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Herpetological Review, 2006, 37(2), 194–195.

A Technique for Restraining Lizards for Field and Laboratory Measurements

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Numerous techniques have been used for restraining lizards including controlling by hand, anesthetizing (Nelson and Jayne 2001), and thermal cooling combined with the use of sticky tape (Hoefer et al. 2003). Restraining devices are often designed for use with members of specific genera (Poulin and Ivanyi 2003) or for lizards of a particular size (Hoefer et al. 2003). Such methods impose limitations on studies that seek to measure morphological characteristics of live lizards representing a broad range of body sizes.

Here we describe an effective technique for restraining various species of lizards that range in body size from 30–250 mm snout-vent length (SVL). Our technique reduces the time spent processing individual animals and may, therefore, minimize handling stress. Our method is easily constructed, inexpensive, and portable making it suitable for both laboratory and field studies. We used this restraining method successfully on three species of agamid lizards (Painted Dragon, *Ctenophorus pictus*; Mountain Dragon, *Rankinia diemensis*; and Bearded Dragon, *Pogona vitticeps*) and one species of gecko (Knob-tailed Gecko, *Nephrurus amyae*). Specifically, we provide detailed descriptions of the methods used to restrain *Ctenophorus pictus* in the field for morphometric analysis using digital photography.

Restraining Tray.—When using digital photography to conduct morphometric analyses it is critical to maintain all lizards in the same position for each image, and to provide an unobstructed view of the appendages. With this in mind, we designed a restraining tray using single-sided Velcro with an adhesive backing to hold the animal's body in place, and a plastic tray as the base. Strips of the hooked side of Velcro were stuck onto the tray, and thin strips of the looped Velcro were cut and the adhesive backing covered in flexible cotton material to avoid dirt and sand sticking to it. Lizards were placed onto the Velcro base of the tray and positioned as needed. We restrained lizards with one strip of Velcro placed firmly over the neck, plus a second strip just above the pelvic girdle (Fig. 1). In the case of juveniles or very small lizards, one strip of Velcro across the neck was adequate for restraint. We surrounded the base of hooked Velcro with strips of looped Velcro, which allowed the claws of the lizards to grip onto the base, ensuring that the limbs remained in the desired position.

Morphometric Analysis.—For the morphometric analysis of *Ctenophorus pictus*, we attached a clear plastic ruler to the restraining tray and a label was included in each image for identification purposes. We then took digital photographs of restrained individuals, ensuring that the ventral surface of the lizards was flat on the tray and that their body was straight (Fig. 1). At least one hind limb and one forelimb were physically extended on the restraining tray to ensure accurate measurement of limb proportions from the digital image. One advantage of digital images is that the photographs can be archived and accessed at any time for analysis.

Six measurements were taken for each lizard (N = 128): head length, SVL, axilla-groin distance, forelimb length, hind limb length, and tail length. Lizards measured included juveniles and adults of both sexes ranging from 31.2–77.9 mm SVL. All lizards measured were successfully restrained using our device, without a single lizard escaping or being injured.

Morphological analyses from the photographs were performed using ImageJ (v. 1.32j) digital image analysis software (Rasband 2004). We tested the accuracy of measuring a subset of the morphological characters by comparing the measurements made with the digital images and analysis software to those recorded with digital calipers. The measurements using ImageJ differed by 1.7% (N = 20) from caliper measurements, which would represent a 0.9 mm difference in the measurement of a 50 mm SVL lizard.

The restraining tray proved ideal for the wide range of sizes of agamid lizards in our study. Our success across these agamid species may be a result of the rough scales and well-defined neck in these lizards, which facilitated holding them in place with the Velcro strips. Hence, this method should be applicable to most

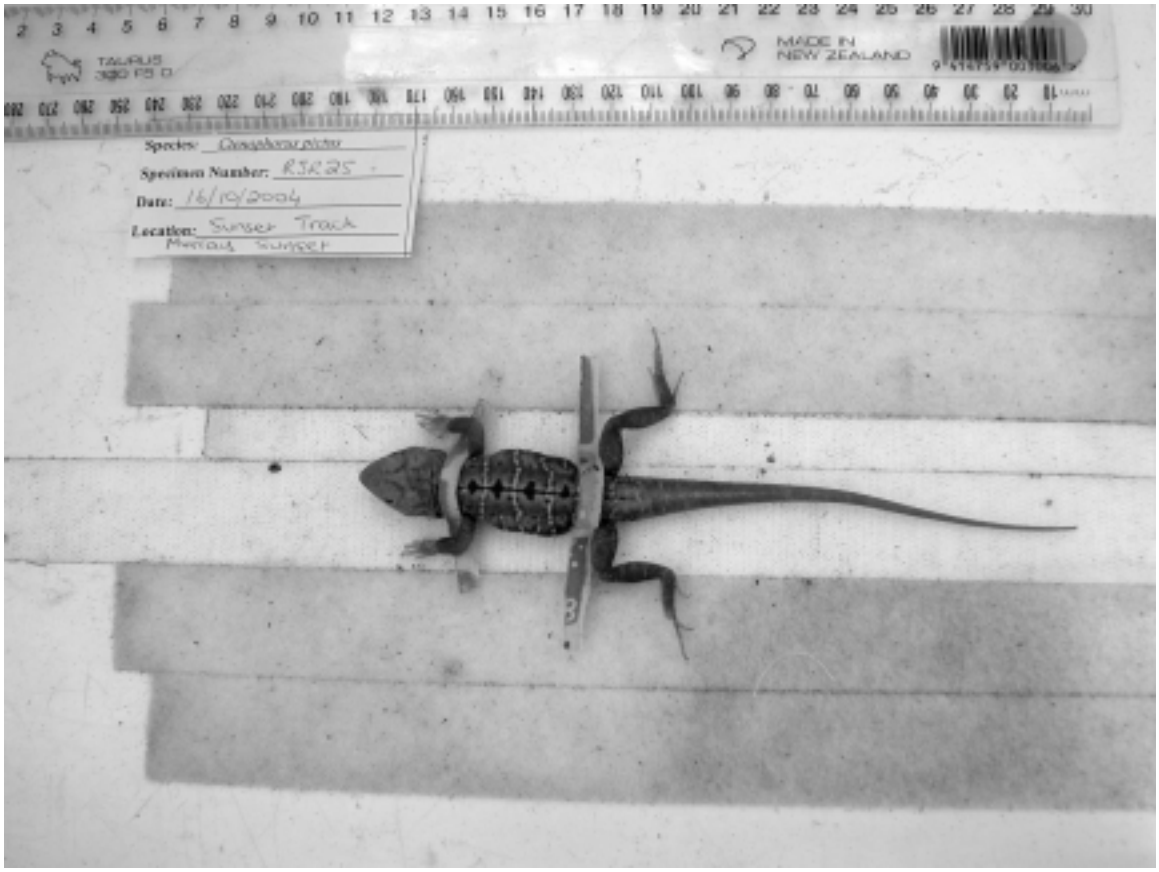

FIG. 1. Digital image of an adult male *Ctenophorus pictus* positioned on the restraining tray.

lizard taxa with rough scales and defined necks, such as agamids, iguanids, cordylids, some lacertids, and many geckos. In fact, we successfully used this restraining method on the gecko *Nephrurus amyae* without any damage to its delicate "knob-tail." This method ensures that lizards are only held for a short period of time, therefore reducing prolonged stress, which can result in tail autotomy.

Our technique is inexpensive and allows efficient data collection in the field or laboratory. The design of the tray allows lizards to be positioned for a number of purposes including taking morphological and color measurements, photographs, or tissue samples.

Acknowledgments.—We thank J. Van Buskirk for his advice and assistance, J. Sinclair, the Live Exhibits staff at Museum Victoria, and two anonymous reviewers. Permits were provided by the Department of Sustainability and Environment Victoria and the Department for Environment and Heritage South Australia (Permit Nos. 10002952 and E24870, respectively). Funding was provided by an Australian Research Council Discovery Grant (DP0452082) and an Australian Society of Herpetologists Student Research Grant. This research was approved by The University of Melbourne Faculty of Science Animal Experimental Ethics Committee and The South Australian Wildlife Ethics Committee.

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