Horseshoe Crab Technical Committee Report

April 19 –20, 2006

The Technical Committee (TC) met on April 19th and 20th to review recent research and monitoring and discuss the biological effects of draft Addendum IV options. Several researchers from the Virginia Tech Horseshoe Crab Research Center presented updates on their work. Some members of the HSC Stock Assessment Subcommittee also participated in the meeting. The meeting was held at the Holiday Inn Central in Washington D.C. The following is a summary of the meeting.

Attendees

Technical Committee Members

Rich Maney (NMFS)
Larry DeLancey (SC), Vice Chair
Tina Moore (NC)
Sue Gerhart (FL)
Greg Breese (USFWS)
Jeff Brust (NJ)
Stew Michels (DE)
Steve Doctor (MD)
Penny Howell (CT)
Lewis Gillingham (VA)
Robyn Burgess (NY)
Frank Germano (MA)
Mike Millard (USFWS), Chair
Joanna Burger (Rutgers)
Scott Olszewski (RI)
Sheri Patterson (proxy for Clare McBane, NH)
Brad Spear (ASMFC), Staff

Stock Assessment Subcommittee Members

Kim McKown (NY)
Michelle Davis (Virginia Tech)

Virginia Tech

Eric Hallerman
Dave Hata
Jim Fraser
Sarah Karpanty

Others

Jason Rylander, Defenders of Wildlife
Michael Oates, Anew, Inc.
Rick Robins, Ches. Bay Packing, HSC AP
Perry Plumart, American Bird Conservancy
Greg Butcher, Audubon Society
Caroline Kennedy, Defenders of Wildlife
Tim Dillingham, American Littoral Society

Virginia Tech Horseshoe Crab Research Center

Virginia Tech's Horseshoe Crab Research Center is the only multi-investigator, multi-institutional research unit dedicated to providing information essential for the management of horseshoe crabs. Its goal is to provide information needed to sustainably manage the horseshoe crab for the benefit of all resource users. The Center has several ongoing research projects. The VT researchers presented updates on the projects at the TC meeting.

Benthic Trawl Survey (David Hata)

The survey has been run each fall since 2001. VT plans to extend the range of the survey in 2006. But, funding for the 2007 survey will likely be reduced. Funding for 2008 and beyond is uncertain.

The 2004 survey results that the Board first learned about in November 2005 contained an error. The calculated densities of horseshoe crabs initially reported were about one-third of what they should have been. That error was corrected and updated values were included in the updated report containing the 2005 survey results.

Indications from the survey are:

- Immature female HSCs in the DE Bay area have increased significantly since 2003
- In the DE Bay area, mature male and femaleHSCs that haven't yet spawned remain variable
- In the DE Bay area, mature male and female HSCs that have spawned remain stable
- There is a lower abundance of HSCs in the New York apex compared to the DE Bay area
- Indices in the New York apex remained variable

The survey is most appropriate for relative abundance. The survey's principal investigator reported that the survey data were not adequate for producing absolute abundance estimates. In 2005, the survey included a bycatch sampling study to identify and quantify non-target species encountered.

One of the major objectives of the study is to develop an easy and effective protocol to identify new recruits to the spawning population. A new method was used on the survey in 2005. This method will be reviewed by the TC for its potential use by port agents and other state staff.

Genetics (Eric Hallerman)

The HCRC is working with Dr. Tim King (USGS) to better understand population genetics of HSCs. They are looking to supplement previously analyzed samples with samples from new areas of spawning assemblages and from commercial fisheries. The research will attempt to inform HSC management by delineating stock structure and identifying contributions in any mixed-stock fisheries. VT expects to get a full genetics report out in about two years, but updates can be given as the work progresses.

Egg Availability for Shorebirds (Sarah Karpanty and Jim Fraser)

VT is also collecting independent data on the interactions between horseshoe crabs and shorebirds to determine if HSC eggs are a limiting resource for migrating red knots. VT's hypothesis is that if red knots are being limited by the availability of HSC eggs, then there should be evidence that red knot habitat selection in the Delaware Bay is driven by horseshoe crab egg abundance. If crab eggs are not a limiting resource for knots in the bay, then there should be evidence of some other factor or combination of factors driving red knot habitat selection. However, that hypothesis has not been investigated. Conclusions of the research so far include:

- Birds exhibit significant preference for sandy beach habitat in comparison to coastal and emergent marsh habitat
- There is evidence of a habitat shift for red knots before and after peak HSC spawning events with increased use of beach and decreased use of marsh
- Habitats used by red-knot had significantly more crab eggs than random points
- Preliminary results indicate no evidence of bird-induced reduction in surface eggs number and some evidence of bird-induced reduction in core eggs number

The HCRC plans to continue and expand its research in this area. Final reports should become available in the near future.

Conclusions and Recommendations

Both VT and the HSC TC agreed that more frequent contact with each other is important and will occur. At least annual meetings between the groups should be held along with remote interaction throughout the year. VT agreed to collaborate with the Stock Assessment Subcommittee (SAS) on using its trawl data in a preliminary catch survey modeling effort. The TC requested that VT provide written protocols for its methods of identifying new recruits and provide an update on the work that has been done at UD for identifying new recruits. As noted earlier, this will assist the TC and SAS determine if the catch survey model (which depends on such information) can be applied for HSC stock assessment.

It is critical at this point in the management history that funding for future work be secured. The Benthic Survey is indicating an increase in immature HSCs. It will be important to document this if it continues into the adult population. Funding for 2007 is insufficient to allow for the full complement of work that is needed. There is no funding for 2008 and later. Currently there is time to increase funding for 2007, and this is the time to begin working toward continued funding in 2008 and beyond.

Delaware Bay Spawning Survey Results

The redesigned spawning survey has been conducted every spring since 1999. Estimates of spawning activity continue to be precise. Peak spawning activity in 2005 was later than normal, similar to what was seen in 2003. Weather may have contributed to the delay in both years. Most of the spawning occurred in June. Baywide spawning activity has been stable over the past seven years. Spawning activity on Delaware beaches has declined significantly from 1999 to 2005 (slope = -0.05), while it has increased (though not significantly) on New Jersey beaches. State-specific trends are compensatory and could represent a response to state-specific harvest or a shift in spatial distribution.

Interaction with Shorebird Technical Committee

TC members agreed that a joint meeting or workshop between the HSC TC and the USFWS Shorebird TC would be beneficial. They recognized the significant time and cost it will take to make that happen. This spring migratory bird population modelers are expected to be in the DE Bay area conducting research. The HSC and SB TCs will take advantage of this opportunity to assemble a small meeting of shorebird and HSC quantitative biologists to discuss individual species assessment modeling and the possibility of working toward an adaptive resource management (ARM) approach, which links the use of several models in a multi-species framework. The objective of the meeting would be to identify issues and recommendations that will help inform and focus a joint meeting between the two TCs. Funding for a joint meeting has not yet been identified.

Biological Effects of Draft Addendum IV Options

The TC discussed and commented on the expected short and long term biological effect of each option in Addendum IV with respect to horseshoe crab abundance and HSC egg availability to shorebirds. Appendix A contains notes from the discussion as recorded at the TC meeting. Below is a summary of the consensus conclusions.

The options in draft Addendum IV are focused on New Jersey, Delaware, Maryland and Virginia. The TC defined 'Delaware Bay Region' for the purpose of its discussion as the area where crabs of Delaware Bay origin are most likely to exist. That area is New Jersey and Delaware ocean and bay waters, and Maryland and Virginia ocean waters. The TC would like to note that there is HSC harvest and some, but poorly understood, shorebird use of HSC eggs outside of the Delaware Bay Region that can be indirectly affected by management actions restricted to the Delaware Bay Regions.

It is important to note that the TC limited its findings to the effects of the options as written in draft Addendum IV, including the timeframe specified for each option. The TC did not consider individual state regulations that have been proposed.

When determining the expected effects of Addendum IV options to the HSC population and egg availability, the TC stated them in terms of a theoretical maximum of harvest as opposed to past catch. For example, for the NJ/DE Option 3 summary below the TC used a theoretical maximum of 300,000 female crabs that would not be harvested due to a moratorium. However, over the past two years under Addendum III New Jersey and Delaware have reported a total female harvest of approximately 61,956 crabs per year.

<u>New Jersey and Delaware</u>

Option 1: This option would allow for continued annual horseshoe crab harvest of up to 2.3% of the total 2004 population estimated in Delaware Bay.[1] As noted in the report from its October

[1] Calculated using current maximum allowable annual harvest from the DE Bay of 300,000 horseshoe crabs as a percentage of estimated abundance of crabs of 13.3 million crabs in DE Bay in 2004. Dave Smith (USGS) has produced the only estimate of absolute abundance of DE Bay horseshoe crabs that has been accepted by the TC. Results of his work at written up in his 2005 report "Mark-Recapture Estimates of Adult Horseshoe Crab

20, 2005 meeting, the TC reports indications of recent increases in juveniles as seen in the DE 16-foot trawl survey and USGS DE Bay surveys. In addition the 2006 VT trawl survey estimated an increase in immature crabs in the core area, though that increase is not statistically significant. This may suggest that there will be an increase in new recruits to the spawning population, or could be due to movements or sampling variability. Current harvest levels are not expected to significantly change the trend in horseshoe crab populations over the short term. Current harvest levels would not change egg availability in the short term either, since horseshoe crabs take 9-12 years to reach spawning age. Several data sets suggest that under the current harvest levels there will be an increase in spawning horseshoe crab abundance in the future, and this may provide for an increase in egg availability for shorebirds as well.

Option 2: This option would allow an annual, delayed harvest of male crabs of up to 3% of the total male population in DE Bay for two years.[2] It may result in bycatch mortality of females depending on harvest method. The current sex ratio of horseshoe crabs will shift slightly toward more females in the short term in DE Bay with uncertain consequences on genetic and mating behavior. In the years following the male only harvest the shift toward females will become less pronounced reducing the small and uncertain effect on genetic and mating behavior. It would result in up to 7.2% fewer removals of mature females annually.[3] It is likely there would be some corresponding increase in egg availability in the short term. In the longer term, this small positive effect on egg availability would be expected to continue at some uncertain level. It should be noted that harvest limitations in DE Bay have resulted, and may result in further increased harvest pressure to populations outside the region.

Option 3: This option would eliminate an annual harvest and directed bycatch of up to 300,000 crabs (approximately 2.3% of the estimated 2004 DE Bay population) for two years. A two-year moratorium would have a small positive effect on the horseshoe crab population in the short and longer term, but it is unlikely that this increase will be detectable with current monitoring programs. It would result in up to 7.2% fewer removals of mature females annually.[4] It is likely there would be some corresponding increase in egg availability in the short term. In the longer term, this option would have a small positive effect on egg availability, but it is unlikely that this increase will be detectable with current monitoring programs. It should be noted that harvest limitations in DE Bay have resulted, and may result in further increased harvest pressure to populations outside the region.

Maryland and Virginia

*The TC notes that benefits of increased egg availability for shorebirds in Delaware Bay resulting from management actions in Maryland and Virginia would be limited to that portion of the catch, which is not quantifiable at this time, in those states that is of Delaware Bay origin.

Abundance in Delaware Bay: Updated Estimates for 2003 and 2004 and Assessment of Bias Due to Tags Overlooked During Recapture."

[2] Calculated using current maximum allowable annual harvest from DE Bay of 300,000 male horseshoe crabs as a percentage of 9.1 million male crabs in DE Bay in 2004 as estimated in Smith 2005. [See Note 1]

[3] Calculated using current maximum allowable annual harvest from DE Bay of 300,000 female horseshoe crabs as a percentage of 4.2 million female crabs in DE Bay in 2004 as estimated in Smith 2005. [See Note 1]

[4] See Note 3.

Option 1: This option would allow continued harvest of up to 323,148 horseshoe crabs annually. The lack of monitoring and data, coupled with the inability to determine what portion of the harvested population spawns in Delaware Bay, makes it uncertain what effect current harvest is having on the crab population in the short and long term. Current harvest levels would not change egg availability in the short term, since horseshoe crabs take 9-12 years to reach spawning age. It is uncertain what effect this option will have on the horseshoe crab population and egg availability in the longer term.

Option 2: This option would allow continued harvest of up to 323,148 horseshoe crabs annually for two years, but it would be later in the season. The lack of monitoring and data, coupled with the inability to determine what portion of the harvested population spawns in Delaware Bay, makes it uncertain what effect delaying the current harvest until after June 7 will have on the crab population in the short term. It is likely there would be some increase in spawning activity and egg availability in the short term, but it is unlikely that this increase will be detectable in Delaware Bay with current monitoring programs. In the longer term, this small positive effect on egg availability would be expected to continue at some uncertain level.

Option 3: This option would allow an annual, delayed harvest of males, up to 323,148 male crabs annually for two years. It may result in bycatch mortality of females depending on harvest method. The sex ratio of horseshoe crabs will shift toward more females in the short term in the region with uncertain consequences on genetic and mating behavior. In the years following the male only harvest the shift toward females will become less pronounced reducing the small and uncertain effect on genetic and mating behavior. It would result in up to 323,148 fewer removals of mature females annually. It is likely there would be some increase in spawning activity and egg availability in the short term. In the longer term, this small positive effect on egg availability would be expected to continue at some uncertain level. It should be noted that harvest limitations in DE Bay Region have resulted, and may result in further increased harvest pressure to populations outside the region.

Option 4: This option would, as written, permanently change Virginia's harvest regulations to allow an annual, delayed harvest of up to ~40,000 male crabs and up to ~20,000 female crabs from Virginia's ocean waters. It would likely have little or no change on the crab population in the short term and longer term. It's uncertain whether the Chesapeake Bay horseshoe crab population will be affected by possible redirected harvest effort into the Bay. It is likely there would be some increase in spawning activity and egg availability in the short term, but it is unlikely that this increase will be detectable in Delaware Bay with current monitoring programs. In the longer term, this small positive effect on egg availability would be expected to continue at some uncertain level.

Option 5: This option would eliminate an annual harvest and directed bycatch of up to 323,148 crabs for two years. A two-year moratorium would have a small positive effect on the horseshoe crab population in the short and longer term, but it is unlikely that this increase will be detectable with current monitoring programs. It would result in up to 323,148 fewer removals of mature females annually. It is likely there would be some small corresponding increase in egg availability in the short term in DE Bay. In the longer term, this option would have a small positive effect on egg availability in the DE Bay, but it is unlikely that this increase will be

detectable with current monitoring programs. It should be noted that harvest limitations in DE Bay have resulted, and may result in further increased harvest pressure to populations outside the region.

Biomedical

Option 1: This option would result in coastwide mortality of up to 58,000 crabs annually. This current level of mortality is not expected to significantly change the trend in horseshoe crab populations over the short or long term, nor change egg availability since horseshoe crabs take 9-12 years to reach spawning age. Several data sets suggest that under the current harvest levels there will be an increase in spawning horseshoe crab abundance in the future, and this will provide for an increase in egg availability for shorebirds as well.

Option 2: This option would allow a delayed utilization of male crabs for biomedical purposes for two years. This option would likely result in an increased number of crabs (male only) harvested annually. It may result in bycatch mortality of females depending on harvest method. The sex ratio would change slightly with uncertain consequences on genetics and mating behavior in the short term. In the years following the male only harvest the shift toward females will become less pronounced reducing the small and uncertain effect on genetic and mating behavior. Up to 58,0000 fewer female crab removals annually would likely result in some corresponding increase in egg availability in the short term in the DE Bay. In the longer term, there would be a small positive effect on egg availability in DE Bay, but it is unlikely that this increase will be detectable with current monitoring programs.

Option 3: This option would result in no mortality from biomedical harvest and use in DE Bay Region for two years. A two-year moratorium would have a small positive effect on the horseshoe crab population in the short and longer term, but it is unlikely that this increase will be detectable with current monitoring programs. It is likely there would be some corresponding increase in egg availability in the short term. In the longer term, this option would have a small positive effect on egg availability, but it is unlikely that this increase will be detectable with current monitoring programs. It should be noted that harvest limitations in DE Bay have resulted, and may result in further increased harvest pressure to populations outside the region.

Appendix A: Technical Committee's Addendum IV Options Notes Tables

NJ/DE Option #1	Expected effect on horseshoe crab population	Expected effect on HSC egg availability for shorebirds
Short term (0-2 yrs.)	•Continued harvest of up to 300,000 crabs annually •Insert conclusions from 10/20/05 TC report	•No change from status quo because of lag time
Longer term	•Current juvenile population increases indicate increased HSC availability in future	•Current juvenile population increases indicate increased egg availability in future

NJ/DE Option #2	Expected effect on horseshoe crab population	Expected effect on HSC egg availability for shorebirds
Short term (0-2 yrs.)	•1 to 3% of male crab population removed annually •bycatch mortality of females depending on harvest method •Sex ratio will change with uncertain consequences on genetics, mating behavior •harvest limitations imposed in the Delaware Bay Region have resulted and may result further in increased impacts to populations outside the Region	•2 to 7.5% fewer removals of mature females annually •Possible corresponding increase in egg availability
Longer term	•Small effect on sex ratio	•Small positive effect on egg availability

NJ/DE Option #3	Expected effect on horseshoe crab population	Expected effect on HSC egg availability for shorebirds
Short term (0-2 yrs.)	•No harvest or directed bycatch mortality (maximum of 300,000 female crab not removed annually) •harvest limitations imposed in the Delaware Bay Region have resulted and may result further in increased impacts to populations outside the Region	•2 to 7.5% fewer removals of mature females annually •Possible corresponding increase in egg availability
Longer term	•Small positive effect on population	•Small positive effect on egg availability

MD/VA Option #1	Expected effect on horseshoe crab population	Expected effect on HSC egg availability for shorebirds
Short term (0-2 yrs.)	•Continued harvest of up to 323,148 crabs annually •Insert conclusions from 10/20/05 TC report	•No change from status quo because of lag time
Longer term	•Uncertain due to lack of past monitoring	•Uncertain due to lack of past monitoring

MD/VA Option #2	Expected effect on horseshoe crab population	Expected effect on HSC egg availability for shorebirds
Short term (0-2 yrs.)	•Possible continued harvest of up to 323,148 crabs annually later in the season	•Small potential increase in egg availability in DE Bay annually
Longer term	•Little or no increase	•Small increase

MD/VA Option #3	Expected effect on horseshoe crab population	Expected effect on HSC egg availability for shorebirds
Short term (0-2 yrs.)	•Up to 323,148 male crabs removed annually •bycatch mortality of females depending on harvest method •Sex ratio will change with uncertain consequences on genetics, mating behavior •harvest limitations imposed in the "Delaware Bay" Region have resulted and may result further in increased impacts to populations outside the Region	•Up to 323,148 fewer mature females removed annually •Possible increase in egg availability in DE Bay Region
Longer term	•Small effect on sex ratio	•Small positive effect on egg availability

VA Option #4	Expected effect on horseshoe crab population	Expected effect on HSC egg availability for shorebirds
Short term (0-2 yrs.)	•Maximum of ~40K males and ~20K females harvested from VA ocean waters annually •Little to no change	•Possible small increase in DE Bay
Longer term	•Little or no change in DE Bay Region • Uncertain effect on Chesapeake Bay population depending on redirected effort	•Likely small increase in egg availability in DE Bay

MD/VA Option #5	Expected effect on horseshoe crab population	Expected effect on HSC egg availability for shorebirds
Short term (0-2 yrs.)	•No harvest or directed bycatch mortality (maximum of 323,148 female crab not removed annually) •Harvest limitations imposed in the Delaware Bay Region have resulted and may result further in increased impacts to populations outside the Region	•Up to 323,148 fewer mature females removed of •Likely small increase in egg availability in DE Bay Region
Longer term	•Small positive effect on population	•Small positive effect on egg availability

Biomed Option #1	Expected effect on horseshoe crab population	Expected effect on HSC egg availability for shorebirds
Short term (0-2 yrs.)	•Continued coastwide mortality of up to 58,000 crabs annually •Minimal effect	•Minimal effect
Longer term	•Minimal effect	•Minimal effect

Biomed Option #2	Expected effect on horseshoe crab population	Expected effect on HSC egg availability for shorebirds
Short term (0-2 yrs.)	•Likely increase of male crab population removed annually possibly exceeding coastwide mortality threshold •Bycatch mortality of females depending on collection method •Sex ratio will change slightly with uncertain consequences on genetics, mating behavior	•Up to 58,000 fewer coastwide removals of mature females annually •Likely very small increase in egg availability
Longer term	•Minimal effect on sex ratio	•Small positive effect on egg availability

Biomed Option #3	Expected effect on horseshoe crab population	Expected effect on HSC egg availability for shorebirds
Short term (0-2 yrs.)	•No harvest mortality in DE Bay Region •Mortality associated with biomedical process likely increase in regions outside of DE Bay •Harvest limitations imposed in the Delaware Bay Region have resulted and may result further in increased impacts to populations outside the Region	•Likely very small increase in egg availability in DE Bay Region
Longer term	•Very small positive effect on population in DE Bay Region •Uncertain negative effect on some populations outside DE Bay Region	•Very small positive effect on egg availability