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SEX-RATIO, SEXUAL-DIMORPHISM, WEIGHT AND MOISTURE-CONTENT IN TERMITE *ODONTOTERMES REDEMANNI* WASMANN (TERMITIDAE : ISOPTERA) AT MID ALTITUDE HILLS OF MEGHALAYA

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ABSTRACT

Odontotermes redemanni Wasmann has been recorded as a polyphagous and serious pest of most of the agricultural, horticultural crops and forest trees in North Eastern Hill Region of India. The swarms of imagoes were observed to emerge from May and continued up to June – July. The emergence of swarms was observed after sunset and the duration was 62 ± 3.25 minutes. Among 1126 swarming imagoes (alate) the females predominant in the ratio of Male 7 : Female 8 (range Male 45.71 – 48.57%, Female 51.43 – 54.28 %). The ratio being Male 1:1.5 Females. The sexual dimorphism in alate and dealate imagoes differed significantly in respect of total length of head and body with wings or without wings, maximum width of head with eyes, maximum width of abdomen suggesting bigger females than their males counterparts. However, there existed no correlation between head width and body length. The wet weight and dry weight of male and female also differed significantly. The females were heavier than the males. The absolute water loss was also significantly higher in females than males.

Termite, *Odontotermes redemanni* Wasmann is a polyphagous pest, have been recorded causing severe damage to crops, viz., upland paddy, maize, arhar, soybean, grasses and to several other species of plants and tress in NEH region of India. Thus they adversely affect the economic status of the farmers, orchardists and forester and thereby deteriorate the production in the country. Sex ratio has considerable biological significance in reproduction, and has also been regarded as a selective value in some species of termites (Sands, 1965). The studies of bio-significance of *O. redemanni* W. were not taken earlier. Hence, the present investigation was carried out at Shillong and Barapani in Meghalaya, which is a constituent part of North-Eastern Hill Region of India.

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MATERIALS AND METHODS

The material studied was consisted of imagoes (alates), which swarmed at Shillong 1500 M, a.m.s.l. (Meters above mean sea level) and Barapani, 20 km North of Shillong 900 M a.m.s.l (Meghalaya). The measurements of body part were taken with the help of Vernier caliper (Mitutoyo, Japan). The points on the body for various measurements were taken as indicated by Roonwal (1964, 1970a). Body weights were taken individually by Mettler (Model, A – 163) balance after drying the imagoes in hot air oven at 105° C where necessary, the difference between the sexes have been expressed as sexual dimorphism percentage (S.D.P.) and Calculated as follows :

$$S.D.P. = \left[\frac{\text{Mean value in female}}{\text{Mean value in male}} - 1 \right] \times 100$$

RESULTS AND DISCUSSION

Emergence : It is seen from the Table –1 that swarms emerge from 1740 hrs. to 1930 hrs. with an average duration of 62.22 ± 3.25 minutes in the evening after sun sets. These swarms were noticed up to June – July.

Sex Ratio : The sexes were enumerated in imagoes in swarming population (Table – 1) Males were being separated from females by the presence, in the latter, of a wider seventh sternum. This difference was confirmed by dissection and examination of the gonads in a number of cases.

A total collection of 1126 imagoes (alate) from 9 swarms was obtained both from Shillong and Barapani. The sex ratio varied from 45.71 to 48.57% (av. 46.54%) males and 51.43 to 54.28 % (av. 53.46 %) females. The male and female ratio was 1:1.15 (Approx 7 males and 8 females) exhibiting the predominance of latter ones. The χ^2 value is 0.327 with 8 degree of freedom. The results have indicated that male and female are depended upon each other during emergence. The sex ratio has been found to vary in each swarm and from place to place. It is difficult to predict a definite ratio between male and female.

In Isoptera in a few cases equal or nearly equal sex ratios have been recorded but in the majority of known cases either one sex or the other predominates (Roonwal and Rathore, 1972). In present study of *Odontotermes redemanni* W. females predominated (average 53.46 %, range 51.42 – 54.29 %) the males (av. 46.54 %, range 45.71 – 48.58 %). The Sex ratio male Vs female was 1:1.15 (i.e. Approx. 7 male, 6 female). Herfs (1951) and sands (1965) also reported the predominance of females (68.3% females) in European species *Reticulitermes lucifugus* Rossi and in *Trinervitermes* (64% females) from West Africa, respectively. Roonwal and Verma (1973) reported the predominance of females in *Microcerotermes raja* R&B in ratio of males 2 : females 3. In contrary the predominance of males have also been found in *Macrotermes gilvus* from Philippinesis (Oshima) (96% males, Uichanco, 1919) and in hawaiin species *Neotermus connexus* Synder (75 % males, Bess, 1970). Roonwal and Rathore (1972) also reported that in *Anacanthotermes macrocephalus* (Desn) and *Microtermes mycophagus*

(Desn) males predominated in the ratio male 9: female 7.7 and male 4.1 : female 3 respectively. Again Roonwal and Verma (1973), found that males were in dominance over females in *Microtermes obesi.* (Male 48.8 – 62 % female 38-51.2 %)

Sexual dimorphism (n = male 50 and female 50; Table 2-a and 2-b)

1. Total length of head and body with wings : The total length varied from 26.45 – 27.54 mm (av. 26.68 ± 0.42 mm) and 26.50 – 28.50 mm (av. 27.42 ± 0.053 mm) in male and female respectively. The difference between male and female is highly significant. Females are quite bigger in length than males. The SDP obtained also suggest that females are 2.77% bigger than males.

2. Total length of head and body without wings : The total average length of body without wings was 11.93 ± 0.049 mm (range 11.66 – 12.80 mm) and 12.78 ± 0.03 mm (12.45 – 13.50 mm) in male and female respectively. There was significant difference in both sexes even in dealated imagoes. Females were larger in size than males. The S.D.P. is 7.12 %

3. Maximum width of head with eyes : The average width was determined 2.07 ± 0.003 mm which has a variation from 2.05 – 2.11 mm in males while in female the average was 2.14 ± 0.005 mm with a range from 2.10 – 2.55 mm. The significant difference occurred in both the sexes suggesting bigger heads in females than males.

4. Maximum width of abdomen : The average width of abdomen in males was 3.22 ± 0.012 mm (range 3.12 to 3.44 mm) while in females the average width was 3.52 ± 0.01 mm (range 3.43 to 3.80 mm). Females has significantly wider abdomen than the male counterprarts. Further, it was observed that the width of abdomen in females was 9.31% more in comparison to males.

5. Head length and abdomen length in dealated imagoes : The total length of head varied from 2.20 - 2.40 mm in males (av. 2,29 ± 0.017 mm) while 2.25 – 2.45 mm (av. 2.35 ± 0.021 mm) in females. The abdomen length in males varied from 9.40 – 9.53 mm (av. 9.47 ± 0.023 mm) while in females 10.35 – 10.50 mm (av. 10.43 ± 0.015 mm).

Correlation : In both sexes the coefficient of correlation between head width and total body length (without wings) was calculated, the values being male 0.043: female 0.138 which showed that there existed no correlation between the two parameters taken into consideration.

Body weight and moisture – content (n = Male 50 and female 50; Table 3 & 4) :
i. Wet Weight : The average weight in alate males was 51.57 ± .32 mg ranging between 46.90 – 55.00 mg and in female 57.57 ± 0.045 mg with a range of 50.50 – 62.30mg. The average weight was 49.80 ± 0.34 mg (range 42.10 – 52.40 mg) in dealated males and 54.80 ± 0.22 mg (range 51.30 – 59.80 mg) in females. The difference between the weight of male and female was significantly higher (p = 0.01). The SDP being 10.04%.
ii. Dry weight : The average dry weight in alate male imagoes was 30.58 ± 0.12 mg with a range of 28.10 – 32.10 mg while in females the average dry weight was 32.38 ± 0.27 mg

(range 28.90 – 34.90 mg). The average dry weight in dealated imagoes was 27.14 ± 0.26 mg, with a range from 22.50 – 29.50 mg in males while in females the average dry weight was 30.01 ± 0.19 mg with a range from 27.30 – 31.75 mg. The dry matter of females was significantly heavier and weighs about 2.9 mg more than males (p = 0.01). The SDP being 10.57%.

iii. Moisture contents : The moisture contents (weight loss of water by drying) in alate male imagoes varied from 16.50 – 23.70 mg (av. 20.98 ± 0.31 mg) while in females from 19.80 – 27.80 mg (av. 25.14 ± 0.34 mg). The moisture content in dealated imagoes varied from 19.20 – 26.70 mg (av. 22.66 ± 0.28 mg) in males and 22.90 – 30.65 mg (av. 24.79 ± 0.27 mg) in females. The absolute water loss in females was significantly higher (p = 0.10) than males.

When reckoned as a percentage of wet body weight the moisture content averaged 40.54 ± 0.40 % with a range from 34.69 – 40.10% in alate males and 43.56 ± 0.38 % with a range of 37.56 – 47.94 % in alate females. The percent moisture contents in dealated males varied from 41.10 – 51.88% (av. 45.48 ± 0.41%) while in females from 42.22 – 52.76% (av. 45.19 ± 0.38 %) there was no significant difference between males and females in this respect.

In *Odontotermes redemanni* W. sexual dimorphism in body size is marked in total body length (both with and without wings). The females are distinctly larger than males in body and in the maximum width of the abdomen. As regards body weight females are heavier than males in both wet weight and dry weight but the sexes do not differ in the percentage of moisture contents in the body.

In the Isoptera, but not in all species, males are smaller than females and the condition in *Odontotermes redemanni* W. conforms to that state at least in the size of body parts and in wet and dry body weights. Sexual dimorphism has been shown to occur not mearly in imagoes but also in the workers and soldiers of some species (Noirot, 1969). Roonwal and Verma (1973) also reported that *M. obesi* and *M. raja* females are distinctly larger and heavier than males. Roonwal and Rathore (1972) also found out that *A. macrophalus* and *M. mycophagus* females are larger and heavier than males.

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REFERENCES

Bess, H.A. 1970. Termites of Hawaii and the Oceanic Island. In *Biology of Termites,* vol. 2 (Ed. By K. Krishna and F. M. Weesner). Newyork and London (Academic Press). PP 449-476.

Herfs, A. 1951. Der Schwarmflug Von *Reticulitermes lucifugus* Rossi. *Z. angew. Ent.*, Hamburg & Berlin, **33** : 69-77.

Noirot, C. 1969. Formation of castes in the higher termites. In *Biology of Termites,* vol. 1 (Ed. By K. Krishna and F. M. Weesner). Newyork & London (Academic Press pp. 311 – 350.

Roonwal. M. L. 1964. Termite measurements and indices. In *Etudes sur les Termites Africains* (Un coloq. Int. Unesco). Leopoldville (Kinsasha) Univ. Lovanium) Pp 69-77.

Roonwal. M. L. 1970 a. Measurements of taxonomic purposes. *J. Zool. Soc. India,* Calcutta, **21** (1) : 9 – 66.

Roonwal, M. L. and Rathore, N.S. 1972. Sex ratios, sexual dimorphism, body weight and moisture content in two desert termites, *Anacanthotermes macrocephalus* (Hodotermitidae) and *Microtermes mycophagus* (Termitidea), from India, *Ann. Arid Zone.* Jodhpur, **11** : 92 – 110

Roonwal, M. L. and Verma, S.C. 1973. Observations on sex ratios, sexual dimorphism, weight and moisture-content in two termites from Indian desert, *Microcerotermes raja* and *Microtermes obesi.* (termitide). *Ann. Arid Zone*. Jodhpur, **12** : 107-104.

Sands W.A. 1965. Alate development and colony foundation in five species of *Trinervitermes* (Isoptera, Nasuitermitidae) in Nigeria, West Africa. *Insectes Sociaux,* Paris, **12** (2) : 117 – 130.

Uichanco. L. B. 1919. General facts in the biology of Philippine mound – building termites. *Phipp. J. Sci.* Manila, **15** : 59 - 65.

Table 1. *Odontotermes redemanni* Wasmann : Swarming and sex – ratio of imagoes in Meghalaya.

Sl. No.	Time of swarming (Hrs.)	Duration (minutes)	Place of swarming	Altitude (Mts. MSL)	No. of imagoes collected			Percentage of sexes	
					Male	Female	Total	Male	Female
1.	1825 – 1930	65	Shillong	1500	21	24	45	46.67	53.33
2.	1730 – 1845	75	- do -	- do -	17	18	35	48.57	51.43
3.	1815 – 1920	65	- do -	- do -	106	117	223	47.53	52.47
4.	1818 – 1920	65	- do -	- do -	62	70	132	46.97	53.03
5.	1815 – 1915	65	- do -	- do -	71	84	155	45.81	54.20
6.	1740 – 1855	75	- do -	- do -	160	190	350	45.71	54.28
7.	1830 – 1915	45	Barapani	900	30	35	65	46.15	53.85
8.	1830 – 1925	55	- do -	- do -	40	44	84	47.62	52.38
9.	1840 – 1930	50	- do -	- do -	17	20	37	45.94	54.05
Average		62.22 ± 3.22	—	—		—	—	—	—
Total and Percentage	—	—	—		525	602	1126	46.54	53.46
Range	—	—	—	—	—	—		45.71 – 48.57	51.43 – 54.28

Ratio = Male; Female 1:1.15 (Approx. Male 7 : Female 8)
$\chi 2 = 0.327$ with 8 df non significant

Table 2 a. *Odontotermus redemanni* Wasmann : Body size (mm) of freshly swarmed alate imagoes

Particulars	Total length of head and Body with wings (mm)		Total length of head and body without wings(mm)		Maximum width of head with eyes (mm)		maximum width of abdomen (mm)	
	Male	Female	Male	Female	Male	Female	Mae	female
N	50	50	50	50	50	50	50	50
Range	26.54 – 27.54	26.50 – 28.50	11.66 – 12.80	12.45 – 13.50	2.05 – 2.11	2.10 – 2.25	3.12 – 3.44	3.43 – 3.80
Mean ± SE	26.80 ± 0.42	27.42 ± 0.053	11.93 ± 0.059	12.78 ± 0.03	2.07 ± 0.003	2.14 ± 0.005	3.22 ± 0.12	3.52 ± 0.01
95% confidence limits of unknown mean in population	26.59 – 26.67	27.31 – 27.52	11.82 – 12.03	12.71 – 12.85	2.06 – 2.075	2.13 – 2.15	3.19 – 3.24	3.49 – 3.54
S. D.	0.299	0.37	0.38	0.25	0.02	0.034	0.08	0.10
CV (%)	1.11	1.38	3.18	1.97	0.97	1.70	2.79	3.008
D.F.	98		98		98		98	
t Value	11.11****		13.49***		14.00***		16.66***	
S.D.P. (♂/♀)	2.77		7.12		3.38		9.31	

S.D.P. = Sexual dimorphism percentage

Table 2 b : *Odontotermus redemanni* Wasmann: Head length and abdomen length of freshly swarmed dealate imagoes.

Particulars	Length of head (mm)		Abdomen length (mm)	
	Male	Female	Male	Female
N	10	10	10	10
Range	2.20 – 2.40	2.25 – 2.45	9.40 – 9.53	10.35 – 10.50
Mean ± SE	2.29 ± 0.017	2.35 ± 0.021	9.47 ± 0.023	10.43 ± 0.015
95% confidence limits of unknown mean in population	2.25 – 2.32	2.31 – 2.39	9.42 – 9.52	10.40 – 10.45
S.D.	0.0547	0.0678	0.0747	0.0469
CV (%)	2.38	2.86	0.788	0.459
D.F.	8		8	
t value	1.09 ns		35.21**	
S.D.P. (♂/♀)	2.62		10.13	

· S.D.P. = Sexual domorphism percentage; ns= non significant

Table 3 . *Odontotermes redemanni* Wasmann : Body weight, moisture content and moisture content percent in freshly swarmed alate imagoes

Particulars	Wet weight (mg)		Dry weight (mg)		Moisture content (loss of Water by drying) By weight (g)		Moisture content percent (in terms of wet weight) (%)	
	Male	Female	Male	Female	Male	Female	Male	Female
N	50	50	50	50	50	50	50	50
Range	46.90 – 55.00	50.50 – 62.30	28.10 – 32.10	28.90 – 34.90	16.50 – 23.70	19.80 – 27.80	34.69 – 44.10	37.56 – 47.94
Mean ± SE	51.57 ± 0.32	57.57 ± 0.45	30.58 ± 0.12	32.38 ± 0.27	20.98 ± 0.31	25.14 ± 0.34	40.54 ± 0.40	43.56 ± 0.38
95% confidence limits of unknown mean in population	50.91 – 52.22	56.66 – 58.47	30.30 – 30.83	31.94 - 32.81	20.35 – 21.60	24.45 – 25.82	39.73 – 41.34	42.79 – 44.32
S.D.	2.31	3.21	0.91	1.96	2.23	2.45	2.85	2.74
CV (%)	4.47	5.58	2.97	6.05	10.62	9.74	7.03	6.29
D.F.	98		98		98		98	
t value	10.86***		6.27***		8.88***		5.40***	
S.D.P. (♂/♀)	11.63		5.88		19.82		7.44	

S. D. P. = Sexual dimorphism percentage

Table 4. *Odontotermes redemanni* Wasmann : Body weight, moisture content and moisture content percent in freshly swarmed dealate imagoes

Particulars	Wet weight (mg)		Dry weight (mg)		Moisture content (loss of Water by drying) By weight (g)		Moisture content percent (in terms of wet weight)	
	Male	Female	Male	Female	Male	Female	Male	Female
N	50	50	50	50	50	50	50	50
Range	42.10 - 52.40	51.30 - 59.80	22.50 - 29.50	27.30 - 31.75	19.20 - 26.70	22.90 - 30.65	41.10-51.88	42.22 - 52.76
Mean ± SE	49.80 ± 0.34	54.80 ± 0.22	27.14 ± 0.26	30.01 ± 0.19	22.66 ± 0.28	24.79 ± 0.27	45.48 ± 0.41	45.19 ± 0.38
95% confidence limits of unknown mean in population	49.10 - 50.50	54.35 - 55.24	26.61 - 27.66	29.62 - 30.39	22.09 - 23.22	24.23 - 25.34	44.64 - 46.31	44.42 - 45.95
S.D.	2.49	1.59	1.87	1.35	1.98	1.96	2.95	2.70
CV (%)	5.00	2.90	6.89	4.51	8.73	7.90	6.48	5.97
D.F.	98		98		98		98	
t value	12.25***		8.91***		5.40***		0.513^{ns}	
S.D.P. (♂/♀)	10.04		10.57		9.40		0.63	

S. D. P. = Sexual dimorphism percentage