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 habitat. In the mid-Atlantic region, Limulus reaches adulthood in 9 to 12 years and undergoes approximately 15 growth stages during this time. Thereafter, molting rarely, if ever, occurs, and the animals live at least an additional 5 years. As a result of boring 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 symbions—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 punctures, 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). (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) anterior; (2) lateral mating scars; (3) posterior mating scar; (4) erosion caused by the male claspers; (5) damage to marginal spines; (5) and (6) hair-like setae (compare A4). (A6) Feeding and resting crabs create characteristic punctures, 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).

COMMENENTARY
Determining the sex, approximate age, and the health or condition of specimens from their exoskeleton 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 ovaries, have molting, and are usually much larger. Adult males have several secondary characteristics related to their role in amplexus, particularly in the modification of the podopuluses into claspers. Other changes are in the frontal area of the prosoma; males exhibit flattened veins 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 12 years for total age) / amount and severity of abrasion 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 punches / inner 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 must to estimate the adult age also apply to the condition of an animal.

(A1) The carapace of a live year male (left) and an older male (probably 7 or 8 years old). (A2) 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. (A3) The mid-piece (opisthosoma) of an adult female Limulus: (1) anterior; (2) lateral mating scars; (3) posterior mating scar; (4) erosion caused by the male claspers; (5) damage to marginal spines; (5) and (6) hair-like setae (compare A4).

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

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