



FIGURE A4-1. View of plastron showing rings from natal (0) to 4th year of growth. Photograph by David J Germano.

APPENDIX 4. COUNTING ANNULI AND AGE DETERMINATION DAVID J GERMANO (Department of Biology, California State University, 9001 Stockdale Highway, Bakersfield, CA 93311)

Determining the age of Western Pond Turtles 0 to 15 y old is based on growth rings that are deposited annually (see text). To count annuli, I recommend using the largest plastral scales (or scutes) because annuli will often be easiest to see on these scales. On the Western Pond Turtle, the abdominal scales, the 2 large scales adjacent to the upper part of the openings in the shell for the hind limbs, are largest and often best. Wear on the plastron may sometimes make other scales preferable for counting annuli. If the abdominals are too worn, one should choose the scale that makes counting easiest.

Once a readable scale has been chosen, the hatching or zero (0) line must be recognized within it (Fig. A4-1). The "0" line defines the size and shape of the scale at the time the turtle hatched. Annuli radiate outward from the 0 line in asymmetric concentric fashion, making it

easy to recognize. On abdominal scales of Western Pond Turtles, the hatching scute is asymmetrically positioned toward the lateral and posterior edges of this scale. In young turtles (<4 y old), the region bounded by the 0 line can also be recognized from its distinctive, rough-textured or ornamented surface. However, this distinctive texture wears smooth rapidly as a young turtle ages, so identification of the 0 line in most individuals will require looking for the line around the smallest polygon on the scale from which the annuli radiate outward.

Count annuli in a lateral to medial direction (from the 0 line toward the midline of the animal). Counting in this direction is recommended because spacing between annuli is greatest along this axis, which makes individual annuli easier to distinguish. A count of annuli should exclude the 0 line, but include all annuli between the 0 line and the midline of the body. Because the turtle for which age is determined will probably have been captured during its active season, the last, or current, annulus (the one that lies with its edge on the midline

suture) will be separated from the immediately adjacent annulus by a distance that reflects the amount of growth up to the capture date. If the capture date is early in the season, the current annulus will be only a short distance from its adjacent one. Still, the last annulus should be counted with the understanding that only part of a year of growth may be represented. A total count in this fashion (excluding the 0 line) will estimate the number of years since hatching.

The greatest difficulty in counting annuli is simply recognizing them and distinguishing yearly annuli from false annuli or growth rings. False annuli are lines that do not represent annual growth increments, but are either an aberration in the way the scale keratin was laid down or reflect periods of stress or arrested growth within an animal's typically active season. False annuli can be relatively easily distinguished from true annuli because they are usually less prominent and have a much less complete concentric pattern than true annuli. False annuli often have a more irregular spacing pattern than adjacent true annuli. Still, some difficulties can be experienced by novices attempting to count annuli. I recommend that individuals inexperienced in counting annuli have at least some training with an experienced individual. The best way to confirm that annuli counts reflect age is to use the technique in a marked turtle population in which recaptured turtles have their annuli recounted. I recommend implementing this approach because it will also allow a better characterization of the nature of false annuli so that future application of annuli counting can be refined. Start by determining the age of younger turtles and then attempt counts on older individuals, keeping in mind there is an upper limit (10–15 y depending on the part of the range where you are working).

To create a record of the annuli for later inspection and measurement of annuli more conveniently, castings can be made using dental alginate material (available through dental supply businesses). The following are instructions to create these casts:

1. I make alginate casts from the 2nd costal and abdominal scutes because the medial edges of annuli are straight (better to measure than curved lines). I use the right

scute in both cases unless they are particularly damaged and the corresponding left scute is better.

2. Make enough alginate to completely cover each scute and about one-half to one-third of the adjacent scutes. Make casts thick enough so they do not easily bend. On smaller turtles, this probably means using 1 scoop of alginate for both casts, but 1 scoop each on large adults.
3. Place each cast on top of a moistened paper towel and fold up gently. Place each set (1 turtle) inside a single ziplock or plastic bag. Do not allow the casts to touch each other (they will meld together).
4. Put an ID tag into the bags with casts. The ID tag (piece of paper) should be written in pencil on write-in-the-rain paper and include the location, date, and turtle identification number. Place all samples from one day and area into a larger plastic bag, and write locality information on the outside of the bag with a permanent marker ink. Keep refrigerated or the towels and impression will be invaded by mold.
5. Each set of casts should be uniquely identified to a data sheet that contains detailed information on the turtle, including: carapace length (CL), plastron length (PL), sex of turtle (juvenile if too small to determine sex), and the number of scute rings (if you are fairly confident of the number). The data sheet helps the alginate reader (if not you), especially when the cast scutes have some missing rings because of wear.
6. If you are sending casts to someone else to read, only cast scutes if they have rings present. Many older turtles have worn shells with no rings visible, and their age can be given as 15+ or 20+, indicating an unknown older age.
7. For those who will read the casts in the lab, a positive of the alginate casting is recommended using a plaster-of-paris mix (Dentstone is one brand from dental suppliers that is excellent) to create a permanent cast. Attempt to count rings or make permanent casts within a few weeks or the alginate impression may become too moldy to use, even when refrigerated.