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THERMAL ECOLOGY OF *CYRTODACTYLUS KOTSCHYI* (STEINDACHNER, 1870) (*SAURIA-GEKKONIDAE*) IN THE INSULAR ECOSYSTEMS OF THE AEGEAN

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ABSTRACT

Initial data on the thermal ecology of *Cyrtodactylus kotschyi* from two insular ecosystems of the Aegean are reported. *C. kotschyi* is a thermoconformer. *C. kotschyi* is an eurythermic gekko and is active all the year in the ecosystems of the Aegean archipelago.

INTRODUCTION

The family Gekkonidae is one in which a high proportion of the species are nocturnal (Avery, 1982). Thermoregulatory patterns within the Gekkonidae include active control of body temperatures at night by selection of appropriate substrates, passive control of body temperature achieved by modification of activity times and diurnal basking (Avery, 1982).

Cyrtodactylus kotschyi (Steindachner, 1870) (Sauria-Gekkonidae) is the most widespread lizard in the insular ecosystems of the Aegean archipelago. Although the distribution and the systematics of this gecko are well known (Werner, 1930, Wettstein, 1953, Beutler, 1981, *et al.*), on the contrary its ecology in the Aegean ecosystems has been studied less. Some data on its ecology are referred by Beutler (1981), Beutler and Gruber (1977, 1979) and recently by Valakos and Vlachopanos (1987).

The initial data on the thermal ecology of *C. kotschyi* are reported in the present study from two insular ecosystems of the Aegean during July and November of 1987 and February and March of 1988.

LOCALITIES AND METHODS

One hundred and thirty geckos were collected from two insular ecosystems of the Aegean archipelago.

Fifty one of the geckoes were collected in the eastern part of the Naxos island (Central Aegean), 6 km south of the small village of Moutsouna, during July, November and March. The main characteristics of the area are the rocky terrain and the vegetation which is maquis. The most predominant plant species is the *Juniperus phoenicea*; however *Pistacia lentiscus* and *Olea europea* are abundant.

Seventy nine of the geckoes were collected from ecosystems located on the small island of Antikythira (SW Aegean), during February. The main characteristics of these ecosystems are the rocky terrain and the vegetation which is degraded maquis, where *Juniperus phoenicea, Pistacia lentiscus, Thymus capitatus* and *Genista acanthoclada* are abundant.

Geckoes were collected by airgun or hand. For every gecko, date, time, length (snout-vent), position in the environment when first observed, body temperature (Tb) (with quick reader cloacal thermometer, Muller & Co), air temperature (Ta), 5cm above the position of gekko and substrate temperature (Ts) (with digital thermometer) were recorded.

For statistical analysis, Mann-Whitney U-tests, Student t-tests and regression analyses, were used as described by Zar (1984).

RESULTS

Average cloacal (Tb), air (Ta) and substrate temperatures (Ts) are given in Table 1. (Twenty three cases which were recorded in winter when the geckoes were in their burrows motionless were not included.)

	Tb°C			Ta°C			Ts°C			
Months	x	SD	Range	x	SD	Range	x	SD	Range	N
July	30.7	3.2	26.6-37.2	27.5	1.6	24.5-31.0	28.8	2.3	25.0-33.8	31
November + March	22.2	3.1	16.5-29.3	17.0	2.1	12.0-20.2	19.3	2.9	15.4-25.1	20
February	15.6	3.1	9.0-22.0	13.9	2.7	8.0-20.1	14.3	2.5	10.0-21.0	56
All the months	21.2	7.3	9.0-37.2	18.4	6.3	8.0-31.0	19.5	6.7	10.0-33.8	107

TABLE 1: Descriptive statistics for body (Tb), air (Ta) and substrate (Ts) of *C. kotschyi*.

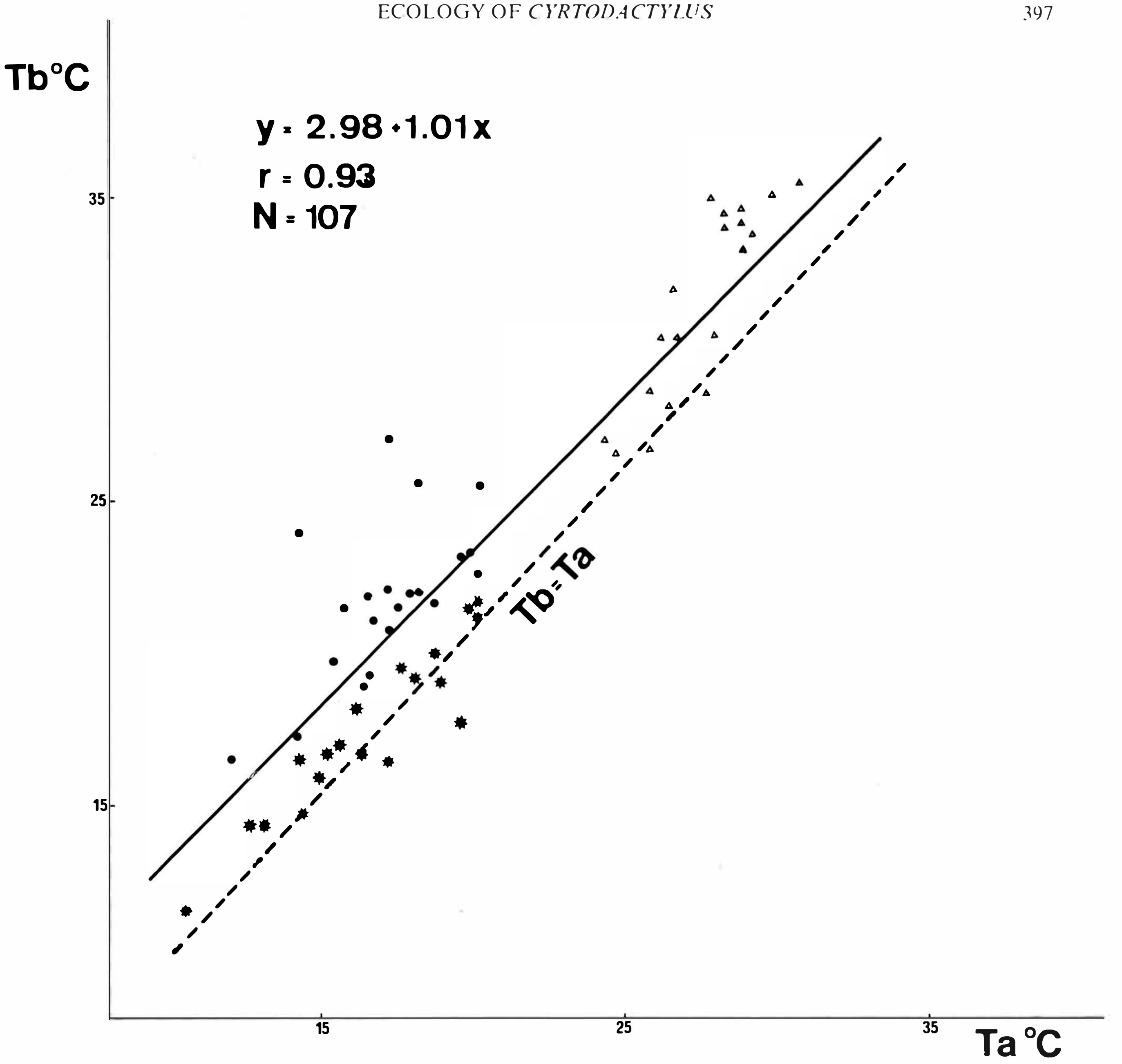

Fig. 1 Relationship between body temperature (Tb) and air temperature (Ta), in *C. kotschyi*. Solid line = line for equivalence, i.e. Ta = Tb, dots = November + March, stars = February, triangles = July.

There was a significant correlation between Tb and Ta (Fig. 1 r = 0.93 P<0.05). Also there was a significant correlation between Tb and Ts (Fig. 2 r = 0.96 P<0.05). The slopes Tb versus Ta and Tb versus Ts did not differ from 1 (Tb ver. Ta t = 0.37 P<0.05 — Tb ver. Ts t = 1.91 P<0.05).

	Tb vs Ta				Tb vs Ts			
	b	r	r^2	P	b	r	r^2	P
July	1.50	0.77	0.60	<0.05	1.12	0.82	0.66	<0.05
November + March	0.83	0.55	0.31	<0.05	0.79	0.74	0.55	<0.05
February	1.06	0.94	0.88	<0.05	1.02	0.95	0.89	<0.05
All the months	1.01	0.93	0.87	<0.05	1.04	0.96	0.95	<0.05

TABLE 2: Correlation between body temperature (Tb) and air (Ta) and substrate temperatures (Ts) in every season (b = slope of the curves). Number of cases as in Table 1.

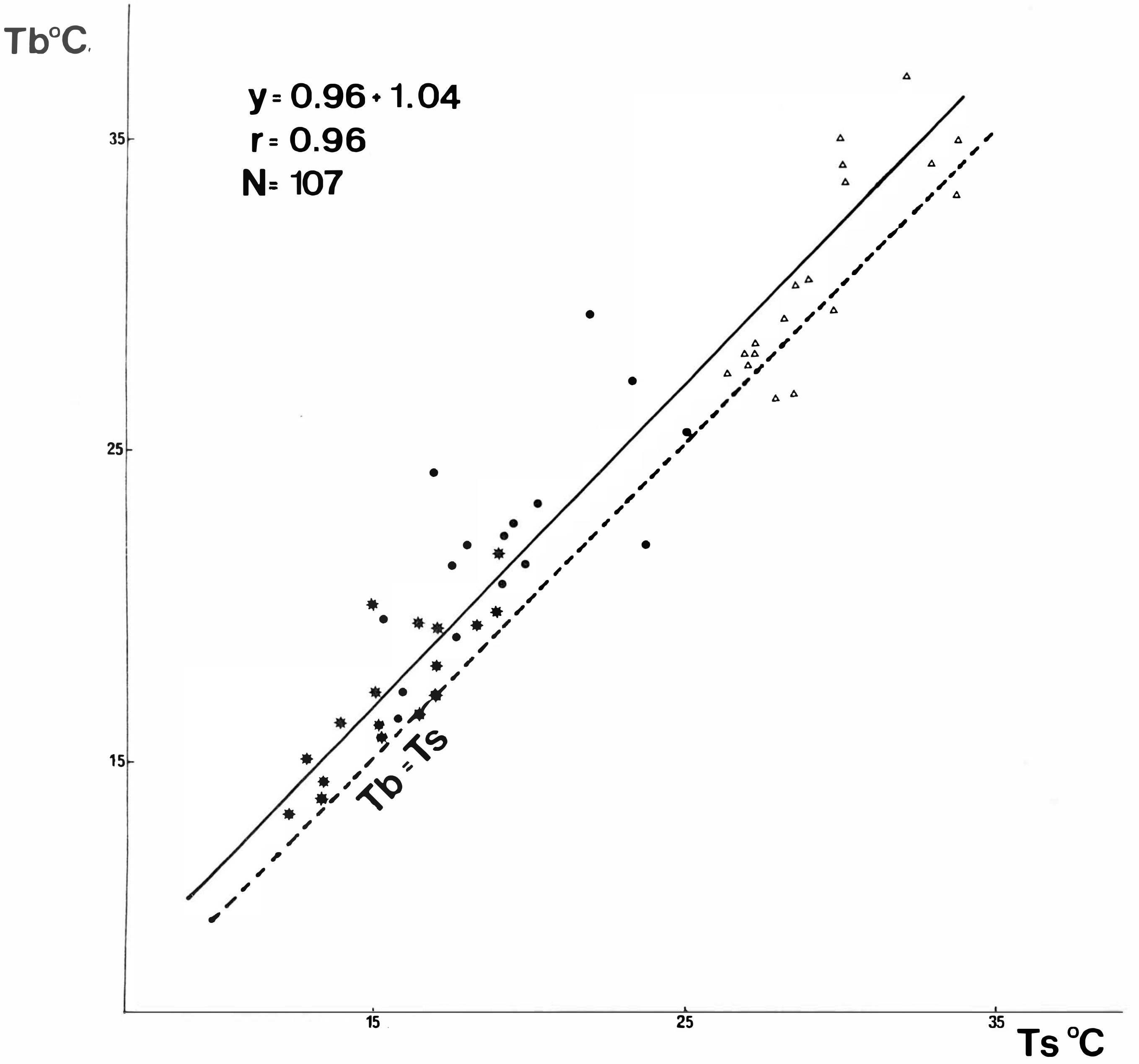

Fig. 2 Relationship between body temperature (Tb) and substrate temperature (Ts), in *C. kotschyi*. Symbols as in Fig. 1.

Also in Table 1 are given average cloacal, air and substrate temperatures. There was no difference between Tb's between November and March (Mann-Witney U test U = 68 $P<0.05$) so the data were pooled. There was a significant correlation between Tb and Ta and also between Tb and Ts every month (Table 2). The slopes of the regression Tb ver. Ta and Tb ver. Ts in every month did not differ from 1 (Tb ver. Ta, November plus March t = 0.58 $P<0.05$, February t = 1.42 $P<0.05$ July t = 2.14 $P<0.01$; Tb ver. Ts, November plus March t = 1.24 $P<0.05$, February t = 1.02 $P<0.05$ July t = 0.83 $P<0.05$).

Activity Periods

In July the geckoes appeared in two periods during the day. One period between sunrise (6.30 a.m.) until 10 a.m. and a second period between sunset (7.00 p.m.) until 10 pm. Tb in the first period ranged from 26.6°C to 37°C and in the second period from 26.9°C to 30.7°C. During these periods the individuals basked on the stones.

In the other months the animals had a unimodal activity. In November and March the geckoes appeared and, basked on the stones from 10 a.m. until 4.30 p.m., when Tb ranged from 16.5°C to 29.3°C, Ta from 12°C to 20.2°C and Ts from 15.4°C to 25.1°C.

In February the gekkoes appeared and basked on the stones or in the holes between the stones from 10 am to 3 pm. Tb's ranged from 9°C to 22°C, Ta's from 8°C to 20.1°C and Ts's from 10°C to 21°C.

Twenty three motionless animals were captured in their burrows and their body temperatures ranged from 8°C to 12°C (mean (9.8°C) Ta ranged from 8°C to 12°C (mean 9.19°C) and Ts ranged from 8°C to 12°C (mean 9.08°C).

DISCUSSION

C. kotschyi is a thermoconformer. The slope of the curve Tb ver. Ta did not differ from 1 (Huey and Slatkin, 1976). Also the slopes of the curves Tb ver. Ta in every season did not differ from 1 (Huey and Pianka, 1977). Thermally passive lizards seem to have longer activity times than thermoregulatory ones (Tanaka, 1986). *C. kotschyi* was active in the biotope of Naxos island even in the cloudy days when the sympatric thermoregulatory species *Podarcis erhardii* (Sauria-Lacertidae) was inactive (per. obs.).

The different mean body temperatures among the seasons showed that *C. kotschyi* is an eurythermic lizard. The eurythermic lizards are also eurytopic (Ruibal *et al.*, 1970). This fact is in agreement with the wide distribution of this gekko in all the Aegean insular ecosystems.

Gekkonidae belongs to the thigmotropic lizards (Spellerberg, 1972). *C. kotschyi* uses the substrate temperature to maintain its body temperature. There was significant correlation between Tb and Ts, and also the value-r^2 was higher than 0.5 every season.

C. kotschyi is the most diurnal gecko in the Europe (Beutler, 1981). Valakos and Vlachopanos (1987) reported that *C. kotchyi* was active in the summer in the twlight zone of the day while in spring and fall, its activity depended on the ambient temperature. From the winter observations it seems that the activity of this gecko depended on the light conditions because it was active even in low ambient temperature. It is known that the activity of lizards is related not only to ambient temperature but also to photic conditions (Heatwole, 1976). The *C. kotschyi* is active in summer at such times so that it avoids the high temperatures during the day, but in other seasons it is active in a wide range of a ambient temperatures and its activity depends also on the light conditions.

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