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A Notching System for Marking Softshell Turtles

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Beginning with Cagle (1939), the marginal scutes of the turtle carapace have often been used for various marking systems on hard-shelled turtles (reviewed in Ernst et al. 1974; Ferner 2007; Plummer and Ferner, *in press*). Because the carapacial margin of trionychid turtles lacks discrete scutes, these turtles present difficulties for unambiguously marking a large number of individuals; thus a systematic marking system for softshells is needed. Herein, I describe a system used in two softshell population studies (Plummer 1977a, 1979). Plummer (1977a) made at least 2300 captures of 1500 marked *Apalone mutica* over a 3-yr period. A long-term population study of *A. spinifera* by Plummer and Mills (*in press*) was based on 570 captures of 270 marked turtles from 1994–2003 and this study continues today (716 captures of 322 turtles as of 2007). Although the marking method was briefly mentioned by Plummer (1977a, 1979), details were not provided.

Marks are made by cutting triangular-shaped pieces from the edge of the carapace using a pocketknife for adults and juveniles and small scissors for hatchlings. Alternatively, a paper hole punch may be used to apply marks (Doody and Tamplin 1992). A small amount of bleeding may follow marking because the shell is vascularized. The depth of the notched cut varies with turtle size, approximately 15–25 mm for adults and 8–12 mm for juveniles. The notches eventually heal and fill to the original carapacial edge; however, the triangular pale scar tissue remains evident. The numerical marking scheme is based on 12 h clock positions. From a dorsal view, the face of a clock is superimposed on the carapace (Fig. 1). Distinct positions are 12 and 6 (opposite each other on the midline of the carapace), 2 and 10 (just anterior to the bridge), and 3 and 9 (opposite each other but perpendicular to the midline. Positions 4–5 and 7–8 are less precise but positioned between unambiguous positions (3, 6, and 9).

To mark a turtle, one to five notches (notching groups 1–5) are cut in the edge of the carapace. Turtle nos. 1–12 are identified by one notch; nos. 13–78 by two notches; nos. 79–142 by three notches; nos. 143–195 by four notches, and nos. 196–238 by five notches (Fig. 1). Within a notching group (Fig. 1 B–L), numbers are consecutive by progressing from last notch clockwise. For example, turtles no. 13–23 are marked as follows: turtle no. 13 has notches at the nos. 12 and 1 positions, turtle no. 14 has notches at the 12 and 2 positions, etc., to turtle no. 23, which has notches at the 12 and 11 positions (Fig. 1B). For a four notch example, turtle no. 181 has notches at the 5, 6, 7, and 8 positions, turtle no. 182 has notches at the 5, 6, 7, and 9 positions, etc., to turtle no. 185, which has notches at the 5, 6, 7, and 11 positions (Fig. 1G). A final example is turtle no. 238, which has notches at the 8, 9, 10, 11, and 12 positions (Fig. 1J). For numbers greater than 238, the 1-238 series may be repeated by coding with additional marks on the plastron or by toe clipping. For example, a notch in the ante-

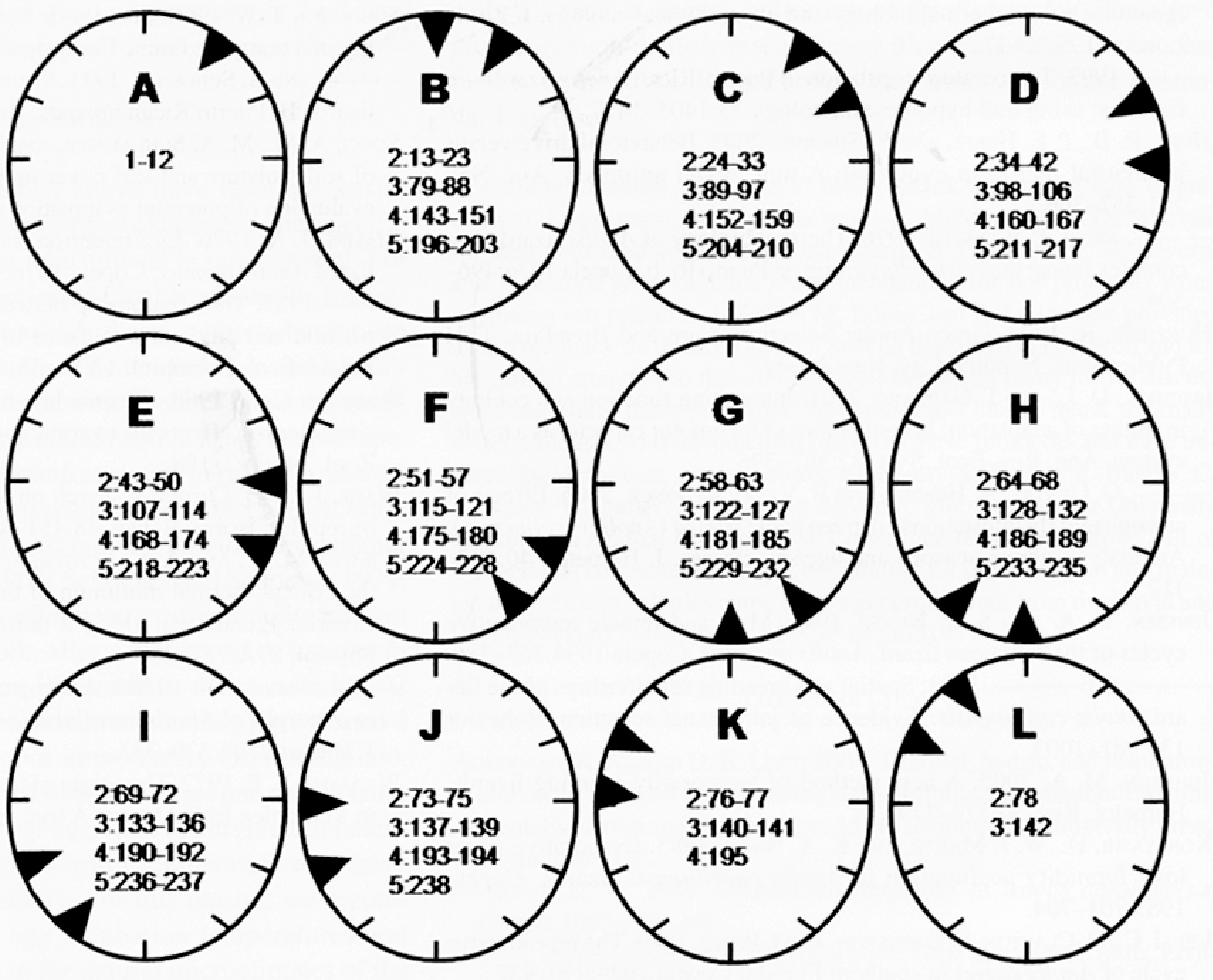

FIG. 1. Schematic of the proposed marking system for softshell turtles. Dark triangles represent notches in the carapacial margin corresponding to the hours of a 12 h clock. The first notch represents the starting position for numbering sequences in B (position 12) through L (position 10) for a two notch sequence. Numbers separated by a colon represent the number of notches to be cut and the range of turtle nos. that can be assigned from the starting position.

rior left quadrant of the plastron codes for turtle nos. 239–476, a notch in the anterior right quadrant codes for nos. 477–714, and notches in both the anterior left and right quadrants code for nos. 715–952. Using the 1–238 notching series and various combinations of just 1–2 notches in the four plastral quadrants would permit marking more than 2500 turtles.

Turtles unambiguously identified after extended periods of time between captures (Plummer and Mills, *in press*) demonstrate the long-term persistence of some marks. For example, 12 adult *A. spinifera* initially marked in 1994–95 were clearly identified 10–13 years later in 2005–07. In addition, five juvenile male *A. spinifera* initially marked at 30–60 mm plastron length (PL) were identified as adults 5–6 years later at 90–100 mm PL and 15 juvenile female *A. spinifera* initially marked at 30–60 mm PL were identified, some as adults, 7–13 years later at 140–215 mm PL. Whether marks on some individuals heal sufficiently to prevent identification is unknown; however, natural processes may occasionally alter marks. For example, the posterior most carapacial edge of adult males, which includes notching positions 5–7, is particularly susceptible to disfigurement resulting from aggressive intraspecific behavior (Doody and Tamplin 1992; Plummer 1977b). Growth from a small juvenile to a large adult may obscure marks such that periodic remarking is needed. Validation studies are needed to quantify the proportion of turtles that possibly "lose" their marks.

Several investigators have used shell marking in softshell mark-recapture studies (Breckenridge 1955; Doody and Tamplin 1992; Fitch and Plummer 1975; Graham and Graham 1997; Plummer 1977a; Plummer and Mills, *in press*); however, none described their marking methods in sufficient detail to be used by others. Thus, a systematic shell marking system designed specifically for the unique problems presented by marking large numbers of softshells for long-term studies is not available. The superiority of the system described herein may be open to question; however, its utility has been clearly demonstrated in population studies of two softshell species (Plummer 1979a; Plummer and Mills, *in press*). Whether the system would be suitable for other trionychid species is unknown. Various tagging techniques, such as PIT-tagging, offer advantages to shell marking and have been used on softshells (Galois et al. 2002), but they also have their own limitations (Gibbons and Andrews 2004).

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AMPHIBIAN CHYTRIDIOMYCOSIS GEOGRAPHIC DISTRIBUTION

This section offers a timely outlet for streamlined presentation of research exploring the distribution and prevalence of the amphibian chytrid fungus *Batrachochytrium dendrobatidis* (*Bd*). *Bd* is an emerging infectious disease linked to mass mortality of amphibians worldwide, yet *Bd* detections in amphibians with no symptoms also are known in many areas. To aid in our understanding of the scope of this issue, we encourage submission of studies on *Bd* geographic distribution, including research on individual species or groups of species, wild or captive animals, native or non-native species, live animals or museum specimens, environmental samples, and findings with no *Bd* detections. We ask authors to: 1) restrict the Introduction of their paper to a **maximum** of two paragraphs to highlight the context of their study; 2) briefly include both field and laboratory Methods; 3) present Results in a Table, although a map also might be very useful, and limited text; and 4) have a short discussion of a **maximum** of three paragraphs to touch upon key findings. Please consider including the following information in submissions: coordinates and description of sampling areas (or please note if locations are extremely sensitive to reveal, and provide general area instead); positive and negative results; disposition of voucher specimens; date of specimen collec-