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Variation and taxonomy of the Hardun, *Agama stellio* (Linnaeus, 1758) (Reptilia, Agamidae)

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ABSTRACT

Five subspecies of *Agama stellio* (Linnaeus) are distinguished: see fig. 8 and key on p. 125.

1. *Introduction*

It has long been known that there is a considerable amount of variation in the Levantine lizard species *Agama stellio*. Especially in the southern part of the range variability as to colouration and scale arrangement appears to be high. Flower (1933) was the first to point to the existence of three different races in the Egyptian-Palestinian region. Haas (1951a) also pays attention to striking geographical differences in the Israel-Jordan area. Two subspecies have been described from this part of the range: *Agama stellio picea* Parker, a melanic form from eastern Jordan, and *Agama stellio brachydactyla* Haas from the Negev desert in Israel. Moreover, Schmidt & Marx (1956) propose, in a casual way, to award subspecific rank upon the populations in Lower Egypt apart from the Sinai peninsula. As the oldest of available synonyms these authors introduce the name *Agama stellio vulgaris* for this form. This view is not yet generally accepted: Mertens & Wermuth (1960), for instance, still mention *Stellio vulgaris* Sonnini & Latreille, 1802 as a junior synonym of *Agama stellio stellio* (Linnaeus, 1758).

The whole remainder of the range, from Central Israel to the Cyclades and to Northern Iraq, is said to be inhabited by the nominate subspecies. Still, surmises have risen of an intraspecific differentation in this area as well. Schmidt (1939) already stated that this affords an attractive taxonomic problem. Hoofien (1961) refers to the Israelian Harduns as to *Agama stellio brachydactyla* Haas and *Agama stellio* subsp. About the Cyprus population, Knoepffler (1963) supposes that there exist constant differences with Israelic specimens.

As these geographical varieties are distinguished especially by colouration

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characters, a taxonomical evaluation of these differences is not an easy problem. Firstly, individuals of *Agama stellio* are said to be subject to some colour variability under the influence of internal and external agents. Schreiber (1912) even speaks about „ein Farbenwechsel der dem des Chamaeleons kaum nachsteht." Klausewitz (1953) carried out investigations on these colour changes in the South African species *Agama atricollis*, which is closely related to the Hardun. He found that external stimulation by factors as light and temperature elicits distinct colour phases. However, the lizards are not able actively to adapt their colour to the background. Presumably the results of Klausewitz's study apply, mutatis mutandis, to our species as well.

Secondly, colour patterns fade away in spirit specimens in the course of years. Therefore, recently collected series from the whole area are necessary for a taxonomical study. In fact, the present investigation could not have been done without the extensive collections made by Mr. H. Hoogstraal in Egypt, Lebanon and Turkey, and now present in the Chicago Natural History Museum. Besides, some small series were available from Antalya (Turkey), collected by the Leyden biology students' expedition in 1957, and from some islands in the Aegean sea (a.o. from Delos, the terra typica of the species), collected by Vincent van Laar and the author in 1963.

All in all, use could be made of:
176 specimens from the Chicago Natural History Museum (CNHM);
69 specimens from the British Museum (Natural History) (BMNH):
28 specimens from the Zoölogisch Museum of the University of Amsterdam (ZMA);
17 specimens from the Rijks Museum van Natuurlijke Historie at Leiden (RMNH);
4 specimens from the collection of Dr. L. Ph. Knoepffler at Banyuls (LAR).

Next to notes made on colour and colour pattern, several biometrical data were collected in this material, and characters of pholidosis were compared in different populations. In section 2, these characters are discussed as far as they show sexual dimorphism or geographical differences.

The localities from where specimens were available are shown in fig. 1. The collection numbers are recorded under the headings of the subspecies in section 3.

I wish to express my gratitude for the loan of material towards dr. R. F. Inger (CNHM), Prof. Dr. L. D. Brongersma and Drs. M. S. Hoogmoed (RMNH), Miss A. G. C. Grandison (BMNH) and Dr. L. Ph. Knoepffler (LAR).

I am indebted also to Dr D. Hillenius (ZMA) for his helpful advices given during the investigation.

2. *The distribution of several variable characters*

Large series were available from only two localities (Burg el Arab, nr. 50 in fig. 1, and Southern Sinai, nrs. 47-49). Many others were represented by one or by a few specimens. To further a comparison of the variability of biometrical and pholidosis characters, the material had to be classed in several

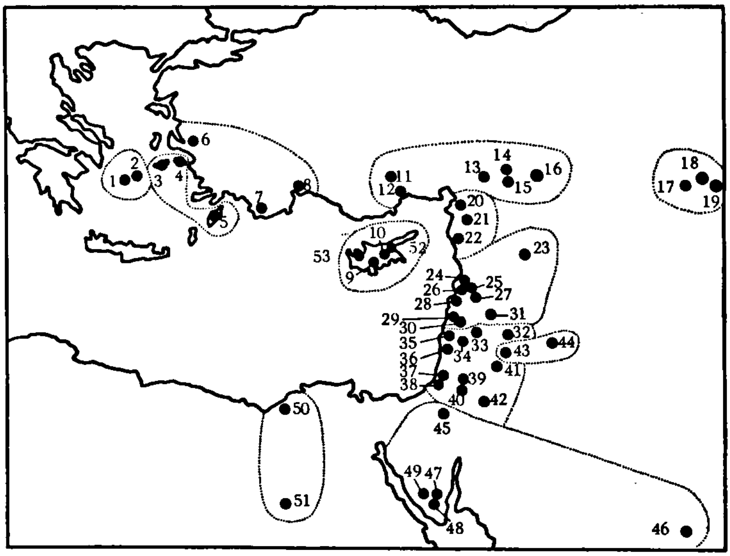


FIG. 1. Localities where the animals investigated have been collected.
Cyclades (I): 1 Delos, 2 Mikonos
Sporades (II): 3 Ikaria, 4 Samos, 5 Rhodes
West Anatolia (III): 6 Izmir, 7 Xanthus, 8 Antalya
Cyprus (IV): 9 Limassol, 10 Nikosia, 52 Salamis, 53 Temple of Vouni
Northern Iraq (V): 17 Dihok, 18 'Aqrah, 19 Rawandiz
South Central Turkey (VI): 11 Zebil, 12 Mersin, 13 Gaziantep, 14 Rumkaleh, 15 Birecik, 16 Urfa
Northwestern Syria (VII): 20 Iskenderun, 21 Amik, 22 Latakia
Lebanon (VIII): 23 Palmyra, 24 Tripoli, 25 Amyun, 26 Jubeil, 27 Les Cedres, 28 Beirut, 29 Adloun, 30 Beth Anath, 31 Damascus
Israel (IX): 32 Jebel ed Druz, 33 Lake Tiberias, 34 Nazareth, 35 Haifa, 36 Caesarea, 37 Ramla, 38 Rehovoth, 39 Jerusalem, 40 Bethlehem, 41 Hammam es Sarkh, 42 Moab
East Jordan (X): 43 Black lava desert, 44 Qasr el Burqu'
Sinai (XI): 45 Sede Boqer, 46 Jebel 'Aja, 47 Mt. Sinai, 48 Gebel Katerina, 49 Feiran oasis
Northwestern Egypt (XII): 50 Burg el Arab, 51 Faiyum

population groups. The boundaries shown in fig. 1 turned out to be the most suitable for such a grouping, considering that the groups should be as homogeneous as possible. In the Syrian-Palestinian area, where some of the characters show larger variability, this demand could not be satisfied completely.

In total, twelve population groups were distinguished: (in brackets the number of specimens)

- I Cyclades (21)
- II Sporades (9)
- III West Anatolia (9)
- IV Cyprus (17)
- V Northern Iraq (4)
- VI South Central Turkey, exclusive of the province Hatay (22)
- VII Northwest Syria, including Hatay (20)

VIII Lebanon, including Palmyra and Damascus in Syria (35)
IX Israel, including Jebel ed Druz (Syria) and West Jordan (30)
X East Jordan (8)
XI Sinai, including Negev (Israel) and Jebel 'Aja (Saudi Arabia) (61)
XII Northwest Egypt (50)

In several cases, groups II and III and groups VI and VII will be taken together.

Length of head and body (HB)

The length of head and body of the animals was measured from the tip of the snout to the anterior edge of the anus. In fig. 2, specimens from the population groups distinguished are arranged in length classes, each including an interval of 5 mm. Black squares represent animals bearing the exterior male character of swollen praeanals and a midventral stripe of swollen scales.

In most population groups, the histograms of fig. 2 show two peak zones: one of adult and one of juvenile specimens. The swollen praeanals and medioventrals occur practically only in the adult groups. The males appear to develop this character when reaching a HB-length of about 70 to 80 mm. Rather arbitrarily, 80 mm is therefore taken as a demarcation value between adult and juvenile specimens. In the adult groups, difference between male and female lizards is very weak: in general, the males reach somewhat larger proportions. However, this is a much less marked distinction than the differences between several of the population groups:

Strikingly large are the animals of group XI (Sinai). This agrees well with the diagnosis by Haas (1951b) of the subspecies *brachydactyla*, as "differing from *Agama stellio* by its stouter habitus." The type specimen of this subspecies is fairly larger than any specimen I have seen, measuring 146 mm HB according to Haas. Calabresi (1923) reports on a

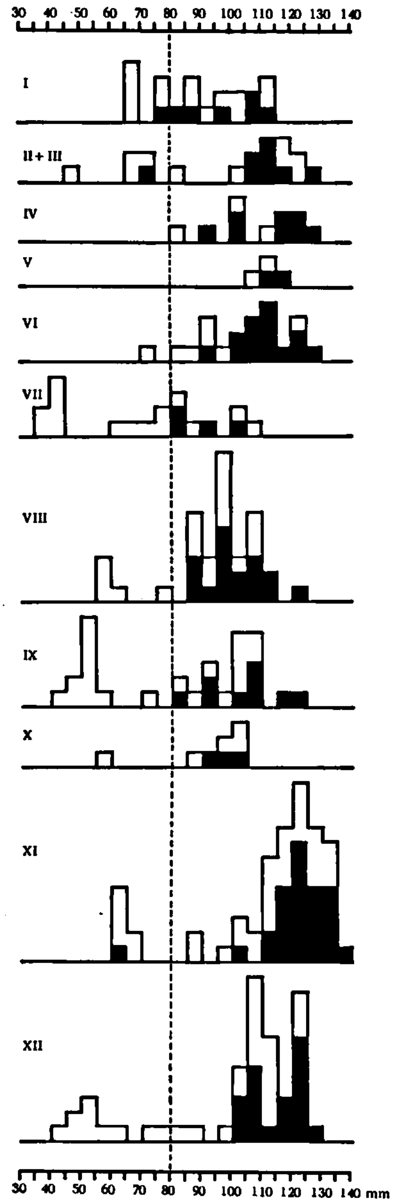


FIG. 2. Histograms showing the distribution of the length of head and body (HB) in the population group samples. Black squares represent male animals.

very large specimen from Kattavia, Rhodes, measuring 141 mm HB.

In group X *(Agama stellio picea)*, animals do not seem to grow as large as in the other population groups. The differences between the latter are not noticeable.

Length of the head (H)

The distance from the tip of the snout to the back of the jaw articulation is the most suitable measurement for the proportion of the head, as it is fairly unaffected by a more or less bad state of the animals. This distance was measured exteriorly with a marking gauge to tenths of millimeters. To compare sexes and population groups, the relation to the length of head and body was used (100.H/HB). In fig. 3 this relation is indicated for all

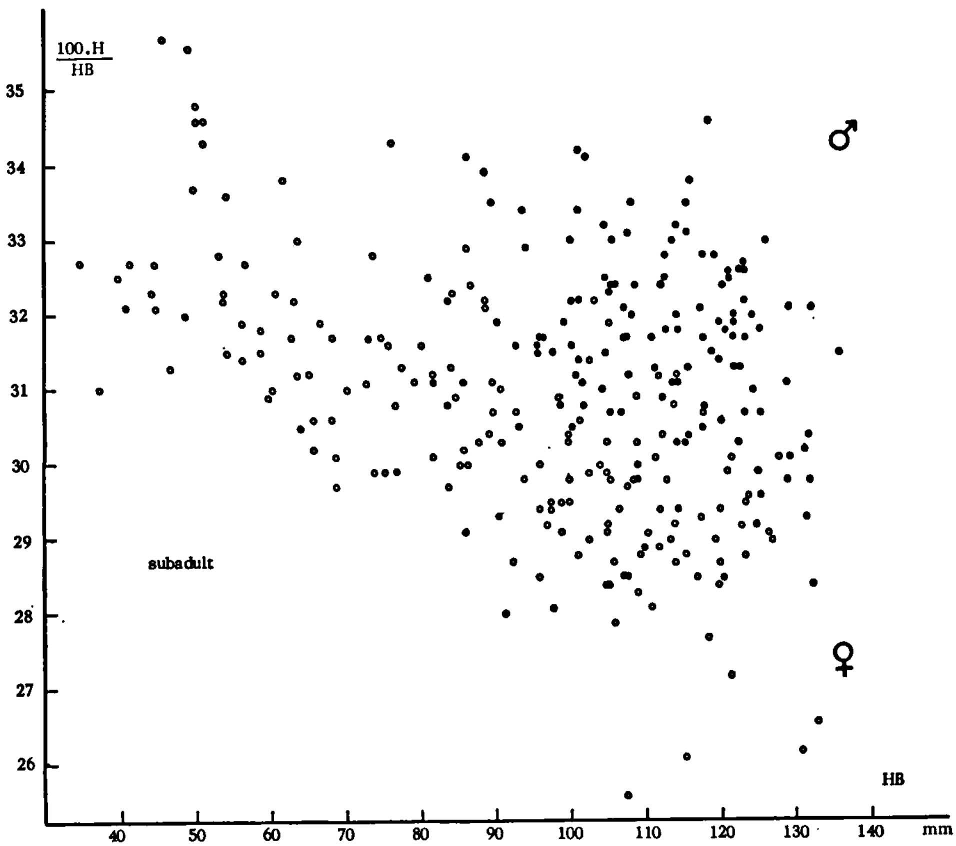


FIG. 3. Relative length of the head in subadults, males and females.

animals measured, in order to show sexual and age differences. Specimens with the male character of swollen praeanal and medioventral scales are represented by solid dots, females and juvenile specimens by circles. Notwithstanding the large dispersion, this figure makes clear that the relative length of head decreases slightly during ontogeny. In the smallest juvenile Harduns, H/HB amounts about to 0.33. In adult females this relation is diminished to about 0.29. The male animals keep proportions which show more conformity with the sub-adults. This faster decline of the relative length of head in females seems to be a general feature in lizards: Peters (1964) proved that the same occurs in *Lacerta trilineata*.

Table I shows, that next to sexual dimorphism, there is no appreciable difference in relative length of head between the population groups.

Table I. Range and average of the relation 100.H/HB in adult animals (HB exceeding 80 mm) in the population groups (n = number of specimens).

Group	Males			Females		
	n	range	mean	n	range	mean
I Cyclades	6	30.7—33.9	32.1	7	28.1—30.9	29.3
II Sporades	3	30.7—31.7	31.2	2	29.2—30.1	29.7
III W. Anatolia	4	30.4—32.8	31.8	4	28.8—32.3	30.0
IV Cyprus	10	30.8—34.6	32.4	4	29.1—31.2	30.0
V N. Iraq	2	32.5—33.5	33.0	2	28.3—29.0	28.6
VI S.C. Turkey	14	29.9—33.2	31.9	7	28.4—31.0	29.5
VII N.W. Syria	5	30.8—33.5	32.9	3	30.4—31.9	31.3
VIII Lebanon	17	29.1—34.1	31.6	16	25.6—32.2	29.7
IX Israel	8	29.3—32.1	30.8	11	27.9—32.9	29.3
X E. Jordan	3	30.5—33.4	31.9	4	28.5—31.1	29.7
XI Sinai	27	28.5—32.4	30.8	27	26.1—32.4	29.4
XII N.W. Egypt	20	30.7—34.1	32.5	19	28.7—31.4	30.0

Length of the tail (T)

The tail length was measured from the anterior edge of the anus to the end of the tail. Only specimens with an unimpaired tail were used. In table II standard values about the relation to the snout-vent distance (T/HB) are given for male and female animals from the population groups distinguished.

In this table, females appear to have, in most groups, shorter tails than

Table II. Range, mean (m) and standard deviation (s) of the relative tail length (T/HB) in the population groups (n = number of specimens).

Group *)	Males				Females				Adults + juveniles			
	n	range	m	s	n	range	m	s	n	range	m	s
I	4	1.31—1.60	1.42	0.13	5	1.32—1.46	1.39	0.12	13	1.29—1.60	1.38	0.09
II+III	4	1.37—1.50	1.44	0.05	1	—	1.47	—	8	1.37—1.50	1.44	0.04
IV	5	1.66—1.92	1.79	0.09	4	1.53—1.82	1.67	0.12	11	1.53—1.92	1.73	0.11
V	1	—	1.47	—	1	—	1.33	—	2	1.33—1.47	1.40	—
VI+VII	10	1.24—1.54	1.41	0.08	5	1.19—1.57	1.37	0.12	25	1.19—1.57	1.43	0.11
VIII	9	1.40—1.63	1.51	0.08	10	1.29—1.55	1.40	0.10	21	1.29—1.69	1.47	0.11
IX	7	1.31—1.56	1.46	0.11	10	1.22—1.54	1.34	0.10	25	1.22—1.58	1.41	0.11
X	2	1.17—1.25	1.21	—	2	1.03—1.13	1.08	—	5	1.03—1.37	1.19	0.13
XI	14	1.25—1.63	1.49	0.10	14	1.33—1.63	1.45	0.08	33	1.25—1.64	1.48	0.10
XII	12	1.35—1.50	1.44	0.05	11	1.19—1.52	1.36	0.10	29	1.19—1.54	1.43	0.09

*) For particularities see Table I.

male Harduns. As this sexual dimorphism is very weak, and as juvenile animals do not show striking differences with adults, the data on all specimens were taken together (table II, third column) in each population group. All differences between averages in adjacent population groups were tested statistically by means of Student's t-test. Significantly high t-values — with a probability level not exceeding 1% — are indicated in fig. 4 by absence of connection lines. Populations groups not significantly differing are connected.

Fig. 4 shows that averages are ranging from 1.38 to 1.48, without significant differences, except for two population groups: Cyprus (1.73) and East Jordan (subspecies *picea*; 1.19). Peters (1964), in his biometrical analysis of the Near

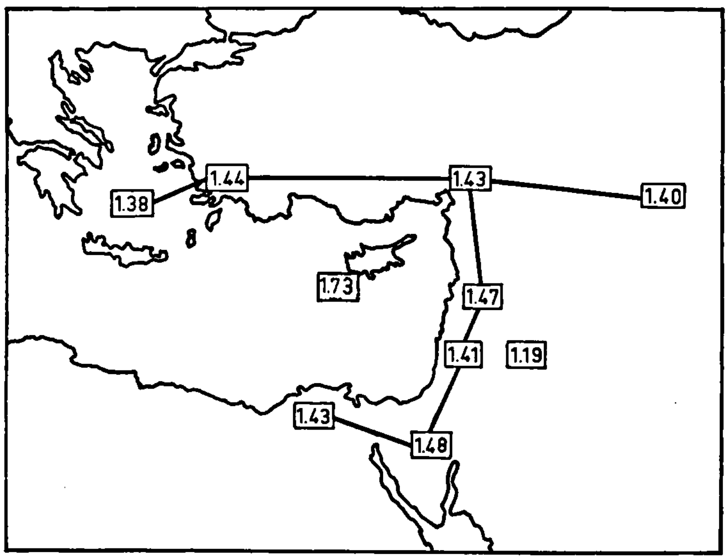


FIG. 4. Averages of the relative tail length. Lines connect samples which do not differ significantly.

East populations of *Lacerta trilineata*, showed that the lizards of this species have relatively longer tails in populations living in a mediterranean climate, than have those which inhabit regions with continental climate circumstances. It is not impossible that the same feature is present, to a much lesser degree, in *Agama stellio*. Unfortunately, only two animals with unimpaired tail were available from Iraq.

The deviation of the population groups Cyprus and East Jordan in the relative tail length could be a reason to give these two groups a separate subspecific status. Usually, subspecific value is attributed to a single character, when the 75% rule is satisfied. For non-alternately distributed numerical characters, Mayr, Linsley & Usinger (1953) gave as an interpretation of this rule, and as a standard of subspecific separation, that 75% of population A should be different from 97% of population B (or: the part of B that is overlapped by 75% of A, should not exceed 3%). This requirement is calculated by Mayr c.s. into terms of CD-values. CD stands for Coefficient of Difference, and is obtained by dividing the difference of the means of the two samples compared by the sum of the standard deviations. A CD-value of 1.28 corresponds to the "conventional level of subspecific difference" (75% rule).

CD-values were calculated between samples which were found to be significantly different as to their relative tail length. The population groups I-III, V-IX, XI-XII, were taken together, the differences between them being not statistically significant.

TABLE III. Coefficients of difference (CD) in the relation T/HB. (m = mean, s = standard deviation).

Sample A	sample B	m_A	m_B	s_A	s_B	CD
IV	all groups except for IV and X	1.73	1.44	0.11	0.10	*1.38*
IV	X	1.73	1.19	0.11	0.13	*2.25*
all groups except for IV and X	X	1.44	1.19	0.10	0.13	1.09

As shown in table III, the subspecies *picea* from East Jordan (X), when compared with the normal populations would not deserve a subspecific status based on its short tail only. But for a subspecific separation of the Cyprus population (IV) CD and overlap requirements are fulfilled in this character.

The number of subdigitals (f3 and t4)

The subspecies *brachydactyla* derives its name from the shortness of fingers and toes. It was found to be of some importance to check how this character is distributed in the whole range of the species. The number of subdigitals provides a suitable absolute criterion, which does not need to be expressed in the relation to HB. Therefore, all data on juvenile and adult animals can be joined. Moreover, no differences were found between males and females, so that these have not to be dealt with separately.

The subdigitals were counted in the third finger (f3) and in the fourth toe (t4). In table IV averages, extreme numbers and standard deviations of each sample are listed. The significance of the differences between averages of adjacent population groups was tested by means of Wilcoxon's test [1]) (probability level of significance $\doteqdot$ 0.01).

[1]) Wilcoxon's instead of Student's test is used here, since a general requirement for the application of Student's test is that the variance (= square standard deviation) of the populations compared should be equal. This requirement is not satisfied in all cases, as could be established by means of the F-test. F-values exceeding the 2.5% point (used as the level of significance here), were found in comparing the samples from Syria, Lebanon and Israel (groups VII-IX) with adjacent population groups (VI, IX, X, IV); in these countries, which lie in the centre of the geographical range, the agamas have a fairly larger dispersion in both characters (f3 and t4) than in the peripheric populations.

TABLE IV. Range, mean and standard deviation (s) of the number of subdigital scales in the third finger (f3) and in the fourth toe (t4).

Group *)	f3				t4		
	n	range	mean	s	range	mean	s
I	20	15—18	16.6	0.9	17—24	20.8	1.6
II + III	18	15—18	16.4	1.0	20—24	21.8	1.2
IV	16	19—22	20.1	1.0	22—28	25.8	1.5
V	4	16—18	16.7	0.9	21—24	22.5	1.3
VI	22	15—18	16.6	0.9	17—23	21.2	1.4
VII	20	16—22	18.2	1.5	20—27	23.5	1.8
VIII	35	14—22	18.6	1.6	19—27	24.2	1.9
IX	30	14—21	18.4	1.7	19—29	24.0	2.2
X	8	15—17	15.5	0.8	19—22	20.7	1.0
XI	61	14—20	16.2	1.2	18—25	21.5	1.5
XII	50	16—23	19.6	1.5	23—29	25.9	1.5

*) For particularities see Table I.

Fig. 5 summarizes the results of these tests: adjacent population group samples which do not differ significantly in the average subdigital number are connected by solid lines. This figure shows that the samples can be pooled into four groups. In the centre of the geographical range (Hatay-Israel, Cyprus-NW. Egypt) the longest toes occur (high subdigital number), whereas peripheric populations (Greece, Turkey, Iraq, Jordan, Saudi Arabia, Sinai) have less subdigital scales.

Again, it may be interesting to know how far these differences alone would

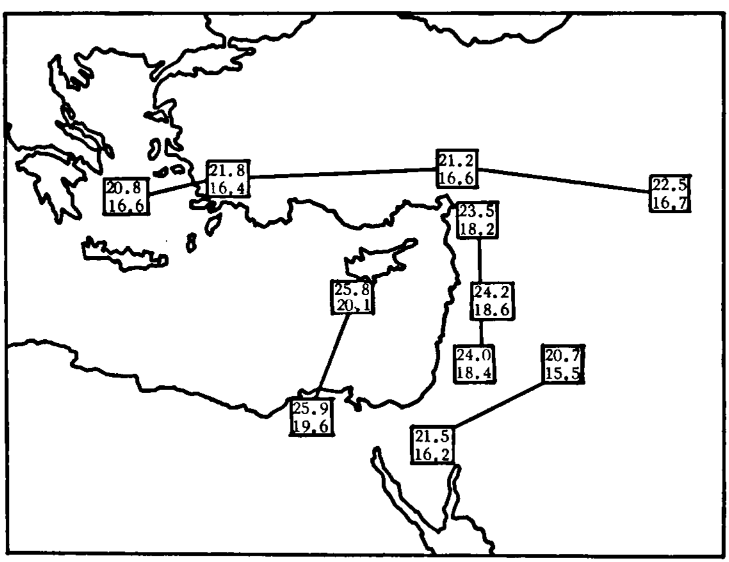


FIG. 5. Average numbers of subdigital scales in the third finger (below) and in the fourth toe (above). Lines connect samples which do not differ significantly.

lead to subspecific separation, when the 75% rule is applied. Table V gives coefficients of difference between the four groups distinguished.

The relations between the groups are the same for the third finger and the fourth toe. In both characters subspecifically large differences (CD-values

TABLE V. Coefficients of difference in the number of subdigital scales.

Population group samples compared

Sample A	Sample B	CD values f3	CD values t4
Greece—Iraq (I—III, V—VI)	Syria—Jordan (VII—IX)	0.71	0.76
„	E. Jordan—Sinai (X—XI)	0.24	0.02
„	Cyprus—Egypt (IV, XII)	*1.30*	*1.55*
Syria—Jordan (VII—IX)	E. Jordan—Sinai (X—XI)	0.84	0.74
„	Cyprus—Egypt (IV, XII)	0.41	0.56
E. Jordan—Sinai (X—XI)	„	*1.65*	*1.52*

exceeding 1.28) only occur between the populations with the extreme values: Egypt and Cyprus with maximal subdigital numbers; Greece, Turkey, Iraq, East Jordan and Sinai with the lowest counts. Subspecific separation, based on this character only, can be made between Cyprus and Turkey samples first, and secondly between New Egypt and Sinai.

The populations in Syria, Lebanon and Israel are likely to form transitional groups. Variability (standard deviation) is higher here. As well in the north as in the south there is a gradual transition to surrounding populations: animals from Iskenderun (fig. 1 nr. 20) (f3 averaging 17.8; t4: 22.8) are apparently intermediates between South Central Turkey (group VI, f3: 16.6; t4: 21.2) and Amik plain (f3: 19.6; t4: 25.2). Iskenderun and Amik specimens were taken together into group VII, because these localities are situated close to each other. There is, however, a mountain range (Gavur Daglari = Amanus Mountains, reaching 7422 ft.) in between, which may have a more or less isolating and gene-flow inhibiting effect.

Two specimens available from Hammam es Sarkh (fig. 1 nr. 41) and Moab (nr. 42) in West Jordan (group IX), localities which lie geographically between the population groups Sinai and East Jordan, have subdigital numbers of 14.15 (f3) and 19.19 (t4). In these figures, they belong clearly to the *picea-brachydactyla* group. Because of scale arrangement and colour properties they were classed in the population group Israel (IX). Also a specimen from Jebel ed Druz (Syria), not for away from the type locality of *A.s. picea*, has low subdigital numbers (f3 = 16; t4 = 21).

In his description of the subspecies *A.s. brachydactyla*, Haas (1951b) compared the type specimens with animals of the nominate subspecies from Israel. From my counts, it is evident that the *brachydactyla* animals are quite typical (i.e., not different from the topotypes from Delos, group I) as to the proportions of their fingers, but the Harduns from Northern Israel are deviating.

Arrangement of enlarged dorsal scales

One of the diagnostical characters of the species *Agama stellio* is the inequality of the dorsal scales. In the middle of the back there is a vertebral zone of enlarged scales, which has transversal offshoots between the granular flank scales (see fig. 6 A, B). This arrangement is identical in nearly the whole range of the species. Only the two southernmost population groups (XI and XII) are deviating. In the Negev, Sinai and Jebel 'Aja specimens (sample XI) the enlarged scales form a much broader middorsal area than in normal *stellio*, and the transversal rows are less conspicuous (fig. 6 C). In this character, as in many others, the Sinai series agrees with Haas' description of *Agama stellio brachydactyla*, except for one point. The type specimens of this subspecies are characterized, according to Haas (1951b), by "the stronger

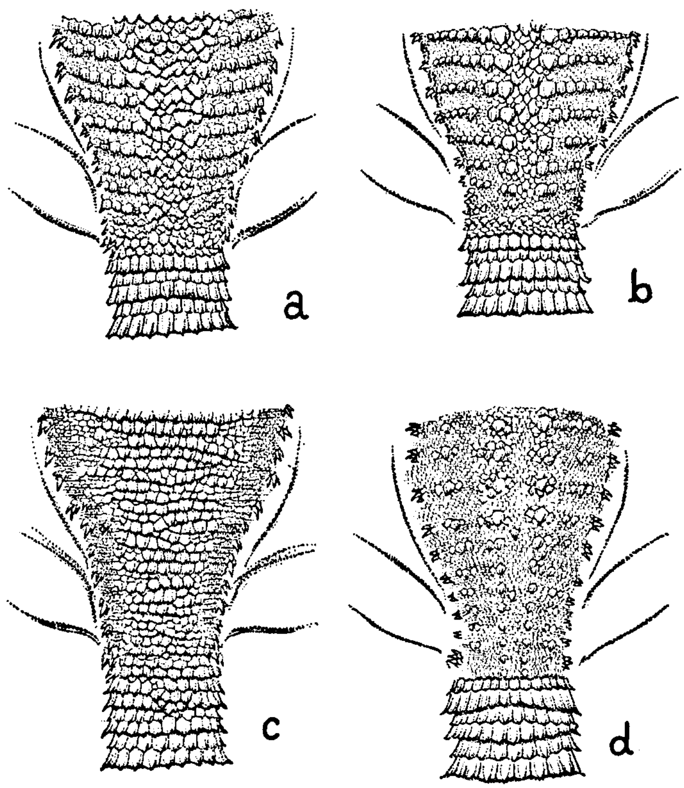


FIG. 6. Types of dorsal scale arrangement: a and b, as in *A.s. stellio*, *A.s. picea* and *A.s. cypriaca*; c, as in *A.s. brachydactyla*; d, as in *A.s. vulgaris*. Drawings by J. A. Mastro.

spinosity of the enlarged dorsal scales, the rugose shields of the head and a much broader middorsal area of enlarged scales." And: "At the posterior half of the back these scales are rugose, strongly serrated at their posterior border, and bigger than in *stellio*." Sinai specimens, on the other hand, have flat, and just feebly keeled dorsal scales. The two animals I have seen from the Negev desert (Wadi Ajram and Sede Boqer) do agree with Haas' description, by the strong spinosity of their scales. On account of the similarity in other characters (e.g., the shortness of fingers and toes) both forms will be reckoned to belong to the same subspecies for the present.

Population group XII (Northwestern Egypt) is characterized in the dorsal scale pattern by an arrangement, opposite to that in *brachydactyla*. Here the enlarged scales are reduced in comparison with normal *stellio*. At the end of the back they are lying loose, each being surrounded by granular scales (fig. 6 D). As well as the arrangement in *brachydactyla*, this arrangement provides a clear diagnostical subspecific character.

Colour pattern

Detailed descriptions of the general colour and colour pattern of the species have been given by Boulenger (1885) and by Schreiber (1912). In general, Harduns are characterized by a light brownish-grey to bluish-black ground colour of the backside of head and body. In the vertebral zone, four to five lighter patches, often described as rhomboid, are outlined (see for instance fig. 7 B). Especially in juvenile animals this pattern is clear. The tail has alternating light and dark segments, each consisting of about three to four scale rings. The ventral side is lightly yellowish in colour, sometimes speckled with dark scales. The gular region has a somewhat darker colour than the belly and shows yellowish spots, especially at the maxillar edges.

Numerous variations of this general pattern occur. It turned out that a number of seven colour varieties could be distinguished which are geographically more or less clearly separated. Local peculiarities being discussed later on, it appears to be useful to give here the characters of these colour varieties: (letters A to G correspond with those in fig. 7 A-G).

A. Back dark grey, head brightly yellow; light dorsal patches present. Gular region unspotted, at the most a very vague marmoration. Black or dark grey collar spot. — Localities 1,2 (Cyclades).
B. Ground colour of head and back bluish to brownish grey; vertebral patches usually present; chin spotted; collar spot not clear. — Localities 3—8, 11—16, 20, 22, 24—25, 27, 30—39 (Sporades, Turkey, Lebanon, Israel and Syria).
C. Dark ground colour often reduced to a dark reticulum of granular scales in the shoulder region; vertebral patches, chin spots and collar spot usually missing in adults. — Localities 9, 10, 52, 53 (Cyprus).
D. Ground colour variable, pale yellowish to greyish buff; vertebral patches present, gular region dark without marmoration or spots, no collar spot. — Localities 45—49 (Negev, Arabia and Sinai).
E. Ground colour dull brownish grey; dorsal patches vaguely present; gular spots present; no collar spot. — Localities 50, 51 (Northwest Egypt).
F. Dark, plain rusty brown in colour, without lighter patches. Chin fairly dark brown with light spots. — Localities 17—19, 21, 23, 24, 26, 28, 29, 40—42 (Iraq, South Turkey, Syria, Lebanon and West Jordan).
G. Ground colour black; orange spots scattered in transverse rows on the back; gular spots present in females, absent in males. — Localities 43, 44 (East Jordan).

Obviously, these differences cannot be due to the individual ability to change colour; in that case, also a large variation within the localities would be found. Series originating from one locality are usually very homogeneous in colour, and in several cases differ from series collected in nearby localities. A few examples will be discussed.

— Agamas from Limassol all have a lead-grey colour, while the other Cyprian specimens are much lighter.

— The Harduns from Jerusalem are rather lightly coloured, with buff hues predominating. They belong to variety B, while those from the neighbouring Bethlehem with their plain rust-brown colour evidently represent form F.

— There is a distinct difference in the general colouration between the large series from Feiran oasis and Jebel Katerina (= St. Catherine's Monastery area) in southern Sinai. Specimens from Feiran oasis, which were caught in sandy wadis and in the oasis, are much paler than the animals from the latter locality, which were caught in a rocky region. These colour differences may very well be due to the different habitats the animals lived in.[2])

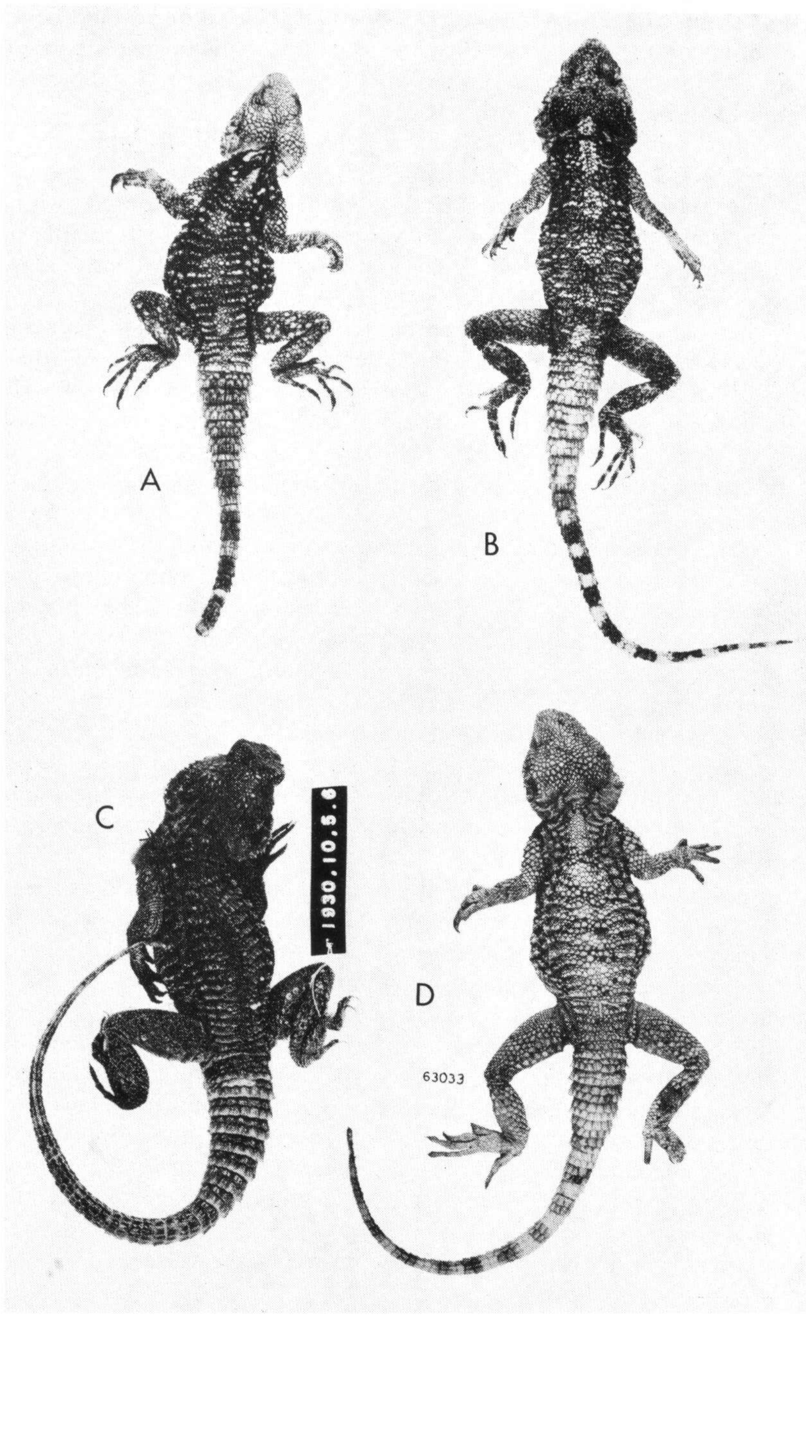
— As in Bethlehem and Jerusalem, also in Lebanon the two strikingly different colour varieties B and F occur, but without being collected at the same time in one locality, and without intermediate forms. The rusty-brown form F was collected along the rocky coastal strip here (CNHM specimens from Tripoli, Jubeil, Beirut, Shemlan and Adloun), whereas in the mountain range the normal variety B occurs (BMNH specimens from Tripoli, Amyun, "Cedars of Lebanon" and Beth Anath).

— Also in Hatay (Turkey), both forms were collected in neighbouring localities: the common variety near Iskenderun, northwest of the mountain range Gavur Daglari, the rust-brown form in the Amik plain, south of these mountains.

Obviously, this variety F, which occurs, in addition, also in northern Iraq, in Syria (Palmyra) and Western Jordan (Bethlehem, Hammam es Sarkh and Moab), has no closed geographical range. Therefore, I am inclined to suppose that the plain rust-brown colour is a local character, adaptive to a certain biotope. Many of the animals from western Lebanon and from Amik plain are still bearing traces of the rust-brown earth they have lived upon. Probably, we have to do with an "ecotype" and it would not do to give this a separate subspecific status, as long as it is unknown in how far this character is either genetically or ecologically determined, the more so as other scale arrangement and proportional characters do not give the impression that this rust-brown variety represents an evolutional stage of specimen in isolated populations.

The latter condition does seem to be present in the varieties C, D and E

2) Flower (1933) reports on a dark rock-dwelling form from Southern Sinai. Haas (1951b) therefore doubts if this population should be referred to his subspecies, which is pale and lives in the open country. Schmidt & Marx (1956) suggest that Flower's animals have been unusual in colour. I am inclined to think that the colour differences between Haas' and Flower's specimens are correlated with the difference in habitat.


A
B
C
1930.10.5.6
D
63033

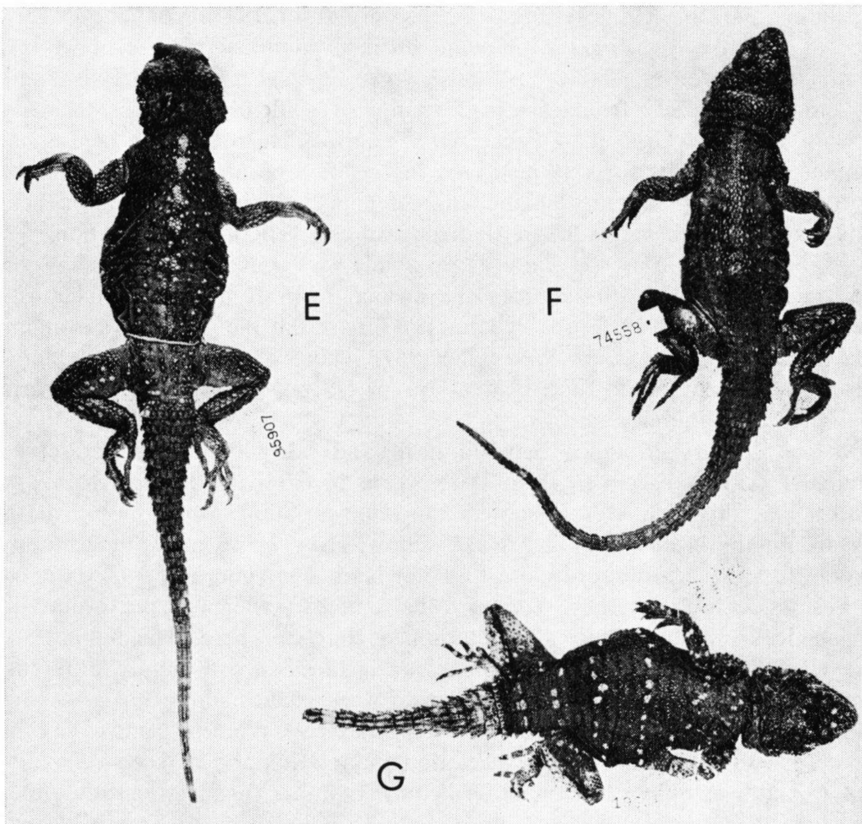


FIG. 7.

A, *Agama stellio stellio*, topotype, ZMA 10692 (♂), Delos, Greece;

B, *Agama stellio stellio*, RMNH no nr. (♂), Atalya, Turkey;

C, *Agama stellio cypriaca*, holotype, RMNH 1930. 10.5.6. (♂), Limassol, Cyprus;

D, *Agama stellio brachydactyla*, CNHM 63033 (♂), Feiran oasis, Sinai (Egypt);

E, *Agama stellio vulgaris*, CNHM 95907 (♀), Burg el Arab (Egypt);

F, *Agama stellio stellio*, CNHM 74558 (♂), Shemlan, near Beirut (Lebanon);

G, *Agama stellio picea*, CNHM 19658 (♀), Qasr el Burqu' (Jordan).

— though they are less deviating from the normal form B — colour peculiarities of which are coupled with some distinct pholidosis and proportional characters. Moreover, C (Cyprus) and E (NW Egypt) are completely isolated.

The black variety from eastern Jordan also evidently deserves the subspecific status, given to it by Parker (1935) and called in question by Bodenheimer (1944). This form is restricted to the biotope of black rocks in the Jordanian desert. The melanistic character, which is an adaptation [3]) to this habitat, may have given rise to ecological and geographical isolation.

— Finally, there is the variety A, which was found on Delos and on Mikonos, and which differs from the normal form B by its conspicuously yellow head. This form probably does not inhabit all the Cyclades belonging to the range of the species: Wettstein (1957) reports that he saw great bluish black male Harduns on the island of Naxos; so probably the Turkish form is represented there.

Is the colour difference between head and body striking in preserved animals, a living specimen from Delos, kept in captivity during two years, shows that this character is subject to some variation: when hiding in its terrarium, the head colour is greyish yellow, growing warmer orange, however, when the lizard keeps close to a hot lamp for some time.

Besides, as in variety F, it remains to be settled whether we have to do with a genetically or an ecologically determined character here. The habitats of the Hardun on Delos and on Samos, for instance, are evidently different: Samos, as well as West Turkey and the other islands along its coast, are much more wooded and greener than the barren Cyclades. Naxos may be covered with somewhat denser vegetation than Delos and Mikonos. Finally, the Cyclade samples do not differ from Anatolian agamas in any other property than colouration.

3. *Taxonomical survey*

In this section an enumeration is given of the subspecies distinguished, each accompanied by a short diagnostic description, and by a list of the

[3]) The selection value of melanism in this biotope is attributed by Parker (1935) to advantages in heat regulation and not to the camouflaging effect. Apart from the appreciation of the importance of heat regulation in desert reptiles, I think that Parker disregards the cryptic effect too easily. He mentions the observation by the collector of the type specimens of the subspecies, Colonel Meinertzhagen, who found the lizards in great numbers upon areas of the rocks which had been whitewashed (as a guide to aircraft). This behaviour — though advantageous, as the whitewashed rocks will be relatively cool places in the heat of a black rocky desert — made the animals extremely conspicuous. Parker concluded: "If there were any intimate connection between the animals colour and that of its background, it would only be reasonable to expect the creature to show a preference for the background to which it is adapted." However, in this black lava desert where no whitewashed sections occur by nature, melanism may very well be selected in darwinian sense because of its protective value without a corresponding behavioural pattern being developed at the same time. Lawrence & Wilhoft (1958), who found that lava habitats in California are inhabited by a melanic form of the horned lizard, *Phrynosoma platyrhinos calidiarum* (Iguanidae), also attribute the selective value of this colouration to the cryptic effect.

collections numbers of the specimens studied. When necessary, distributional notes are made. The general distribution is given in fig. 8. For the synonymy of the species I refer to Mertens & Wermuth (1960).

Fortunately, the nomenclature of the species is by now stable enough to make the complete synonymy of each subspecies unnecessary. In the 19th century, records of the species were made mainly under the names *Stellio vulgaris* and *Stellio cordylina.* After publication of Boulenger's Catalogue of Lizards (1885), the name *Agama stellio* has been used exclusively.

Subspecific value is awarded only upon numerical characters when satisfying the 75% norm (relative tail length, subdigital number) and upon such geographical colour varieties, which are significantly deviating from normal *stellio* also in scale arrangement or proportional characters, as discussed in the preceding section. It is possible that the study of more extensive material would lead to the conclusion that the nominate subspecies still has to be divided into three taxonomic units, corresponding with the colour varieties A, B and F. Besides, there may rise arguments to split up the subspecies *brachydactyla,* and to attribute a distinct trinomen to the Sinai-Jebel 'Aja populations. Although not separated here taxonomically, these varieties are mentioned separately in the following key.

Key to the subspecies of *Agama stellio:*

1a. Upper side of head and body black, often with a few orange scales arranged in transversal rows across the back and in rings around the tail; length of tail divided by the snout-vent length generally less thans 1.3 .... *A.s. picea* (East Jordan)
b. Body colour not black; at the most dark brown. T/HB usually exceeding 1.3 2
2a. Enlarged dorsal scales above the pelvis lying more or less isolated, each surrounded by granular scales (see fig. 6d) .... *A.s. vulgaris* (Northwest Egypt)
b. Enlarged scales coherent in a middorsal zone, running on above the pelvis 3
3a. Dorsal area of enlarged scales much broader than its lateral offshoots are long. (fig. 6c). Largest dorsal scales in adult specimens usually exceeding 3 mm in diameter 4
b. Middorsal zone of enlarged scales as broad as its lateral offshoots (fig. 6 a, b). Largest dorsal scales in adult specimens generally less than 2.5 mm in diameter 5
4a. Dorsal scales very sharply keeled or spinose; head shields rugose; ventral scales keeled .... *A.s. brachydactyla* (Negev desert)
b. Dorsal scales flat or feebly keeled; ventral scales are smooth .... *A.s. brachydactyla* (Sinai, Saudi Arabia)
5a. Head and body plain dark brown .... *A.s. stellio* (several localities in SW Turkey, Iraq, Syria, Lebanon and Jordan)
b. Head and body not plain dark brown 6
6a. Gular region marmorated of spotted .... *A.s. stellio* (Sporades, Turkey, several localities in Syria, Lebanon and Israel)
b. Gular region without marmoration or light spots 7
7a. Length of tail divided by snout-vent distance less than 1.6; subdigitals third finger less than 19, subdigitals fourth toe less than 24. Head conspicuously lighter than ground colour of the back .... *A.s. stellio* (Delos and Mikonos)
b. Length of tail divided by snout-vent distance exceeding 1.6; subdigitals f3 exceeding 18 in number, subdigitals t4 more than 24 .... *A.s. cypriaca* (Cyprus)

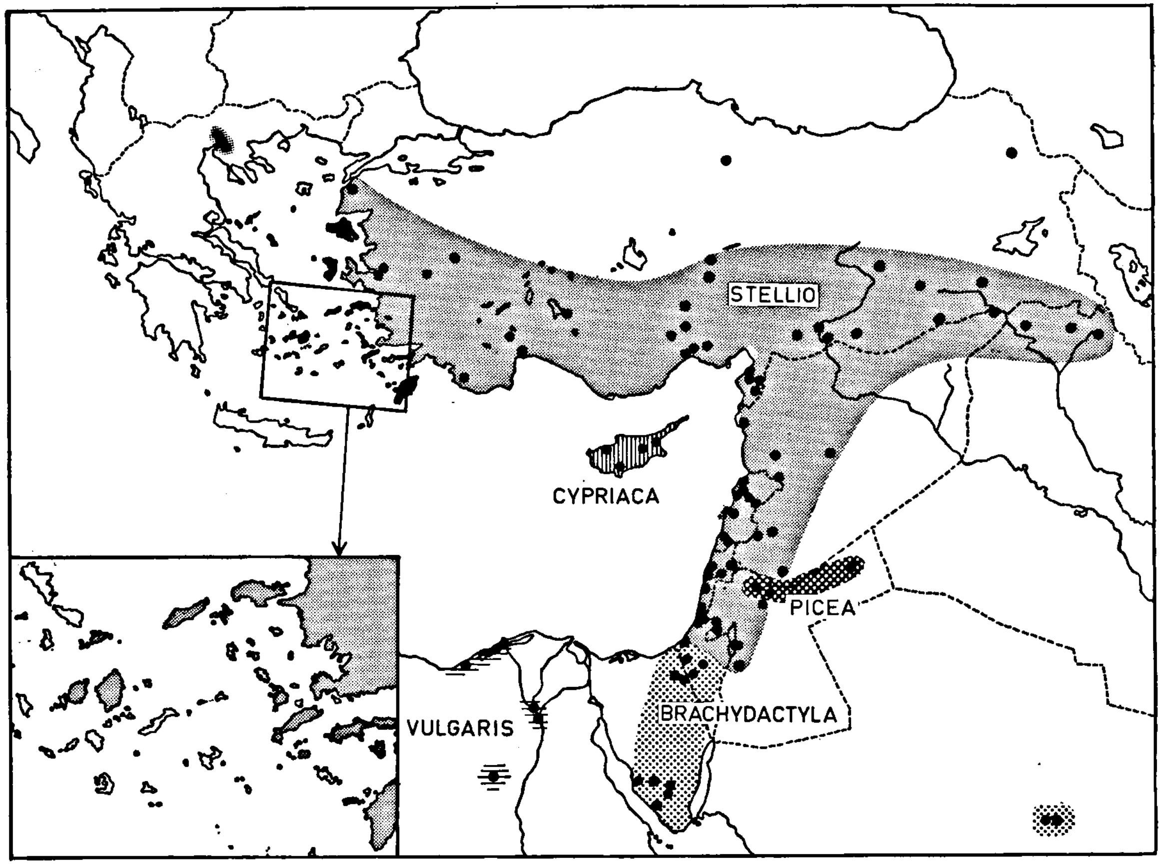


FIG. 8. Distribution of the subspecies of *Agama stellio*.

Agama stellio stellio (Linnaeus, 1758)

Lacerta stellio Linnaeus, 1758, Syst. Nat., Ed. 10, **1**: 202 — Terra typica restricta (Mertens & Müller, 1928): Delos, Cyclades.
Stellio antiquorum Eichwald, 1831 (nomen substitutum pro *Lacerta stellio* Linnaeus), Zool. spec. Ross. Polon., **3**: 187 — In Caucaso (?).
Agama stellio Boulenger, 1885, Cat. Liz. Brit. Mus., **1**: 368 (partim).
Agama stellio stellio Bird, 1936, Ann. Mag. nat. Hist. (10), **18**: 261.

Type specimen: lost.
Material: 153 specimens

Greece: Delos (16): ZMA 10692, 10696, 11531—43, 11841; Mikonos (5): ZMA 10697; BMNH 1933.12.2.6—7; 1920.1.20.1114; Ikaria (Therma Loutra) (2): ZMA 10695, 11546; Samos (Pyrgos, Marathokampos) (5): ZMA 10670, 10679—80, 10690, 10698; Rhodes (2): BMNH 1917.5.11.239—240; Corfu (near Limni Chalikiopoulo) (3): RMNH 12802—04.
Turkey: Izmir (2): BMNH 94.10.2.2; Xanthus (2): BMNH 55.10.16.96; Antalya (6): RMNH no number; Zebil (Bolkar Daglari) (5): BMNH 76.7.21.2, 76.7.21.9; Mersin (1): RMNH no number; Iskenderun (14); CNHM 78641—46, 78648—55; Urea (7): CNHM 78634—40; Gaziantep (7): BMNH 1935.11.4.103—109; Rumkaleh (1): BMNH 79.11.5.2; Birecik (1): BMNH 79.11.5.1; Amik plain (5): CNHM 25345—49.
Iraq: Dihok (1): BMNH 1923.6.26.1; 'Aqrah (1): CNHM 19640; Rawandiz (2): CNHM 74564.
Syria: Latakia (1): BMNH 1957.1.11.72; Palmyra (1): CNHM 47412; Damascus (1): BMNH 81.6.6.10; Jebel ed Druz (1): BMNH 1933.11.19.7; "Syria" (2): RMNH 10396, 10402.
Lebanon: Tripoli (6): BMNH 1955.1.11.1—4; CNHM 74554; Jubeil (=Byblos) (5): CNHM 74557; Beirut and Shemlan near Beirut (5): CNHM 74555—59; Adloun (3): CNHM 74560; Amyun (7): BMNH 1957.1.11.73—79; "Cedars of Lebanon" (4): BMNH 1957.1.11.80—83; Beth Anath (= Ainata) (1): BMNH 1933.11.19.8.
Israel: Lake Tiberias (2): BMNH no number; Nazareth (1): BMNH 1923.1012.55; Haifa (2): ZMA 11547, BMNH 1937.7.15.1; Caesarea (1): CNHM 74472; Tel Aviv (1): CNHM 62568; Ramle (3): BMNH 81.6.6.8, 1927.8.12.22, CNHM 74473; Jerusalem (3): BMNH 81.6.6.7, 1959.1.1.53, CNHM 74471; Rehovoth (1): CNHM 26883; "Palestine" (3): CNHM 48470—72.
Jordan: Bethlehem (10): CNHM 74561—63; Hammam es Sarkh (1): CNHM 11070; "Moab" (1): CNHM 1588.

Diagnosis — The normal, well-known form, as described by Boulenger (1885), characterized by a narrow middorsal zone of enlarged scales with regular transversal offshoots between the flank scales. These enlarged scales are keeled but not very spinose. Adult animals generally have a snout-vent distance of 90—120 mm. Length of tail in relation to this distance averaging 1.43 (range 1.2—1.7). Fingers and toes are short in the northern part of the range (number of subdigitals averaging 16.5 in third finger and 22 in fourth toe) and long in the southern part (f3 : 18.5; t4 : 24). Colouration is rather variable. Generally a dark greyish ground colour of head and body, against which a pattern of four to five vertebral patches is outlined. Behind the head, at both sides before the shoulders, sometimes a black collar spot is present, not unlike the dark spot in *Agama atricollis*.

Exceptional in colouration are animals from Delos and Mikonos, with lemon-coloured upperside of head and a light unspotted chin (see fig. 7A). Specimens from Corfu and Samos are darker than the Cyclade series; they have a bluish-grey head and body. The chin shows a clear spotted pattern. In general, Harduns from Corfu and the Sporades have more resemblance with those from Turkey than with animals from the Cyclades. In Turkish Harduns (fig. 7B) bluish tinges predominate in the west, whereas in eastern Turkey more brownish and buff colours occur. Normal *stellio* from the Lebanean-Israelian mountain range are slightly lighter than in Turkey. In the Near East countries around the Syrian desert and along the coastal strip of Lebanon, a very dark, plain rusty-brown form occurs, in which the dorsal patches generally have disappeared completely (fig. 7F). The local race from the northern half of the Transjordanian highplateau, mentioned by Haas (1951a) as "rather dark, even blackish; having blue patches on the side of the body; and being quite different from specimens from Palestine", is very likely to belong to this variety.

Distribution — The nominate subspecies covers the greater part of the range of the species (see fig. 8). The exact distributional borders are incompletely known, except for the European part. On the Greek continent the lizards are found only in the surroundings of Thessaloniki (Klaptocz, 1910; Chabanaud, 1919; Kattinger, 1941; personal observation in August, 1963). Wettstein (1953) supposed this to be a relict population. In view of the situation in Egypt, where also a limited area around an important seaport (Alexandria) is inhabited, and in the island of Corfu, where a limited population lives near the city of Kerkyra (Mertens, 1961), I doubt if this explanation is necessary: the Hardun may very well have been introduced more or less recently from elsewhere through means of the intensive ship transport in the Aegean Sea.

The Aegean islands inhabited by the Hardun are, according to Wettstein (1953): Mikonos, Delos, Naxos, Paros, Antiparos (Cyclades) and Lesvos, Chios, Ikaria, Furni, Thimena, Samos (Sporades), Kalymnos, Kos, Nisiros, Simi, Chalki, Rhodos (Dodecanese), Flower (1933) abusively mentioned the islands Milos and Cephalonia (= Kephalinia) as places of record.

In Turkey, *Agama stellio* is found regularly in the southern half of the country. Distributional records are summarized by Bodenheimer (1944). Only two records, from Amasia (Boettger, 1890) and Kötek (Mertens, 1952), show the occurrence in Northern Turkey. Syria is not very well known herpetologically. In this country, Harduns are found in the western parts and in the extreme northeast in Kurdistan (Ain Divar; Angel, 1936). In Lebanon and Israel the species is quite abundant (Haas, 1951a). Finally, the west Jordan populations are reckoned to belong to the nominate subspecies.

Agama stellio picea Parker, 1935

Agama stellio picea Parker, 1935, Proc. zool. Soc. London: 142; Pl. I — Terra typica: Black Lava desert, 32°10'N, 36°40'E, Jordan.

Material: 8 specimens

Jordan: Black Lava desert (4 syntypes): BMNH 1946.8.28.53—56; Qasr el Burqu' (4): CNHM 19655—58.

Diagnosis — A melanic race, with deep black colouration, in females with a few orange spots scattered on head and legs and in transversal rows on the back. Both males and females have orange rings around the tail. The ventral side is plain dark brown in males, and spotted in female animals. *A. picea* is a small subspecies, with a snout-vent distance not exceeding ten cm. The tail is short: T/HB ranges from 1.03 to 1.25 in the four syntypes. Of the Qasr el Burqu' specimens, only a subadult one (CNHM 19656) has an unimpaired tail, with a T/HB relation of 1.37. Fingers are short (f3 averaging 15.5; t4 20.7). Dorsal scale arrangement as in typical *stellio.*

Distribution — The area of the subspecies seems to be limited to the Black Lava desert in Jordan. In addition to the two localities from where material was available, *Agama stellio picea* is recorded from between Oil camp H4 and Mafraq in Jordan (Wettstein & Löffler, 1951).

Agama stellio cypriaca n. subsp.

Stellio cyprius Fitzinger, 1843 (nomen nudum), Syst. Rept., 1: 85— Cyprus.
Stellio cordylina, Günther 1879, Proc. zool. Soc. London: 741.
Agama stellio stellio, Knoepffler, 1963, Vie et Milieu, 14 : 843.

Material: 17 specimens

Cyprus: Limassol (4): BMNH 1930.3.12.4 (♂), 1930.3.12.5 (♀), 1930.10.5.6—7 (♂ ♂), collector R. L. Cheverton, 1930.
Nikosia (4): RMNH (♀, no number), coll. W. J. Roosdorp, 24.VIII.1952; LAR 1010 (♂), 1012 (juv.), coll. Monniot, 1962; ZMA 13073 (♀), coll. H. Schnurrenberger, 1962.
Salamis (1): LAR 1009 (♂), coll. Biguet, 1962.
Temple of Vouni (1): LAR 1011 (juv.), coll. Monniot, 1962.
No exact locality (7): BMNH 87.9.27.1 (♀, bad state) 87.9.27.2—5 (♂ ♂), coll. Lord Lilford, 1887: RMNH (♀, ♂, no number), coll. H. Rolle, 1905.
Holotype: BMNH 1930.10.5.6.
Paratypes: the other specimens from Limassol, Nikosia, Salamis and Vouni.

Diagnosis — *Agama stellio cypriaca* is characterized mainly by its long tail: tail length reported on the snout-vent distance ranges from 1.53 to 1.92, averaging 1.73. In the other subspecies, this relation rarely exceeds 1.6. Fingers and toes are long (19—22 subdigitals under the third finger, 22—28 under the fourth toe), like in *A.s. vulgaris* and in the Lebanean-Israelian populations of *A.s. stellio.* Exact proportions are given in table VI. In the dorsal scale arrangement, the agamas from Cyprus agree well with the nominate subspecies. The small scales of the chin, especially in the region of the gular fold, are strongly spinose.

TABLE VI. Proportional data on the specimens of *Agama stellio cypriaca* n. subsp. (T = length of tail; HB = snout-vent distance; H = length of head; f3 = number of subdigitals third finger; t4 = number of subdigitals fourth toe)

Collection number		sex	T	HB	H	f3	t4
BMNH 1930.10.5.6.	(holotype)	♂	215	119	41.2	19	24
BMNH 1930.10.5.7.	(paratype)	♂	195	101	34.7	20	26
BMNH 1930.3.12.4.	(paratype)	♂	163	91	28.9	20	26
BMNH 1930.3.12.5.	(paratype)	♀	154	85	26.5	21	28
LAR 1009	(paratype)	♂	—	130	40.1	21	27
LAR 1010	(paratype)	♂	—	130	41.0	20	25
LAR 1011	(paratype)	juv.	130	73	22.2	19	22
LAR 1012	(paratype)	juv.	135	80	24.6	21	28
ZMA 13073	(paratype)	♀	149	97	28.4	22	26
RMNH (h) (Nikosia)	(paratype)	♀	179	105	30.6	21	26
RMNH (i)		♂	—	124	39.8	19	25
RMNH (j)		♀	181	113	34.2	19	27
BMNH 87.9.27.2		♂	201	118	38.8	19	25
BMNH 87.9.27.3		♂	—	122	39.7	21	27
BMNH 87.9.27.4		♂	177	100	31.7	20	25
BMNH 87.9.27.5		♂	—	130	41.6	20	25
			mm	mm	mm		

Colouration varies from yellowish grey to dark grey. The rhomboid patches are very vague, and in most animals even completely missing. The granular scales on the back are in part darker than the enlarged scales. They often form a black reticulum, especially in the shoulder region. The tail, as in all other races, bears alternating light and dark rings. The head usually has the same colour as the back. The belly is light yellowish and, like the somewhat darker chin, nearly unspotted.

The type is a rather large male specimen (see fig. 7C), almost plain lead-grey in colour, with brown tinges in the tail rings, and in the orbital region. The darker reticulum above the shoulders is missing here.

Distribution: Cyprus.

Agama stellio brachydactyla Haas, 1951

Agama stellio stellio, Schmidt, 1941, Publ. Field Mus. nat. Hist., (zool.) 24—12 : 162 — Jabal 'Aja.

Agama stellio brachydactyla Haas, 1951, Ann. mag. nat. Hist., (12) **4** : 1052 — Terra typica: Jebel Lussan, Negev, Israel (SSW of Beer Sheva).

Holotype (not seen): Hebrew University, Jerusalem, cat.nr. HUJ 1801.

Material: 61 specimens

Israel: Wadi Ajram (1): BMNH 1951.1.2.54; Sede Boqer (1): CNHM 74474.

Egypt: Sinai peninsula: Mt Sinai (3): RMNH 3124, CNHM 3908—09; Feiran oasis (24): CNHM 63025—34, 63036, 95874—78, 95882—85, 95890—93; Gebel Katerina (28): CNHM 58694, 95879—81, 95886—89, 129976—95; no exact locality (1): RMNH 3125.

Saudi Arabia: Jebel 'Aja: Qishliya (1): CNHM 31656: Ha'il (2): BMNH 1963. 747—748.

Diagnosis — Exceptional in this subspecies is the dorsal scale arrangement: the enlarged dorsal scales are larger than in any other subspecies and lie in a broad vertebral zone (see fig. 6c). Sinai and Saudi-Arabian specimens have very flat dorsal scales, while animals from the Negev desert are characterized by their strong spinosity. Colouration varies from one locality to the other. Predominating tinges are pale yellowish and dark brownish grey, sometimes with rufous-vermilion tinges, which disappear, however, in spirit after some time, as Haas states. Two recently collected specimens from Ha'il still have preserved the brightly reddish brown colour in alcohol. The alternating light and dark annuli around the tail are especially clear in the pale coloured lizards, On the back most animals show a pattern of five to seven vertebral spots (4—5 in *stellio*). The gular region is nearly always unspotted.

Agama stellio brachydactyla is certainly the largest form of Hardun: the average snout-vent distance of adult males and females exceeds 120 mm. T/HB averages 1.48. Number of subdigitals low (f3 : 16.2; t4 : 21.5). Foot and hand "look rather stout and clumsy" (Haas, 1951b).

Distribution — Negev, southern Sinai, Jebel 'Aja. It is not known whether these three populations are isolated or not.

Agama stellio vulgaris Sonnini & Latreille, 1802

Stellio vulgaris Sonnini & Latreille, 1802, Hist. nat. Rept., **2** : 22 — Terra typica restricta (Mertens & Wermuth, 1960): Lower Egypt.
Agama stellio vulgaris, Schmidt & Marx, 1956, Fieldiana (Zool.), **39** : 26.
Type: existing?

Material: 50 specimens

Egypt: Western desert: Burg el Arab (44): CNHM 67204—06, 82784—96, 95894—95912, 129971—75; Ras el Hikma (4): CNHM 66125—28; Fayum province: Kom O Shim (3): CNHM 67201—03; "Egypt" (3): ZMA 11548—50.

Diagnosis — Deviating from typical *stellio* by the much looser arrangement of enlarged dorsal scales (see fig. 6d). In the neck these scales form a singular longitudinal row, giving the impression of a minute crest. Behind the shoulders they are arranged in transversal rows, interrupted in the middle of the back by a zone of smaller scales. Posteriorly, the enlarged scales lie quite loose from each other, with regular distances separated by the granular scales. Rather abruptly this type of arrangement passes into the tail rings.

Colour is dull brownish grey. The pattern of four light vertebral patches, still present in many juvenile animals, fades away in most adults. The chin is spotted; the dark collar spot of the topotypes of *stellio* is missing.

Proportions: maximal snout-vent distance measured 126 mm in males, 121 mm in females. T/HB averaging 1.43 (range 1.2—1.6). Fingers and toes long: subdigitals f3 averaging 19.6; t4 25.9.

Distribution — The subspecies *vulgaris* is entirely isolated from the geographically nearest form *brachydactyla*. Flower (1933) states that the Hardun occurs in Egypt only in the surroundings of Alexandria originally. About 1896 Alexandrian specimens were imported into two zoological gardens near Cairo (Gizeh Gardens and Delta Barrage Gardens), in order to "protect the plants from damage by rats," At the time of Flower's publication these had formed well-established populations, limited however to a small area around these Zoos. As shown by the specimen from Fayum (Kom O Shimx, collector Mr. H. Hoogstraal, 1951) the species has been introduced there too, in more recent times. It is hardly acceptable that both Anderson (1898) and Flower (1933) have overlooked the lizards in this locality.

Concerning the origin of the population near Alexandria, Flower suggests that this may be the result of introduction by human agency. This might very well be possible: the animals from northwestern Egypt are obviously different from *Agama stellio brachydactyla* in Sinai, and problably more allied to the Syrian and Israelian populations, in which occur the same long fingers and toes, the same spotted chin, and the typical scale arrangement, which is an intermediate between *vulgaris* and *brachydactyla.*

Moreover, also the Greek continental population inhabits a limited area around an important seaport (Thessaloniki). That hazardous displacements by human agency are not imaginary may be illustrated by a specimen of *Agama stellio* collected in Tetuan, Morocco by E. Lort Phillips in 1886 (BMNH 86.5.19.1).

The introduction of the species in Egypt must have taken place long enough ago to have enabled the population to develop a well distinguishable subspecific character.

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