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Blinding induces copulatory activity among inactive males of South Indian gerbils

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The effect of blinding on reproductive behavioural physiology of male South Indian gerbils (*Tatera indica cuvieri*) was assessed. Blinding of reproductively inactive adult males resulted in 60% of them exhibiting sexual activity. Reproductive behavioural variables studied, such as intromission frequency, thrust frequency, ejaculation frequency and postejaculatory copulation frequency were exhibited to the level of reproductively active males. Such reproductive activation was also reflected in the epididymal sperm count. These studies reveal that blinding (constant darkness) may have a stimulatory effect in the reproduction of the tropical rodent *T. indica cuvieri*.

AMONG mammals, photoperiodic cues determine the periods of sexual activity and inactivity especially in temperate species[1,2]. Several investigations have been carried out to establish the influence of photoperiodic changes on reproduction. In hamsters, exposure to short photoperiod resulted in gonadal regression and loss of sexual behaviour[3,4]. Constant darkness (blinding) also influences reproduction of male rodents. According to Hard and Larsson[5], though mating was not fully impaired, the intervals between ejaculations were shorter for blinded male laboratory rats. In laboratory rats whose visual function was destroyed neonatally, a deficit in copulatory behavioural variables coupled with a decreased androgen level were observed[6]. Lack of responsiveness of the reproductive system to photoperiodic changes has been reported for male laboratory rats[7] and prairie voles[8]. Among tropical rodents gonadal regression consequent to short photoperiod has been reported for Indian palm squirrel *Funambulus pennanti*[9]. Another tropical rodent, the cane mouse (*Zygodontomys brevicauda*), however, was not responsive to variation in photoperiod with regard to the weight of testis and seminal vesicle[10]. Sinhasane and Joshi[11] reported that in Indian desert gerbil, *Meriones hurrianae*, constant light resulted in reproductive inhibition whereas constant darkness was stimulatory.

The South Indian gerbil *Tatera indica cuvieri* is a burrow dwelling tropical rodent with adult males and females occupying separate closed burrows[12]. They were found to be breeding throughout the year[13]. Our field observations show that the animal is nocturnal with foraging habits during the night after the onset of darkness. The male reproductive behaviour pattern of this rodent has been described[14]. The mating pattern consists of a courtship fighting (upright boxing), several mountings by the male, and intromissions. Ejaculation takes place during one of the intromissions. Typically a male exhibits one to four ejaculations during a complete mating period, and following the final ejaculation the male continued the copulatory activity without any ejaculation. However about 50% of the males were found to be reproductively inactive and did not exhibit these mating sequences[15]. Though photoperiodic alterations do influence the reproductive phenomenon of rodents, the response depends on the experimental schedule and the species employed. Hence further investigations on the male reproductive mechanism of this rodent is worth undertaking. As a first step we carried out the present study by assessing the impact of blinding on the reproduction of adult reproductively inactive male gerbils.

Gerbils were collected regularly from the field throughout the year, brought and acclimatized to the laboratory conditions under light/dark cycle of 12 : 12 h. Adult animals (165–185 g) were selected from among a stock of healthy ones. Only those males ($n = 8$) which did not copulate in several mating tests (range 4–6) were employed for blinding experiments. These reproductively inactive males did not show any mating behaviour other than random mounting attempts. Animals were housed individually in polypropylene cages provided with bedding of wood shavings and paper bits. They were maintained on laboratory rat feed and water *ad libitum*.

Blinding (constant darkness) was effected according to the method described by Thomas and Oommen[16]. For this, 0.2–0.3 ml of absolute alcohol (Merck, Germany) was administered into the vitreous chamber of the eye under mild etherization. This volume ensured a rapid and uniform distribution of the alcohol within the vitreous chamber under a pressure, with the excess flowing out. Following this the iris turned white, and an antiseptic eye ointment was applied to prevent any possible infection.

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Table 1. Reproductive behavioural variables of reproductively inactive, blinded and reproductively active males of *Tatera indica cuvieri*

Group	Courtship frequency	Courtship duration	Mount latency	Intromission frequency	Thrust frequency	Ejaculation frequency	Postejaculatory copulation frequency
Inactive males before blinding ($n = 9$)	3.7 ± 0.9	50.3 ± 11.6	511.1 ± 218.6	0.4 ± 0.2	0.9 ± 0.4	0	0
Blinded males ($n = 8$)	2.6 ± 1.4^{NS}	55.1 ± 15.5^{NS}	299.5 ± 171.2^{NS}	6.2 ± 0.6*	23.8 ± 1.0*	2.8 ± 0.2**	6.8 ± 2.3^{NS}
Reproductively active males ($n = 7$)	5.0 ± 0.8	76.1 ± 15.2	414.5 ± 126.2	4.6 ± 0.3	19.6 ± 1.2	2.3 ± 0.2	9.1 ± 1.6

Values are means ± SE; NS, Not significant (Wilcoxon–Mann–Whitney test, two-tailed).
*Blinded males vs inactive males before blinding, $p < 0.05$.
**Blinded males vs reproductively active males, $p < 0.05$.

Standard male copulatory behavioural variables were measured 12 days after blinding, employing healthy adult females chosen from the main stock. For this, a receptive female showing natural oestrus cycle was introduced into the male cage and observations were recorded till the end of the entire copulatory activity including the postejaculatory copulations, or 60 min without any intromissions. Each male was given three pre-experimental and three experimental mating tests. Data on epididymal sperm count were taken by sacrificing the males after 90 days of experiment. For this the epididymis were dissected out, finely minced and lightly homogenized in a 10 ml medium (20 ml Triton-X-100 in 100 ml saline) for one minute to obtain a complete sperm suspension, and centrifuged at 1000 rpm for one minute to separate the tissue debris. Sperm count in the supernatant was determined using a counting chamber. Statistical methods employed include Student's *t*-test and Wilcoxon–Mann–Whitney test[17].

Blinding resulted in sexual activity being induced among the formerly reproductively inactive adult males. A considerable proportion of such males (5/8) exhibited ejaculation. The reproductive behavioural variables of the blinded males were more or less equal to that of the reproductively active males (Table 1). This impact was also discernible at the level of the reproductive system as evidenced by an increase in the epididymal sperm count (Figure 1).

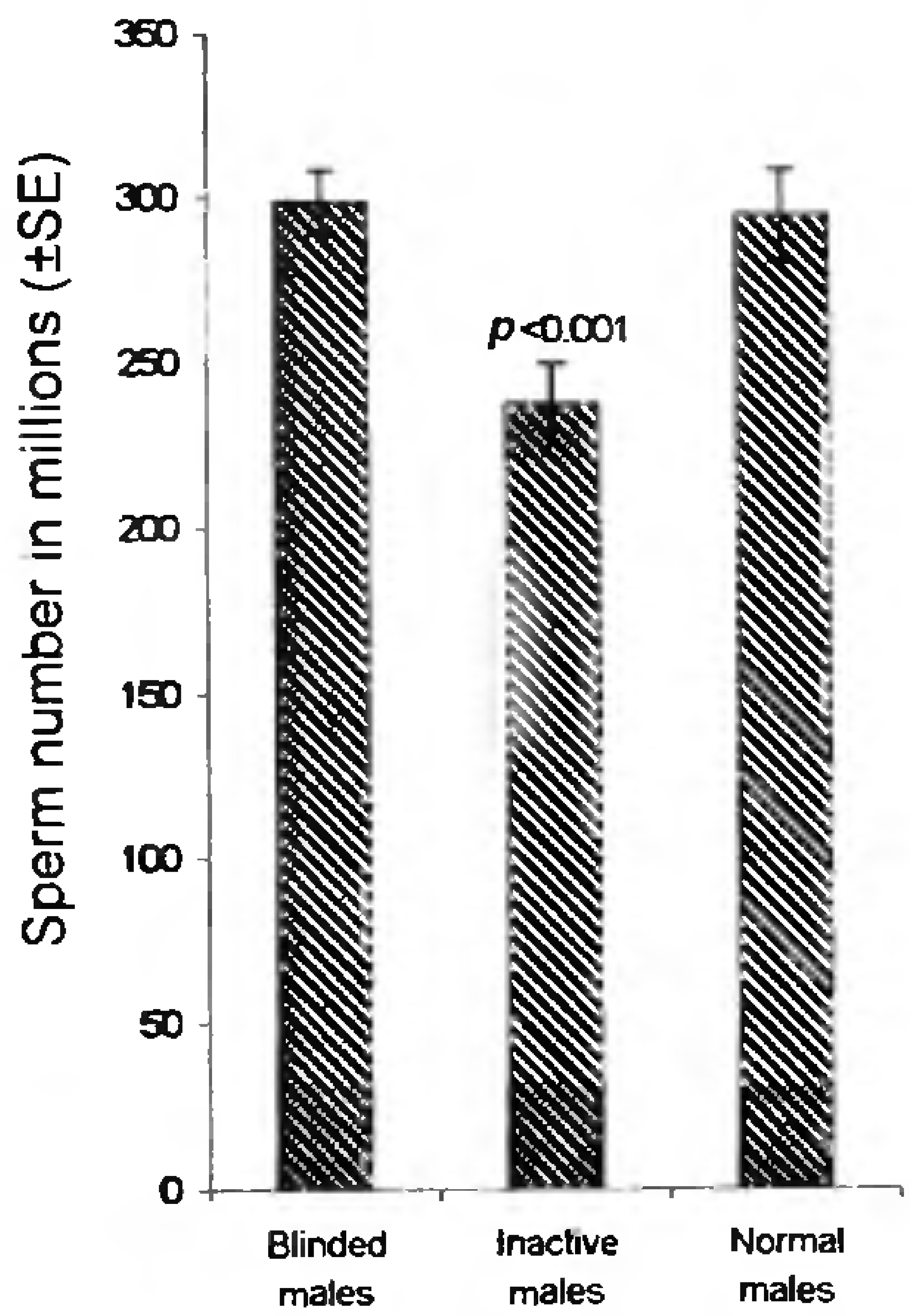

Figure 1. Effect of blinding on the epididymal sperm count (Student's *t*-test).

The reproductively inactive males, on blinding, attained active reproductive status. Reproductive behavioural variables such as intromission frequency, thrust frequency and ejaculation frequency exhibited by the blinded males were comparable to that of the reproductively active males suggesting that the blinded males were capable of inducing pregnancy. This is further evidenced from the postejaculatory copulation frequency since postejaculatory copulation is reported to have a major role in inducing pregnancy in this species[14]. Blinding also leads to an increase in the epididymal sperm count in them. Considering the fact that photic alterations can bring about changes in the androgen sensitivity of the brain[18], the stimulatory effect of blinding can be ascribed to be androgen-related.

These responses of *T. indica cuvieri* to blinding is worth mentioning, as constant darkness in several instances resulted in deficit in copulatory behaviour and gonadal regression of other rodents[6,19,20]. Increased exposure to darkness also brought about deficit in reproductive behaviour and delayed sexual maturity[3,21,22]. These suppressive effects on reproduction by increased darkness is attributed to an antigonadal effect of the pineal gland and its secretion, melatonin[23]. Comparable to our observations, increase in reproductive organ weight and epididymal sperm count consequent to darkness is reported for another Indian gerbil *M. hurrianae* for which the pineal hormone, melatonin, is ascribed a role[11]. Since the action of the pineal gland among mammals is closely related with the photoperiodic history of the concerned species[24], the present stimulatory effect of blinding can also be pineal-mediated.

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Large palaeolakes in Kaveri basin in Mysore Plateau: Late Quaternary fault reactivation

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Late Quaternary movements along the faults that demarcate tectonic boundaries of the N-S trending terranes of Biligirirangan and Closepet Granite in the Southern Indian Shield caused ponding of the River Kaveri and its tributaries Suvarnavati, Kabini and Shimsha of the Mysore Plateau. The resulting large lakes stretched tens of kilometres upstream in their valleys. Approximately 10 m thick black carbonaceous clay, characterized by prolific calcareous nodules including rhyzocretions in the top horizon, and covered locally by overbank fine sediments in floodways, represents the lakes that came into existence in the Late Pleistocene and lasted until Late Holocene. Subsequent fault movements were responsible for vertical displacement and attenuation of the lacustrine sediments. On-going movement is indicated by stream ponding in some segments and accelerated erosion of the elevated blocks.

THE much-faulted Southern Indian Shield (Figure 1) has time and again witnessed reactivation of faults of Precambrian antiquity[1]. Neotectonic activities on the multiplicity of faults are responsible for the evolution of the > 1200 m high Biligirirangan–Mahadeswaramalai Ranges in the east and > 1800 m Central Sahyadri mountain in the west. These high mountains bordering the Mysore Plateau enclose the basin of the Kaveri, an antecedent river of

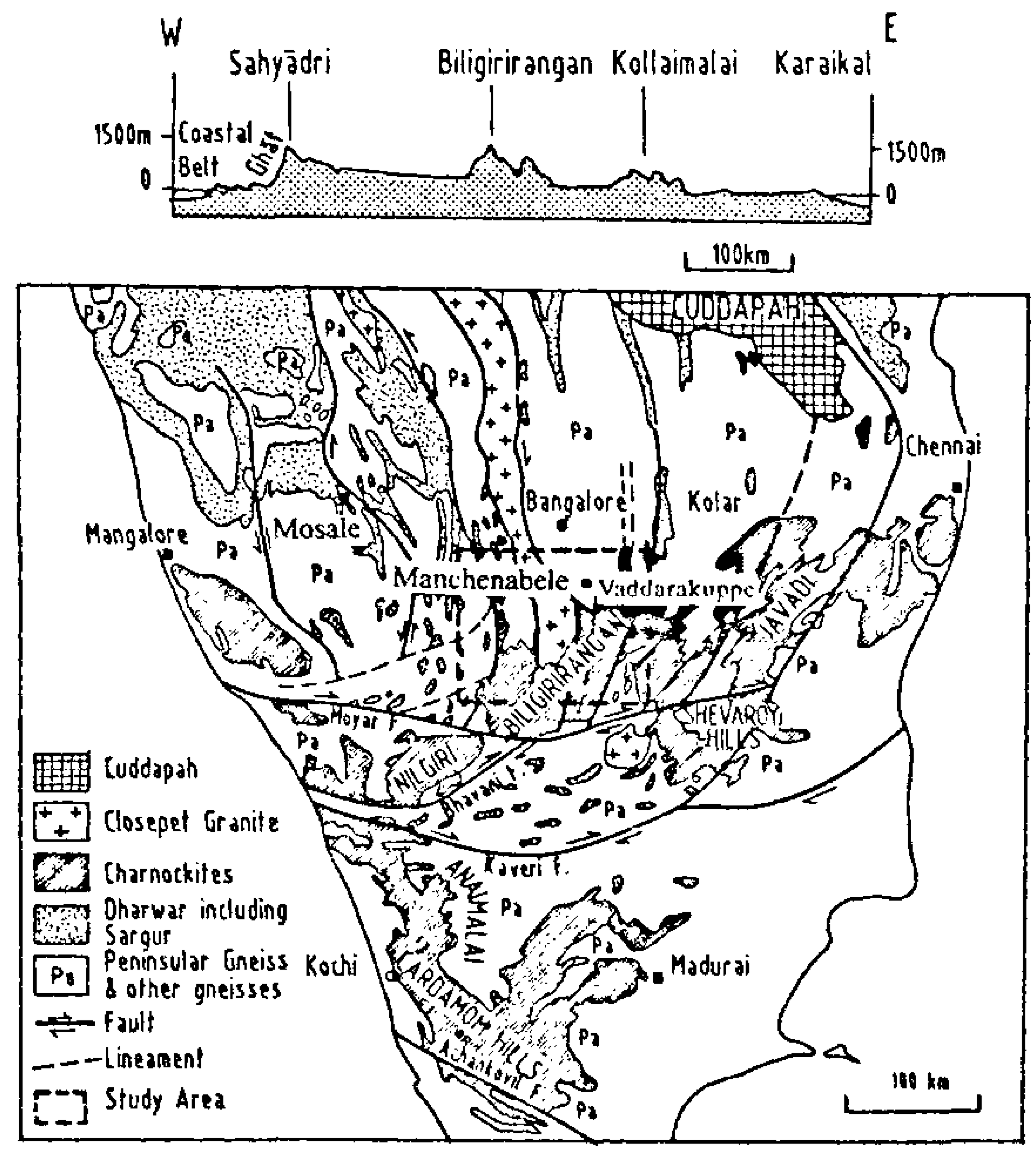

Figure 1. Much faulted Southern Indian Shield[1] showing the faults and shear zones that demarcate boundaries of Precambrian terranes. The profile across the Southern Indian Shield is after Vaidyanadhan[7]. The Kaveri basin lies between the BR and central Sahyadri.

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