Reading Adult Horseshoe Crab Shells

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ABSTRACT

The condition of the exoskeleton of the adult horseshoe crab, *Limulus polyphemus*, reveals much about its natural history, such as age, health, activities, and habitats. In the mid-Atlantic area, *Limulus* reaches adulthood in 9 to 12 years and undergoes approximately 18 growth stages during this time. Thereafter, molting rarely, if ever, occurs, and the animals live at least an additional 8 years. As a result of burrowing activities and wide-ranging migrations for feeding, breeding (A1), and resting (A2), horseshoe crabs are exposed to a variety of environments within estuaries and on the continental shelf. Criteria for estimating the age of adult *Limulus* and three major impacts on the exoskeleton—abrasion, injuries, and symbionts—are depicted in this exhibit.

INTRODUCTION

This poster is a pictorial introduction to some common impacts to the shells of horseshoe crabs.

(A1) The range in abrasion of the shells shows this spawning group is composed of several year classes.

(A2) Feeding and resting crabs create characteristic puddles on intertidal flats.

COMMENTARY

Determining the sex, approximate age, and the health or condition of specimens from their exoskeletons is an intertwined activity since one often defines the other.

Sexual Characteristics

All juvenile horseshoe crabs and adult females are very similar in appearance. However, adult females contain mature ova, have mated, and are usually much larger. Adult males have several secondary characteristics related to their role in amplexus, particularly in the modification of the pedipalps into claspers. Other changes are in the frontal area of the prosoma; males exhibit flared rims and a more convex arch.

Approximate Age

The criteria for aging adult horseshoe crabs are subjective. The descriptions below follow the format: age in adult years (add about 10 years for total age) / amount and severity of abrasions to exoskeleton / numbers and kinds of epibionts / response to handling.

Young: 1–3 years / none to few abrasions; shell shiny / usually no epibionts / very agile; fighters.
Middle-aged: 3–6 years / many scratches and patches of darkened shell / usually bears epibionts / less resistant.
Old: 6–10 years / shell almost all black; some areas may be eroded down to the innermost, cream-colored shell or to flesh / large epibionts / passive.

Health/Condition

The criteria used to estimate the adult age also apply to the condition of an animal.

(A3) The carapace of a first year male (left) and an older male (probably 7 or 8 years old).
(A4) Lateral view of a section of the prosoma of a young adult female showing the mosaic pattern on the surface of the shell and the fringe of hair-like setae.
(A5) The mid-piece (opisthosoma) of an adult female *Limulus*: (1) axial and (2) lateral mating scars. (3) posterior mating scar, (4) erosion caused by the male clappers, (5) damage to marginal spines, and (5) and hair-like setae (compare A4).

Abrasion: Mating, feeding, and resting (A1 and A2) continually expose horseshoe crabs to abrasion and sessile organisms (S1 and S2).

Injuries: The most common injuries from trawls are puncture wounds, caused by another animal's telson, and fractured shells with bleeding. Less common injuries include caved-in carapaces (I1) and cuts (I2 and I3), in this case healed, with regeneration of severed limbs (at arrows).

Symbionts: Horseshoe crabs are walking natural history museums. Information about the animal's habitat can often be gathered by examining the species and number of attached organisms. (S1) Slipper shells have completely ringed in and hindered the action of the legs (blue mussels have a greater impact). (S2) Oysters, barnacles, and an encrusting bryozoan on an old-age female. The larger epibionts, through their quantity and size, can severely hamper the activity of a crab and destroy tissue.

CONCLUSION

Reading the exoskeleton of *Limulus* can add an important dimension to studies on the health of spawning populations and stock assessments.

REFERENCES

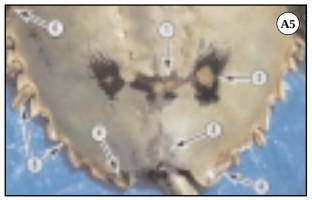
Allee, Ward Clyde. 1922. Studies in marine ecology. II. An annotated catalog of the distribution of common invertebrates of the Woods Hole littoral. In: Marine Biological Laboratory Library, Woods Hole, Massachusetts.

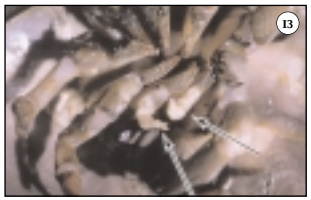
Botton, Mark L. and John W. Ropes. 1988. An indirect method for estimating longevity of the horseshoe crab *Limulus polyphemus* based on epifaunal slipper shells (*Crepidula fornicata*). J. Shellfish Res. 7: 407-412.

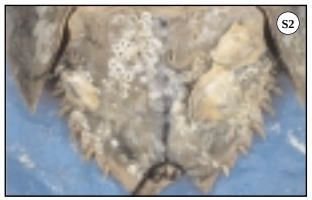
Botton, Mark L. 1981. The gill books of the horseshoe crab (*Limulus polyphemus*) as a substrate for the blue mussel (*Mytilus edulis*). Bull. New Jersey Acad. Sci. 26 (1): 26-28.

Grant, Dave. 2001. Living on *Limulus*. In: Tanacredi, John T. (ed.). *Limulus* in the Limelight. Kluwer Academic/Plenum Publishers (New York): 135-145.

Swan, Benjie Lynn. 2002 manuscript. Recovery of a live crab, eight years after tagging (see also the poster HORSESHOE CRABS ARE WANDERERS).







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