Rhamphichthys which fires its electric organ in discrete pulses much as *Hypopomus* does. A burst duration coder in *Hypopomus*, with maximal sensitivity at the spectral frequency *f*, fires a series of spikes in response to a stimulus pulse, with an initial spike frequency near *f* [T. H. Bullock, *J. Gen. Physiol.* **55**, 563 (1970); J. Bastian (*5*)]. This supports the assumption that the receptor rings at this frequency and that one spike is triggered on each suprathreshold cycle (C. D. Hopkins, personal communcation).
14. This measurement is based on 40 specimens of each species from Rio Negro habitats (*3*).
15. Supported by grants from the National Science Foundation (BMS 76-20761) and the National Institute of Mental Health (PHSMH 2614901) to W.H. We are most grateful to T. H. Bullock, J. Thorson, C. Hopkins, C. Baker, J. Bastian, T. Viancour, and two anonymous referees for most helpful criticisms.

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Infrared Video Viewing

The use of video to render visible the ordinarily invisible ultraviolet patterns found in nature has been described (*1*). We now describe a similar system for video viewing in the near infrared (700 to 1000 nm) which permits both the visualization of infrared patterns (*2*) and the study of nocturnal behavior. In this system (*3*) a commercially available video camera is fitted with an optional silicon diode imaging tube originally developed for low light level surveillance. The spectral sensitivity of the silicon diode tube spans the visible range (400 to 700 nm) and extends beyond 1000 nm, thereby including the near-infrared region. These spectral properties can be used to advantage in the investigation of various biological problems.

The nocturnal behavior of animals is difficult to observe and record. The lighting necessary for conventional photography, cinematography, videotaping, or direct observation may inhibit or alter the animal's behavior. Use of the silicon diode camera, however, permits illumination in the near-infrared region where most animals appear to be blind (*4*–*7*). We have used this technique to study the nocturnal courtship of an arctiid moth, *Utetheisa ornatrix*, and nocturnal predatory behavior of the Florida mouse, *Peromyscus floridanus* (Fig. 1). The courtship of the moth is disrupted by most artificial light sources; however, normal courtship could be observed and recorded under infrared illumination. In the mouse study, complete darkness was required since the purpose of the study was to investigate predatory behavior when visual information is limited. Again, the fact that the camera is sensitive in a region where the subject is not sensitive permitted videotaping of this behavior. Our experience, therefore, suggests that infrared video viewing will prove generally useful in the study of nocturnal behavior.

Other methods available for viewing in darkness include infrared photography and cinematography, infrared imaging devices (for example, "sniper scopes"), and light amplifying devices ("starlight scopes"). Compared with these, infrared video has the familiar advantages of conventional video which include simultaneous monitoring and storage and instant playback. Also, although we have not done so, the video system could easily be made portable in the field, as are many infrared imaging and light amplifying devices. The quality of the video image is good, although a sharper image can be obtained through the more laborious techniques of infrared photography and cinematography. The starlight scope functions at even lower light intensities than the video system described. At present, though, this instrument is substantially more expensive than infrared video and is not as generally available. In many situations, therefore, the silicon diode video system seems to offer significant advantages. Furthermore, the system is not restricted to use in the infrared or at low light levels; it can be used without modification in visible light and at normal illumination levels.

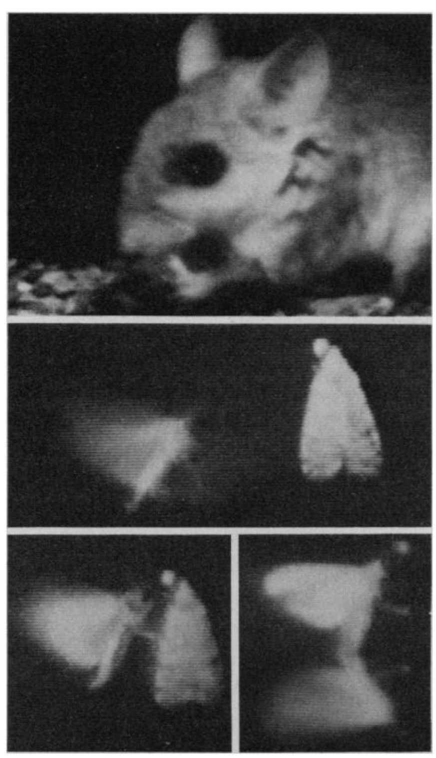

Fig. 1. (Top) Mouse feeding in total darkness. (Bottom) Sequential views of moth courtship showing a male approaching a stationary female, orienting to her, and copulating. All photographs are of infrared images as they appear on a television screen. To freeze the image for photography the video recorder was operated in the stop-action mode. This results in a marked decrease in image resolution. The fully interlaced video picture obtained during normal playback yields a significantly sharper image.

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References and Notes

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2. P. A. Schwalm, P. H. Starrett, R. W. McDiarmid, *ibid.* **196**, 1225 (1977). These investigators found that several Neotropical frogs, in contrast to a number of temperate frogs, are reflective in the near infrared and thus match their background at both visible and infrared wavelengths. Infrared photography was used to demonstrate this crypsis, but we suggest that a video system such as we describe could provide a rapid means of screening animals for comparative reflectance in the visible and infrared.
3. We use a General Electric video camera (model TE44BS) with a silicon diode imaging tube (No. 7164425P94). We record on either of two Sony videocorders (model AV5000A or the more portable model AV3400). The image can be displayed on any closed circuit television monitor. Infrared images are obtained by operating the system in total darkness with illumination provided by two 40-watt incandescent lamps that shine through infrared filters. The transmittance of the filters is less than 1 percent below 900 nm and less than 0.03 percent below 700 nm.
4. Since evidence on visual sensitivity in the near infrared is extremely scarce, the possibility exists that some animals can form visual images under infrared illumination. To date, however, no infrared-sensitive visual pigment has been discovered (*5*). Furthermore, tests of the spectral sensitivity of animals by behavioral methods suggest that the infrared limit of vision does not surpass that of humans (*6*), although, unfortunately, actual tests at longer wavelengths have apparently not often been done. Of course the definition of the limit of vision is arbitrary since sensitivity falls off gradually. Humans can detect radiation at 1000 nm, for instance, but at this point sensitivity is reduced to approximately 10^{-12} of the best sensitivity (*7*).
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