

## Effects of Shielding the Parietal Eye on Exposure to Lights and of Parietalectomy on Testicular Development in *Chalcides ocellatus* Forssk (Reptilia: Scincidae)

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**ABSTRACT.** The effects on exposure to light of shielding parietal eye and of parietalectomy on testicular activity were investigated in *Chalcides ocellatus*. Differences between the means of the numbers of lizards exposed to light after shielding their parietal eyes and of control animals was not significant ( $P > 0.1$ ). There was a significant variation ( $P < 0.7$ ) however, in the numbers of animals exposing themselves to light at different hours of the day, but no significant difference was obtained between the sums of the daily counts ( $P > 0.05$ ). Histological assessment of testicular activity showed that neither the parietalectomized nor the control lizards performed better than one another.

The lizard parietal eye, first described by Leydig (1872), may be a "photothermal radiation dosimeter" synchronizing daily and seasonal activity (Glaser 1958, Stebbins and Eakin 1958), or else a component of a "physiological illuminometer" involved in regulating the amount of exposure to sunlight (Packard and Packard 1972).

Shielding of the parietal eye (Stebbins and Wilhoft 1966, Packard and Packard 1972) or removal of the parietal eye (Stebbins 1970, Stebbins and Eakin 1958) may cause lizards to increase their amount of exposure to sunlight, with increased exposure being accompanied by increased locomotor activity (Glaser 1958, Stebbins and Eakin 1958).

Contradictory observations on the effect of parietalectomy on the testis have been reported. Clausen and Poris (1937) claimed that parietalectomy in *Anolis carolinensis* accelerated spermatogenesis, while inconclusive results were reported by Fox and Dessauer (1958). On the other hand, Licht and Pearson (1970) reported that parietalectomy did not affect the testis of this species. In *Xantusia*

*vigilis*, parietectomy seemed to accelerate spermatogenesis (Stebbins 1970) while, in *Sceloporus occidentalis*, parietectomy had no effect on the testes (Stebbins and Cohen 1973).

In this work the effects of shielding the parietal eye on exposure to light and of parietectomy on testicular activity were investigated in *Chalcides ocellatus*.

## Material and Methods

### *Animals*

Skinks (*Ohalcides ocellatus* Forssk.) used in this work were kept in wooden vivaria with a sand substrate in which the animals could burrow. Air temperature was maintained at  $31^{\circ}\text{C} \pm 2^{\circ}\text{C}$  from 08.00 - 21.00 hr. The light was provided by 'day-light' fluorescent lamps from 07.00 - 21.00 hr. Additional light and local heat were provided by a 60W tungsten lamp (08.00 - 21.00 hr) about 25 cm above a few flat stones on the surface of the sand. With this additional lamp, temperature ranged from  $40^{\circ}\text{C}$  directly underneath the bulb to about  $29^{\circ}\text{C}$  at the sides of the vivaria.

### *Experiment I*

Thirty-two lizards of mixed sexes were matched with respect to body size. The interparietal scales of the experimental lizards (16) were covered with a thick plaque of aluminium paint to prevent light from reaching the parietal eye. The painted areas were covered with a small patch of surgical tape to prevent abrasion of the paint when the animals burrowed. The vivaria was shielded with black polythene sheets so that lizards could be observed without undue disturbance. The container was quietly approached at intervals of one hour from 07.00 - 21.00 hr every day for 10 continuous days and all lizards seen were counted. Counts of exposed lizards are considered to be reliable indices to light exposure (Stebbins and Eakin 1958, and Packard and Packard 1972).

### *Experiment II*

Twenty male lizards over 9 cm in snout-vent length were used; the length and width of the right testis of each lizard was measured *in situ* at laparotomy after cold anaesthesia. Positive identification of all lizards was achieved by number attached to the tails, and by toe-clipping. Two days after laparotomy in 10 lizards, parietectomy was carried out. Under a binocular microscope the interparietal scale was lifted and the exposed parietal eye was destroyed by a fine-point diathermy instrument (The Gento-Urinary MFG Co.). The wound was sealed with New-Skin (Germolene) and covered with a patch of surgical tape. The lizards (controls and experimental) were maintained at  $31^{\circ}\text{C}$  with L:D/ 14:10 photoperiod

for periods up to 40 days. At the end of the experiment, the length, width and histological condition of the right tests of each lizard was examined.

### *Statistical Analysis*

Student's t-test was used to assess the variation between the means of exposure to light of parietal eye shielded and control lizards. The significance of the mean of exposure to light of the two groups at the different hours of the day was tested by the G-test.

## **Results and Discussion**

### *Observations on Exposure to Light*

Observations showed that the lizards would expose themselves fully or only partially, remaining partly buried in the sand. On several occasions, the stones in the vivaria were covered with lizards lying one on top of one another. Lizards were seen basking in the area of high temperature and light intensity beneath the bulb more often than elsewhere in the vivaria.

The daily pattern of exposure involved long periods of quiescence with periodic lifting of the head.

### *Effect of Parietal Eye-shielding on Exposure to Light*

Figure 1 compares the daily pattern of exposure to light of control lizards and animals with their parietal eyes shielded. The pattern of exposure was virtually the same in each group. A high incidence of exposure occurred during the early hours of the light period, when the ambient temperature was rising slowly and more lizards sought warmth beneath the bulb than at other times when the ambient temperature reached a stable maximum, the number of lizards basking dropped and remained more or less steady throughout the warm light period. When the temperature fall just before the end of the light period, few lizards remained active.

Although lizards with their parietal eyes shielded were seen more frequently than the control animals (Fig. 1) variation between the numerical means of the two groups was not significant ( $P > 0.1$ ) as calculated by Student's t-test (Table 1a). Comparing the mean of the observations of the two groups using the G-test (Table 1.b), reveals that there is a significant variation ( $P < 0.7$ ) in exposure to light at the different hours of the day, but no significant difference between the sums of the daily counts (10 replicates) ( $P > 0.05$ ). Interaction assessed by the G-test showed that lizards of neither group exposed themselves more or less than those of the other.

Shielding of the parietal eye of *C. ocellatus*, did not significantly affect the daily pattern of exposure to light in the present study, but there is some evidence

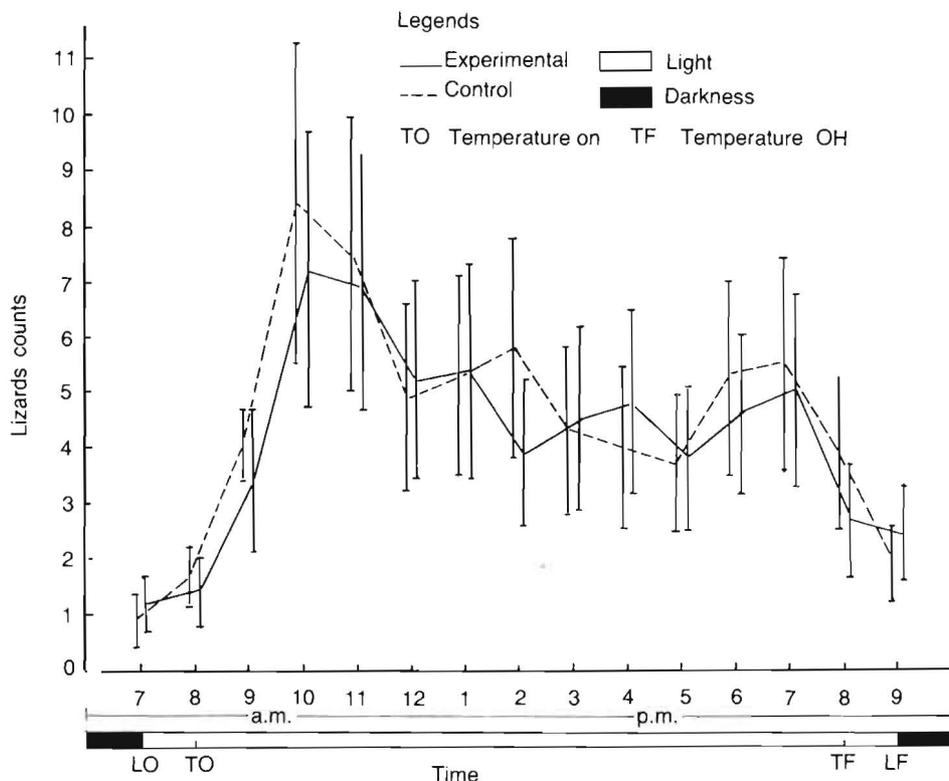


Fig. 1. The number of parietal eye shielded lizards basking at different times of the day (hourly counts).

that the amount exposure increased after parietal eye-shielding (Table 1b and Fig. 1.). Increased exposure to light following parietal eye-shielding has been reported in several species of lizards, *e.g.* *S. occidentalis*, *S. virgatus* and *X. vigilis* (Stebbins 1963, 1970, Stebbins and Eakin 1958, Stebbins and Wilhoft 1966) and in the males but not the females of *Callisaurus draconoides* (Packard and Packard 1972). From observations on parietal eye-shielded or parietectomized lizards it was suggested that the parietal eye functions as an "illuminometer", regulating the amount of exposure to sunlight (Glaser 1958, Stebbins and Eakin 1958, Packard and Packard 1972). On the other hand, in a photothermal gradient parietectomized lizards selected a higher temperature for basking than did control lizards, indicating a direct thermoregulatory function of the parietal eye (Hutchison and Kosh 1974, Engbretson and Hutchison 1976, Roth and Ralph 1976, 1977). Ralph *et al.* (1979) suggested that this thermoregulatory function may be complementary to any function as a light illuminometer.

**Table 1.** Statistical analysis of numbers of parietal eye-shielded and control lizards observed**a. T-test.**

Time (hr)	Experimental		Control		S.E.M.	Value of t
	N	$X_1 \pm SE$	N	$X_2 \pm SE$		
07.00	9	0.9 ± 0.43	12	1.2 ± 0.57	1.62	0.41408
08.00	17	1.7 ± 0.50	14	1.4 ± 0.62	1.82	0.36854
09.00	40	4.0 ± 0.65	85	8.5 ± 1.34	4.12	0.27136
10.00	84	8.4 ± 2.87	72	7.2 ± 2.49	8.12	0.30771
11.00	75	7.5 ± 2.50	69	6.9 ± 2.43	8.60	0.30779
12.00	49	4.9 ± 1.70	52	5.2 ± 1.79	5.10	0.16770
13.00	53	5.3 ± 1.83	54	5.4 ± 1.94	6.12	0.03649
14.00	58	5.8 ± 1.97	39	3.9 ± 1.34	5.46	0.77773
15.00	43	4.3 ± 1.49	45	4.5 ± 1.60	5.10	0.08921
16.00	40	4.0 ± 1.46	48	4.8 ± 1.66	5.08	0.35194
17.00	37	3.7 ± 1.27	38	3.8 ± 1.31	4.19	0.03527
18.00	53	5.3 ± 1.70	46	4.6 ± 1.44	5.11	0.30614
19.00	55	5.5 ± 1.90	50	5.0 ± 1.71	5.86	0.19067
20.00	39	3.9 ± 1.37	27	2.7 ± 0.96	3.84	0.69877
21.00	19	1.9 ± 0.70	23	2.3 ± 0.25	2.52	0.35493

**N.B.** (total of 10 replicates) means ( $\bar{X}_1$ , experimental;  $\bar{X}_2$ , control), standard error (SE) and standard error of the mean (S.E.M.)

**b. Summary of the G-test**

Source	D.F.	Value of G.	Probability
Row (0700-2100 hr)	14	24.60	P > 0.05 (sum of daily counts)
Columns ( $X_1$ and $X_2$ )	1	0.17	P < 0.70 (Photoexposure at different hours of the day)
Interaction ( $X_1 + X_2$ )	14	0.85	P > 1.00

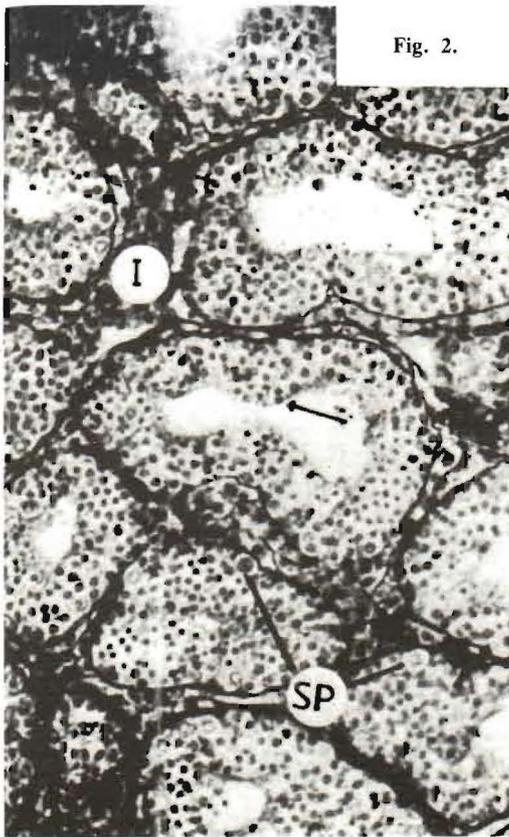
\* for  $X_1$ ,  $X_2$  see Table 1a.

**Parietalectomy and testicular condition**

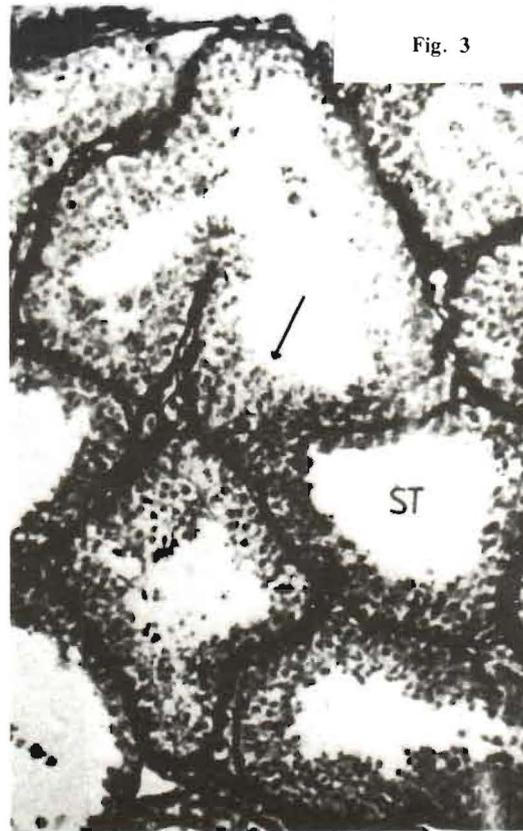
Table 2 indicates the spermatogenic condition of the control and experimental lizards. A comparable range of spermatogenic stages (Figs. 2, 3, 4, 5) is shown by each group. Although the results indicated that parietalectomized and control lizards responded similarly during the experimental period, it must not be concluded on the basis of these experiments that the parietal eye of *C. ocellatus* has no role to play in the control of reproduction. The experiments were not performed at a time of year when more marked results might have been expected. It would have been better to run some when all the animals were quite inactive (about November) and another series when recrudescence was just becoming established (April/May).

**Table 2.** Effects of parietectomy on spermatogenesis in *Chalcides ocellatus* maintained under (31°C, L:D/14:10).

Group	Duration in days	Number	Snouth-Vent (cm)	Body weight (g)	Spermatogenic stage								
					1	2	3	4	5	6	7	8	
Control	20	5	10.91 ± 0.75	19.39 ± 4.02	1	2	1	1	1				
Parietalectomized	20	5	10.67 ± 0.42	21.03 ± 1.65	1		2	2					
Controls	40	5	11.38 ± 0.17	23.87 ± 0.92	3			2					
Parietalectomized	40	5	10.33 ± 0.27	20.23 ± 2.15	3			2					



**Fig. 2.**



**Fig. 3**

**Fig. 2,3,4 and 5.** Cross sections of *Chalcides ocellatus* testis. All Figures magnified X 198. 7 µm, Mallory triple stain.

**Fig. 2.** Stage 3, note secondary spermatocytes on luminal margin (arrow).

**Fig. 3.** State 5, metamorphosing spermatids on luminal margin (arrow).

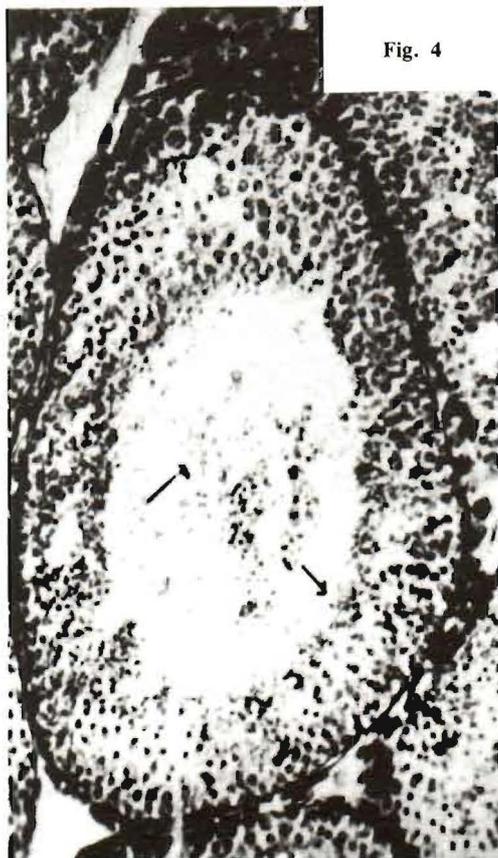


Fig. 4



Fig. 5

Fig. 4. Stage 6, many sperms on luminal margin and the lumen (arrow).

Fig. 5. Stage 7, note the small size of the seminiferous tubules (ST), narrow lumen and a massive layer of interstitial cells (I) between the ST; SP. Spermatogonia; S, Sertoli cells. 7.

Parietalectomy was reported to accelerate spermatogenesis in *A. carolinensis* (Clausen and Poris 1937), but inconclusive results were reported by Fox and Dessauer (1958) who pointed out that Clausen and Poris used experimental lizards which had not been matched for size with the controls. Licht and Pearson (1970) also reported that parietectomy did not affect the testes when they attempted to repeat the experiment of Clausen and Poris. They likewise, drew attention to the poorly controlled thermal conditions and lack of matching in the sizes of the experimental and control animals. Parietalectomy was found to accelerate testicular recrudescence in *X. vigilis* (Stebbin 1970), but was reported to have no effect on reproduction in males of *S. occidentalis* according to Stebbins and Cohen (1973), who acknowledged that their experimental design was poor.

It is concluded that, since the mechanism regulating mediation of photic stimuli to the brain through retinal receptors is a complicated one and might involve extra retinal photoreceptors (Underwood 1973), the negative results of these experiments do not indicate a lack of involvement of the parietal eye in the reproductive activity of *C. ocellatus* but simply that the particular experimental design has not demonstrated such an involvement.

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(Received 21/05/1985;  
in revised form 04/01/1986)

## أثر تعقيم العين الثالثة في التعرض للضوء وإزالتها على نشاط خصى السحلية كالسيدس أو سيلاتس

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درس تأثير التعرض للضوء في مجموعتين من السحالي، منع الضوء في إحدهما من الوصول للعين الثالثة بتعقيمها، بينما تركت المجموعة الثانية بدون تعقيم. لوحظ من دراسة سلوك السحالي أن المجموعة التي منع الضوء من الوصول لعينها الثالثة تخرج من الرمل وتتواجد أكثر من المجموعة الأخرى في الساعات المختلفة من مدة الإضاءة. وقد تمت معالجة العينات المتجمعة بالطرق الإحصائية. تمت أيضاً دراسة تأثير إزالة العين الثالثة في نمو ونشاط خلايا الخصى، وخلص البحث إلى أن إختيار توقيت التجربة مهم جداً في تجديد الدور الذي تؤديه العين الثالثة بالنسبة للنشاط التناسلي للذكور.