estigator's ability to recognize specific nals on recapture.

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METHOD FOR MANUAL **VENTILATION OF** RANQUILIZED TORTOISES

Many modern clinical and field techniques herpetology require the administration of esthetic or chemical immobilizing agents. en the subject is immobilized, care must taken to prevent prolonged apnea. During 31. Bolson tortoises, Gopherus flavomarlatus, at the Mapimi Biosphere Reserve boratorio del Desierto in Durango, México re restrained for blood sampling via juguvenipuncture, cloacal palpation for sex termination, and the administration of oxyin for induction of oviposition. Immobilition, accompanied by drooping of the per eyelid (ptosis), and hind limb rigidity, sulted within 3-5 minutes after intramuscuinjection of succinylcholine hydrochlole (0.50 mg/kg BW), a neuromuscular blockg agent. Body temperatures of tortoises amined ranged from 27-35° C.

During the course of these procedures, one us (BB) developed a technique for mainning adequate ventilation in immobilized rtoises without the need for tracheal intubain. The procedure consists of elevation and tension of the forelimbs while the subject is a prone position, followed by direct rearard compression of the forelimbs alongside e head and into the axillary space (Figure During this motion the humeri are kept trallel to the long axis of the body and the bows are flexed at 90°. As a result, the lungs e filled as the pleuroperitoneum expands ith the extension of the limbs, and emptied hrough the nares) as compression occurs. he rigidity of the hind limbs augments this fect by preventing pressure relief through xpansion of the abdominal cavity via the iquinal region. One to two complete cycles er minute are sufficient to perfuse adequately immobilized tortoises, we applied the technique continuously during the course of our examination (5-30 minutes) and once every 15 minutes for the next hour. In 6 years of experience since the technique was developed we have never experienced a fatality or complication in hundreds of uses involving more than 50 animals. The authors believe that the technique would be effective in all tortoises.

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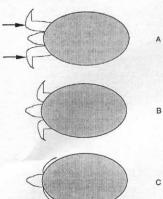


Figure 1. Dorsal diagrammatic view of limb positions during manual ventilation. A. Beginning technique with humeri extended, parallel to the head; arrows showing points and direction to exert pressure. B. Halfway through technique with humeri retracted. C. Ending position of technique with forelimbs pressed into the shell openings.

TECHNIQUES FOR PHO-TOGRAPHIC SIZE ESTIMA-TIONS OF CROCODILIANS

Making accurate size estimates of subjects is often required during herpetological field work. Magnusson (1983) demonstrated that size estimations of crocodilians could not be made accurately by inexperienced observers from direct observation. Such difficulties are likely to be as acute, or worse, for other taxa.

Here I report on a generally applicable photographic method for improving the accuracy of size estimations. This method, developed during work on the black caiman Melanosuchus niger in Peru, allows direct calculation of the subject size from the image size in a photographic negative. Another method for photographic size estimations based on the same basic principle has been arrived at independently by Grahame Webb and coworkers for use with the estuarine crocodile Crocodylus porosus in the Northern Territory of Australia (Choquenot and Webb 1987). Both methods depend for their validity on the mathematical relationship between the variables in an image-producing (photographic) lens system. This relationship is expressed in Equation 1 below, which is derived from the lens formula

(Equation 1)
$$H = \frac{U - F}{F} \times h$$

where: H = Subject size

U = Camera-to-subject distance

F = Focal length of lens

h = Image size in photographic

negative

The convergence of the two methods perhaps emphasizes the practicality of what is essentially the same technique. The technique as developed for use with M. niger in Peru uses Equation 1 explicitly in its calculations, so I will call it the Lens Formula Method Webb and colleagues' methodology depends on the basic truth of the formula, but does not use it directly. Rather their method employs an empirically derived calibration curve for each lens. I shall refer to it as the Calibration Curve Method.

LENS FORMULA METHOD

For the methodology developed with M. niger a series of photographs is taken perpendicular to the dimension to be measured. For each photograph the focal length of the lens used is noted together with the camerato-subject distance. Camera-to-subject distance is read from an accurately calibrated real distance scale on the lens focusing ring. I found it necessary to recalibrate the distance scale etched by the lens manufacturer on the focusing ring for this purpose.

Given these values, and the size of the image in the resulting photographic negative, the actual size of the subject photographed can be calculated directly using Equation 1 above. Only sharply focused photographs should be used for this purpose, since poorly focused photographs indicate that the camera to subject distance read from the focusing ring was inaccurate. Special care must also be taken when measuring the image size in the photographic negative. As the multiplier in Equation 1, it can be an important source of error. Accurate measurement is not easy direct from the negatives, but it can be achieved by projecting the negative at a standard magnification and calculating the original size of the image in the negative from the projected image. If only the head of the crocodile is photographed, the snout-vent length can still be estimated since the relationship between the two dimensions is well documented for a variety of crocodilians (e.g. Kramer and Medem 1955; Webb and Messel 1978; Montague 1984).

CALIBRATION CURVE METHOD

This method, developed by Webb and colleagues, involves taking a series of photographs of a standard metre rule at various distances recorded from an arbitary distance scale on the lens focusing ring. These data are used to scale the long axis of the photographic negative to real size at that distance. If for example the image of a one metre rule was X mm in a 2X-mm-long negative at a distance measured on the arbitary scale as Y, then the total length of the negative can be scaled to a real negative width of 2X metres at that distance. A series of such real negative widths plotted against their corresponding arbitary distances gives a calibration curve for the lens used. Thus, if during a survey a perpendicular photograph of a crocodile's head is taken at the distance Y, and the image occupies one quarter of the frame length, then its real length is simply calculated as the proportion of the negative length occupied by the image multiplied by the real negative width obtained from the calibration curve. In the example above where the real negative width was 2X m at distance Y, the head length is 0.25 x 2X m = 0.5X m. As a point of detail, Webb and co-workers measure the proportion of the negative's long axis occupied by the image using the graticule on the eyepiece of a dissecting binocular microscope.

It is worth noting that the calibration curve which Choquenot and Webb (1987) derive empirically could also be derived mathematically for each lens with the lens formula provided the relationship between the arbitrary distance scale and real distance is known. The advantage of deriving the curve empirically is that it compensates for lenses not being to the manufacturer's stated focal length. The disadvantage is that it introduces the possibility of experimental error into the calibration exercise.

A COMPARISON BETWEEN THE METHODS AND EQUIPMENT

The accuracy obtained with the two methods is similar. Both give estimates ± 5-8% of the real subject size (head lengths of crocodilians, 6-45 cm), using a 200 mm lens within the optimal distances range of about seven m. The methods are also more or less equivalent in terms of ease of use. Both require an initial calibration exercise, one to derive a calibration curve, the other to derive an accurate real distance scale. One possible advantage of retaining the lens formula in the calculation rather than deriving a calibration curve is that the former can accommodate variation in the focal length of the lens. This potentially allows a variable focal length (zoom) lens to be used for the surveys, an advantage when the likely range of subject sizes and approach distances is great. It should be noted, however, that in practice the introduction of the lens focal length as an additional variable produced an error in excess of 10% in laboratory trials on a model subject. Considerable refinement of the zoom lens technique would be required to improve the accuracy, and for the present at least a fixed telephoto lens appears a better choice.

With regard to equipment in general, I found the best combination to be a 35 mm format single lens reflex camera together with a powerful dedicated flash with telephoto adaptor and a 200 mm lens (with rotating polarizing filter to improve image clarity of submerged parts of the subject). It is important that the lens have a long infinity rating and a shallow depth of field at maximum aperture to allow the camera-to-subject distance to be accurately recorded. A drum extension on the focusing ring enables the scale to be more finely graduated and easier to read. The accuracy of the distance scale should be checked before surveys since the focusing ring of a damaged or inferior quality lens may be prone to 'slipping'. Slipping occurs when the lens focusing ring is free to move to some extent without actually changing the focus distance of the lens. This introduces error into the camera-to-subject distance reading. In general there is room for improvement on simply measuring the camera-to-subject distance from the lens focusing ring. Possibly a more sophisticated light beam range finder could be employed for this purpose. The dedicated telephoto flash should ideally have a fast recycling time to allow a series of photographs to be taken in rapid succession during night surveys. Good 'off-flash' rechargeable battery packs provide almost instantaneous recycling and are also more economical for long term studies.

OTHER PHOTOGRAPHIC TECNHIQUES FOR SIZE ESTIMATION

Earlier authors have proposed contrasting techniques for estimating subject sizes with the aid of photography. Unlike the Lens Formula Method and the Calibration Curve Method, these techniques do not depend on the relationship expressed in the lens formula for their basic validity. Parker and Watson (1970) for example used pre-positioned anchored reference markers to calibrate aerial photographs of Crocodilus niloticus individuals in the same frame. This technique is excellent for aerial surveys which are essentially "two dimensional" but is not immediately applicable in the many situations where a boat survey is required.

I experimented on a variation of Parker et al.'s technique employing a horizontal rule suspended below a long lightweight pole and positioned over the heads of M. niger individuals encountered during night cance survevs. The method helped place the caiman in broad size class categories during direct observation and could also be used to calibrate photographs in the manner of Parker and Watson. The equipment was unwieldy, however, and it was often hard to place the rule in the same focusing plane as the black caiman. Attempts to use the technique with the more wary spectacled caiman, Caiman

crocodilus, in Peru, and the Nile crocodile. Crocodilus niloticus, in Madagascar were also hindered by the subject frequently submerging in response to the disturbance and even occasionally lunging at the rule!

Gorzula (1984) outlines another type of photographic size estimation technique using snout-length/total-head-length ratios calculated from field photographs to estimate the total snout-vent length of the individual photographed. The technique was suggested for use with C. crocodilus but as Webb and Messel (1978) point out, the relationship between these morphometric dimensions appears to change unpredictably with age for a variety of other crocodile species so far studied. It remains to be seen whether morphometric ratios calculated from photographs of other herpetological subjects could be successfully used to estimate the actual size or age of an individual.

OBLIQUE IMAGES - A PROBLEM

An important problem common to all the photographic techniques described is that of length attenuation of dimensions not photographed at right angles to the subject-tocamera line. For M. niger it proved easy to approach individuals during surveys and to obtain good photographs perpendicular to the subject-to-camera line using the caiman eyes to align the camera. For other subjects this may be impracticable and Choquenot and Webb (1987) use reference templates of a preserved head photographed at various angles in order to derive a correction factor for non-perpendicular photographs. As they point out, the development of "3D" computer graphics suggests both the possibility and direction of future improvements in this field.

CONCLUSION

The Lens Formula and Calibration Curve methods of photographic size estimation have proved to be practical ways of estimating the size of M. niger in Peru, and C. porosus in Northern Australia, respectively. The basic principle which underlies these two methods, that of deriving the actual subject size from its image size in the negative given the camera-to-subject distance and lens focal length, is in no way dependent on any feature particular to these species. The general technique is, therefore, applicable to any subject, crocodilian or otherwise. The ultimate choice of lens and accuracy of the technique depends very much on the size and ease of approach of the subject.

For M. niger the photographic technique has proved to have an added advantage in that juveniles and sub-adults are individually recognizable from the configuration of large black pigment spots on the lower jaw. Perhaps individuals of other reptilian species will prove to be individually identifiable as well. The ability to recognize individuals without resorting to mark/recapture techniques is especially valuable for crocodilian species which often learn to avoid recapture (Cocroft pers. comm., Webb and Messel 1979). Work is planned to determine how the pattern changes for M. niger individuals with age, and whether photographic files of individuals in a

population can be used to identify specimens in long term ecological studies.

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LIFE HISTORY NOTES

See Herp. Review 19(2) for author's instruc-

ANURA

BUFO MARINUS (Marine Toad). PREDA-TION. On 31 October 1987 in savanna woodland close to Alter do Chão Pará, Brasil (2°31'S, 55°00'W) at 0813 h I intercepted a grisson (Galictis vittata) entering the forest from the savanna, with a large (ca. 25 cm TL) Bufo marinus hanging from its mouth. The grisson stopped within five m of me for about 20 sec. The frog was not collected but as B. marinus is the only large bufonid in the area there can be no doubt as to its identity. Bufo marinus are extremely common in the area and it is unlikely that the adult grisson had not been exposed to toads before. Rather, it seems that the potent skin toxins of B. marinus are not an effective defense against arissóns.

Submitted by RENATO CINTRA, Departamento de Ecologia, Instituto Nacional de Pesquisas da Amazonia (INPA) CN 478 Manaus, 69000, Brasil.

RANA AREOLATA AESOPUS (Florida Gopher Frog). MOVEMENT. An adult female Rana areolata aesopus (84 mm SVL), marked at the Breezeway Pond on the Katharine Ordway Preserve/Swisher Memorial Sanctuary, four km E of Melrose, Putnam Co., Florida, on 30 March 1987, was caught in a Sherman live trap set at the mouth of an active gopher tortoise burrow on 26 July 1987. The recapture occurred 2.0 km WSW of the Breezeway breeding pond on a disturbed longleaf pine-turkey oak site dominated by planted slash pine. We believe this to be the first documented observation of a long-distance movement for this species. Carr (1940.

Herpetology of Florida, p. 64) states these frogs "...travel some distance to congregate at widely separated ponds, since I have found them a mile (1.6 km) from water."

Submitted by RICHARD FRANZ, Florida State Museum, University of Florida, Gaines-ville, FL 32611, C. KENNETH DODD JR., National Ecology Center, U.S. Fish and Wildife Service, 412 N.E. 16th Avenue, Rm. 250, Gainesville, FL 32609, and CHERI JONES, Department of Zoology, University of Florida, Gainesville, FL 32611, USA



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