during 25 years and the hybrids *T. vulgaris* x *T. h. helveticus* 10 years.

In the wild, however, the selection do not promote the great ages. Our histograms show that the specimens with the highest dimensions are more frequent in both sexes only in few populations : in the century-old forest Slătioara, Colbu brook (1970) swamp No. 2 Slătioara, Martin brook (1968).

It is worth noting that in populations where the sexual maturity is reached by smaller sizes (Putna Valley, Neagra and Martin brooks), the persistence of old individuals is less conspicuous than in populations in which the sexual maturity is reached at higher sizes (a more advanced age) : Lake Roşu, century-old forest Slătioara, Colbu brook, Kürov (Fig. 2 a, b).

The selective action resulting in changes within the class dimensions (ages) of different Carpathian newt populations raises new research problems. The future investigations should check up if the change in the age structure (sizes) result in phenogenetic changes.

Conclusions

1. The Eastern Carpathian newt populations reach their sexual maturity at various sizes.

2. The size at which both sexes reach their sexual maturity is constant within each population.

3. The occurence of geographically close populations but differing by their body sizes (statistically reliable) and their maturing speed, demonstrate that these forms are reflecting the biotopic variability.

4. The various frequencies of the age classes depending on the biotope and the reaching of sexual maturity at different sizes, as well as the metric body variability in various biotopes, speak in favour of a phenogenetic diversity in the Eastern Carpathians populations.

5. The Carpathian newt shows the higest density during the reproductive aggregation period in the swamps and marshes within the brooks of Neagra, Colbu and Putna Valley.

6. The whole individual collection during three successive years (1968-1970) in the biotopes Neagra and Colbu brooks and Putna Valley show a relatively constant numerical level as compared to the nature of the biotope concerned.

At the same time it may be stated that the population uses at the highest degree the local ecological conditions, by achieving the whole reproductive capacity of the species in the respective stage.

7. The very low percentage (O to 20 per cent) of *T. alpestris* and the lacking of *T. cristatus* in some biotopes indicate that there is no interspecific competition, this being probably a reason for the increasing density of *T. montandoni* in these biotopes.

CERCETĂRI ASUPRA DENSITĂŢII ŞI STRUCTURII POPULAŢIILOR DE *TRITURUS MONTANDONI* (BOUL.) ÎN PERIOADA DE AGREGARE REPRODUCTIVĂ DIN CARPAŢII ORIENTALI ŞI NORDICI

Rezumat

1. Populaţiile de solomîzdre carpatice din Carpaţii Orientali şi Nordici ating vîrsta sexuală la dimensiuni diferite.

2. Dimensiunile la care ambele sexe ating maturitatea sexuală se păstrează constante în cadrul fiecărei populaţii.

3. Prezenţa unor populaţii apropiate geografic dar diferenţiate prin dimensiunile corporale (care prezintă asigurări statistice) cît şi faptul că ele au viteza de maturizare diferită, ne face să le considerăm drept forme de manifestare ale variabilităţii biotopice.

4. Frecvenţa diferită a claselor de vîrstă în funcţie de biotop şi atingerea maturităţii sexuale la dimensiuni diferite cît şi prezenţa unei variabilităţi metrice corporale în diverşi biotopi, pledează pentru manifestarea diversităţii fenogenetice la populaţiile din Carpaţii Orientali şi Nordici.

5. Solomîdra carpatică în perioada de agregare reproductivă are cea mai mare densitate în bălţile şi smîrcurile situate în pîraiele Neagra, Colbu, V. Putnei, din Valea Bistriţei.

6. Recoltarea totală a exemplarelor în trei ani consecutivi (1968-1970) din biotopii : p. Neagra, p. Colbu, V. Putnei, ne indică un nivel numeric relativ constant în raport cu natura biotopului respectiv.

Totodată se desprinde faptul că populaţia foloseşte la maximum condiţiile ecologice locale, prin realizarea întregii capacităţi de înmulţire a speciei din etapa respectivă.

7. Procentajul foarte mic (0-20%) a solomîzdrei alpine *(T. alpestris)* şi lipsa solomîzdrei crestate *(T. cristatus)* în unii biotopi, este un indiciu al lipsei unei eventuale concurenţe interspecifice care pot constitui totodată şi una din cauzele creşterii densităţii în aceşti biotopi.

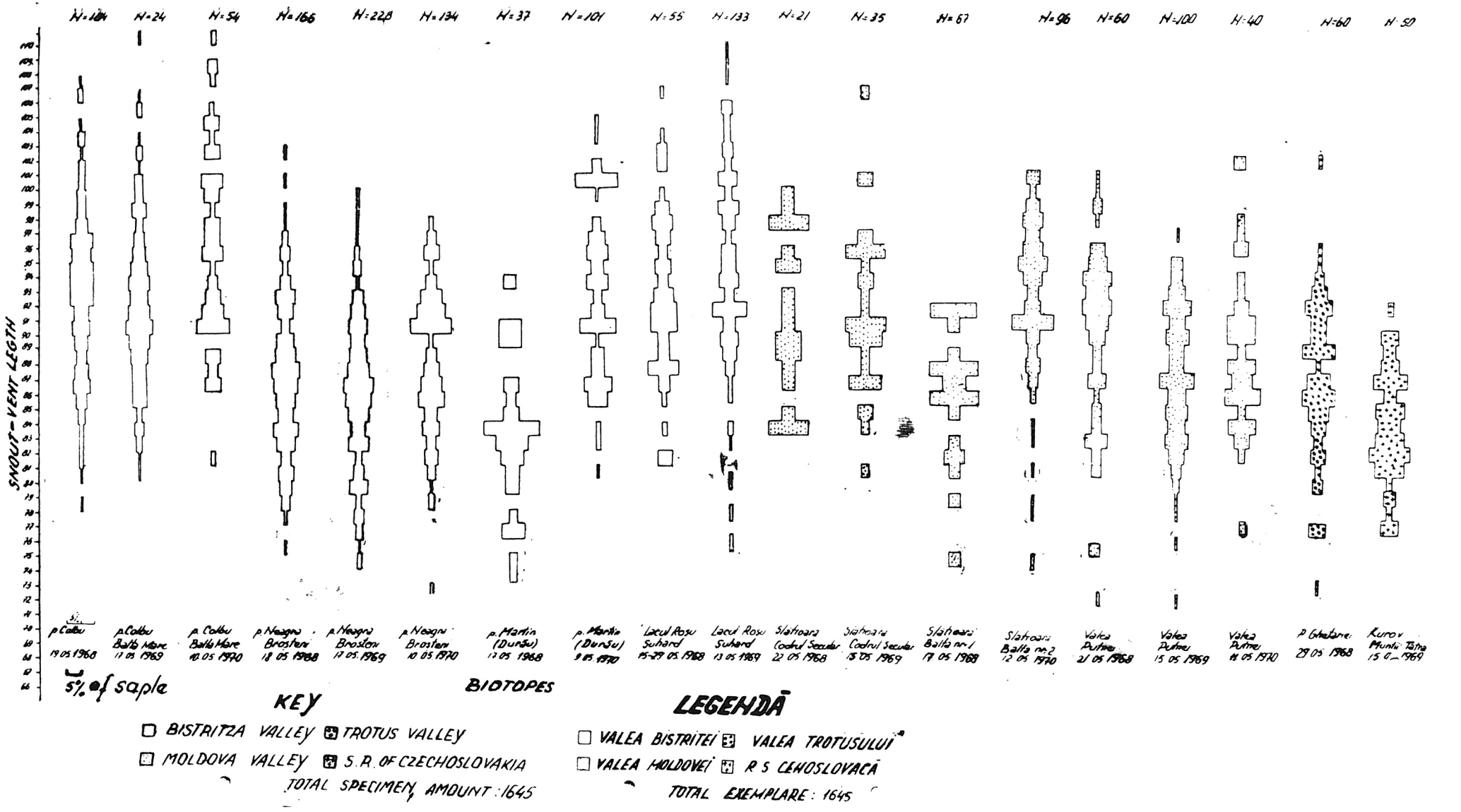

Fig. 2a. Bodi length histograms in the male population of *Triturus montandoni* in the Eastern and Northern Carpathians 1968—1970.

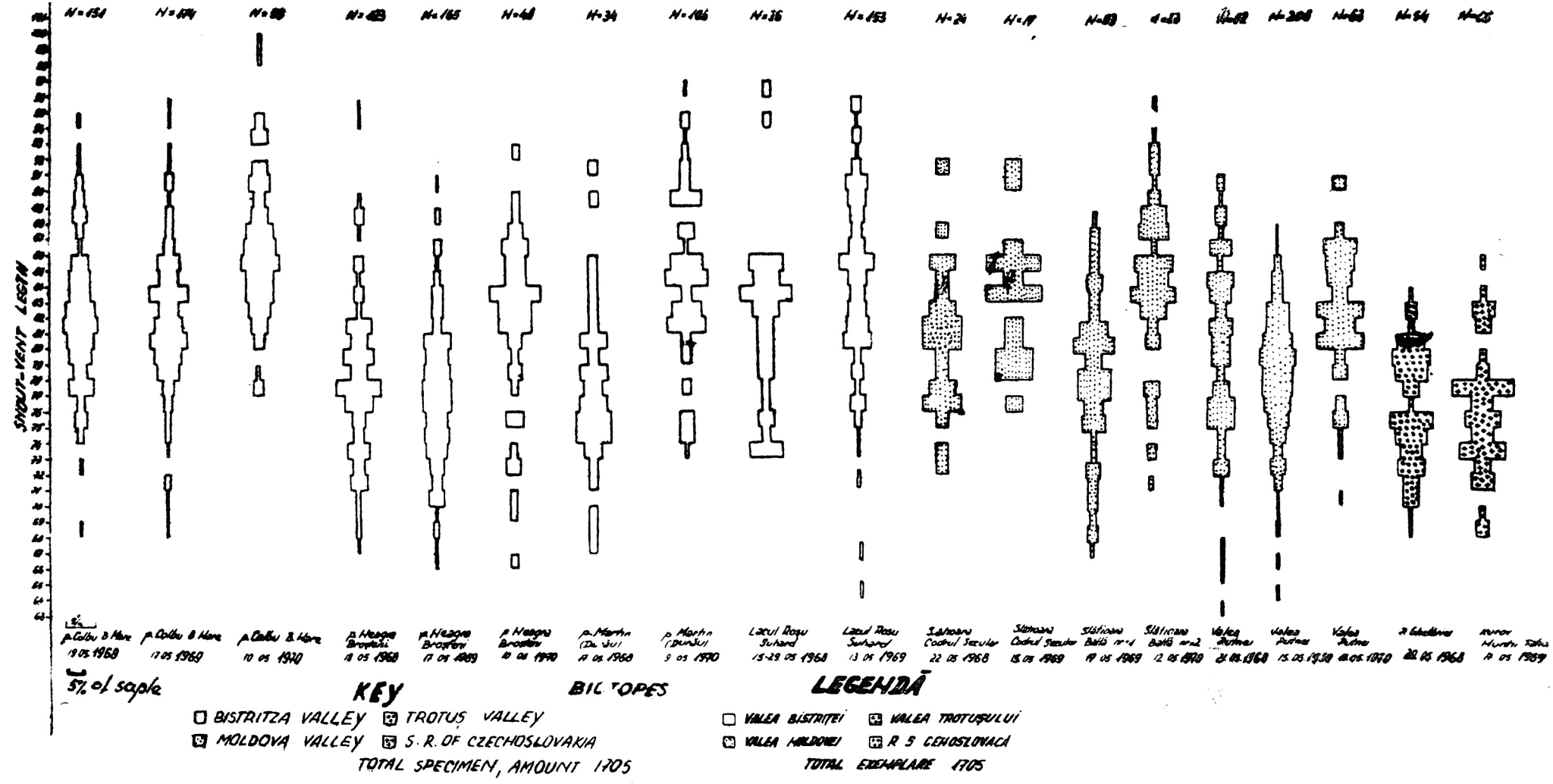

Fig. 2b. Body length histograms in the female population of *Triturus montadoni* in the Eastern and Northern Carpathians 1968—1970.

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Table No 2

PLACES AND NUMBERS OF *TRITURUS MONTANDONI* COLLECTED DURING THREE SUCCESIVE YEARS (1968—1970) IN THE EASTERN CARPATHIAN

No.	Place	Day Month	Year	Total spec men amount	Collecting area in sq. m	Body length X±Sm 1970
1.	Brook Neagra	16, 17, 18 mai	1968 1969 1970	864	9	88,10 ± 0,29
2.	Brook Colbu	10, 17, 19 mai	1968 1969 1970	873	6	95,60 ± 0,53
3.	Putna Valley	11, 15, 21 mai	1968 1969 1970	613	7	88,43 ± 0,41

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