

Foraging ecology of trap-building arthropods in subtropical forests

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Summary

Many trap-building terrestrial arthropods such as orb web spiders in the tropics and subtropics exhibit both bright and dark markings, and recently these bright markings have been considered to be important in predator-prey visual interactions in both diurnal and nocturnal context. In this practical students will perform field manipulations to evaluate whether the bright markings of orb web spiders are visually attractive to nocturnal prey by using infrared video cameras to monitor the responses of insects to spiders receiving different body color signal manipulations.

Key concepts

- Many trap-building terrestrial arthropods such as orb-weaving spiders in the tropics and subtropics exhibit both bright and dark markings.
- Recently these bright markings have been considered to be important in predator-prey visual interactions in both diurnal and nocturnal context.
- From the eyes of pollinator insects, the brightly-colored markings are conspicuous but the dark parts become indistinguishable from the vegetation background.
- Those high-contrast bright and low-contrast dark markings are arranged in such a way that it greatly alters the contour of the spider and generates a signal unlike that of a predator.
- Many insects would associate the bright yellow markings of spiders with food resources such as flowers and new leaves.
- The coloration patterns of trap-building arthropods such as orb web spiders not only provides a signal that is easily perceived by insects, but it also masks or alters the appearance of the spiders into a form similar to food source.



Estimation of catching area of an orb web:

Catching area of an orb can be estimated by using the ‘Adjusted Radii – Hub’ formulae of Herberstein and Tso (2000). The formulae assumed a circular approximation treating each web half as a semi-circle, but it adjusted the vertical radii by taking the horizontal diameter into consideration. In the first survey of the day orb radius from four cardinal points should be measured then use the following formula:

$$\text{Catching area} = \left[\frac{1}{2} \pi r_{au}^2 - \frac{1}{2} \pi (Hr_u)^2 \right] + \left[\frac{1}{2} \pi r_{al}^2 - \frac{1}{2} \pi (Hr_l)^2 \right]$$

where r_{au} is adjusted upper radius, r_{al} is adjusted lower radius, Hr_u is upper hub radius, Hr_l is lower hub radius. The adjusted upper and lower vertical web radii are calculated as follows:

$$r_{au} = \frac{r_u + \frac{d_h}{2}}{2}, \quad r_{al} = \frac{r_l + \frac{d_h}{2}}{2}$$

where d_h refers to the horizontal diameter of the orb.

Estimation of insect catching rates:

To estimate the insect catching rate of orb-weaving spiders first the chosen web sites of the giant wood spiders *Nephila pilipes* should be marked by fastening a plastic strip in the vegetation nearby. In half of the spiders the yellow markings of the spiders are covered by black markers while in the other half same amount of paint is applied on black body parts of the spiders. During the survey each web site should be monitored by infrared video camera placed at about one meter away from each web. Before the survey the orb radius should first be measured from four cardinal points and the ‘Adjusted Radii - Hub’ formulae be used to calculate catching area. While viewing the video clip of the nocturnal survey the number, size (in mm) and taxa (in order) of insects orienting towards the web should be recorded. The nocturnal insect attraction rate is defined as the number of insects flying toward the web per hour of monitoring. The effect of body color signal treatment on nocturnal insect attraction rate while considering spider orb’s catching area could be analyzed using the following general linear model (Tso et al. 2002):

Insect attraction rate = constant + A × treatment + B × catching area.

Further readings:

Herberstein, M. E. & Tso, I. M. 2000. Evaluation of formulae to estimate the capture area and mesh height of orb webs (Araneoidea: Araneae). *Journal of Arachnology*, **28**, 180-184.

Tso, I. M., Lin, C. W. & Yang, E. C. 2004. Colorful orb-weaving spiders and web decorations through a bee's eyes. *Journal of Experimental Biology*, 207: 2631-2637.

Tso, I. M.*, Huang, J. P. & Liao, J. P. 2007. Nocturnal hunting of a brightly coloured sit-and-wait predator. *Animal Behaviour*, 74, 787-793.

Chuang, C. Y., Yang, E. C. & **Tso, I. M.***. 2007. Diurnal and Nocturnal prey luring of a colourful predator. *Journal of Experimental Biology*, 210: 3830-3837.

