

BIOLOGY AND REPRODUCTIVE BEHAVIOUR
OF CYPHODERRIS STREPITANS

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Objectives

Cyphoderris is a primitive orthopteran genus, a relict of the family Haglidae. This family is known almost exclusively from fossil remains (Sharov, 1968). Only one other recent genus exists, *Prophalangopsis*, based upon a single specimen collected in Asia before the turn of the century (Zeuner, 1939).

Grand Teton National Park harbours several populations of *Cyphoderris strepitans* (Morris and Gwynne, 1978). This species is abundant in sagebrush flats of the Snake River watershed and a population near Pacific Creek was the main focus of our studies last year. It is also found in Yellowstone Park at much higher elevations: in June 1979 we located and worked with a population on the lower slopes of Mt. Washburn. Males perch at night upon the sagebrush or other plants and produce a sustained calling song to which the females are attracted.

The haglids gave rise to the ancestors of modern katydids and crickets (Zeuner 1939, Sharov 1968), groups known for their elaborate acoustical signals. *Cyphoderris* is important because it shows us the behavioural lineage of cricket/katydid sound signals. It is also of interest because the mating habits of this peculiar insect allow field determination of a male's recent sexual experience. The fleshy metathoracic wings of the male, useless in flight, as are the sound-generating forewings, are adapted for consumption by the female during copulation. Unmated (virgin) males have intact hind wings; non-virgins are revealed by their damaged hind wings and the proportion consumed indicates the probable number of matings achieved by a male. Thus it is possible to mark and recapture individual males over successive nights and to record for each his mating success.

Discrimination between potential mates by females is theoretically widespread in animals, though actual field-based data are scanty. Theories of sexual selection hold that females, by responding positively to certain male features, have ritualized these features into signals. Thus an acoustic display such as the calling song of a *Cyphoderris* male could incorporate cues which are predictors of mate quality. Our general purpose in this study is 1) to determine whether mate

discrimination occurs and if so, 2) what cues, acoustic or non-acoustic, function in expressions of mate preference by females.

Last season (1979) we discovered that a discrimination by females between males as potential mates does occur: in the early part of the mating season females prefer to mate with virgin rather than non-virgin males, presumably because previously mated males are less likely to provide a fully-formed spermatophylax...a nutrient food gift which accompanies the male's sperm ampullae and is consumed by the female after mating.

Methods and Results

Singers were captured in 1979 by localizing and approaching the source of their calling song until the animal was actually viewed. Initial and subsequent capture locations were marked by small stakes bearing the individual's specimen number and the date of each capture. Each night's search was begun in staked areas, then extended into new contiguous habitat once all singers near previous stakes had been investigated. An attempt was made to scan staked areas several times during each night.

At each capture the following information was recorded: date and time, perch plant, height of the singer above the ground, orientation of the singer (head up or down), and the distance to his previous perches (usually the original stake). His current location was then staked and the insect brought to a central location. Here a microscope was used to view the tegmina and wings. Pronotum midline length was measured with an eyepiece reticle, tegminal overlap (which varies in *Cyphoderris*) recorder, drawings made of wing feeding damage and the state of the wing wounds noted as new or old. At this point a first capture specimen would be marked on the pronotum with coloured enamel paint to permit individual identification. The last step was to weigh the male and return him to his perch of the night.

At the Pacific Creek site over the interval May 31 to June 16, 10 matings were detected among 39 virgin males; at Mt. Washburn (June 20, 21 & 24) 9 were detected among 21. Combining the two sites, 50 virgin males were detected in 19 matings. These figures are based upon males either discovered initially with freshly wounded wings, the extent of wing damage indicating a single mating, or marked initially as virgins, subsequently relocated, and by the evidence of their chewed wings found to have mated. Recapture success varied greatly between individuals; many marked insects presumably mated but were not retaken.

At Pacific Creek during the same time period only 1 mating was discovered among 22 non-virgin males and at Mt. Washburn only 1 among 13. Combining the two sites, 32 non-virgin males were detected in just 2 matings. These figures incorporate individuals, marked originally

as virgins, that subsequently joined the non-virgin ranks by mating. If a male was captured with freshly wounded wings indicating one mating he represented a virgin mating and would not be classified as a non-virgin until the next relocation.

The detected mating success among our marked virgin males was 38%. This contrasts strongly with a non-virgin success of only 6% and suggests that females may be actively preferring virgins over non-virgins. To draw the conclusion that females discriminate against non-virgins as mates we must assure ourselves that 1) both singer types are equally likely to become part of our records i.e. there is nothing about virgin males that makes them easier or harder to relocate than non-virgins and 2) that the basis of the observed difference in mating success is not merely a reflection of greater numbers of virgins than non-virgins within the singing population.

An estimate of the relative abundance of virgin and non-virgin males can be obtained from the records of our marked population. There were 14 nights during the study interval at Pacific Creek when the weather permitted singing activity. Over the first 4 nights (May 31-June 3) and using only first-time captures, 7 males were marked as virgins, 10 as non-virgin. Two individuals mated and joined the non-virgin ranks as first-time captured non-virgins. These figures estimate 1.7 non-virgins for each virgin male. There were in fact more non-virgins than virgins available as mates early in the study interval. This would not lead us to predict an imbalance in mating success in favour of virgins.

Are both singer types equally likely to contribute to our records? On average at Pacific Creek a marked virgin male was located 3.2 times, a non-virgin 3.7 times. The frequency of finding marked individuals on successive nights was about the same for both singer types. This result supports the claim that virgins and non-virgins do not differ in any factor relating to their capture by acoustic stalking (e.g. singing incidence, sedentariness) that would bias the likelihood of relocation.

Simple comparison of the number of individuals, virgin or non-virgin, that successfully mated ignores much of the information in the recapture records. Some males were retaken several times over intervals of many days. If a male's wings retain their previously observed state then it is possible to infer a number of intervening unsuccessful singing nights without having actually relocated the individual on each night. Nights on which bad weather prevented singing activity can be deleted. If females prefer virgin males over non-virgins as mates, then the average number of nights of singing invested without mating success should be less for virgins than for non-virgins.

At Pacific Creek 14 non-virgin males accumulated 58 nights of unsuccessful singing; 14 virgin males accumulated only 33 nights. Mean number of observed unsuccessful singing nights by non-virgins was 4.2, by virgins it was 2.4. Two males each went 10 nights as non-virgins

without succeeding in mating; one non-virgin male was still unsuccessful after 12 nights. The greatest number of unsuccessful singing nights tallied by a virgin was 5. Early in the season virgin males seem to be preferred as mates.

Virgin males of Cyphoderris strepitans at the Pacific Creek study site showed an average body weight (first captures only) of 701 mgm (n=25). Non-virgins from the same site, individuals whose wings indicated mating activity within 24 h of capture (n=8), had an average body weight of 629 mgm. A Student's t one-tailed test shows this difference to be significant at the 1% level. Thus the body weight of males reflects their mating activity up to 24 h afterward.

The foregoing represents only a partial assessment of the data gathered in 1979. Information yet to be analysed concerns the movement of marked males within the habitat, the height of singing perches above the ground (averaging about 30 cm on the sagebrush at Pacific Creek), body orientation of singers (uniformly head downward), tegminal overlap variation, and some indication of a small day by day weight loss that seems related to high daytime soil temperatures. In addition a considerable insight was achieved into C. strepitans' feeding habits. Nymphs feed on Purshia tridentata (bitterbrush) and on a gall caused by insects and occurring commonly on sagebrush.

Literature Cited

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