Horseshoe Crab Delaware Bay Ecosystem Technical Committee Report

June 29, 2011
9:00 a.m. – 12:30 p.m.

At its March 23, 2011 meeting, the Board requested an update on the status of shorebirds for its August meeting. In response to this request, the Delaware Bay Ecosystem Technical Committee (DBETC) met on June 29 via conference call to review the recent data on shorebirds populations in the Delaware Bay area and compile a report to the Board. The DBETC considered multiple data sources, including a summary white paper from shorebird state and local researchers (Dey et al. 2011b), Virginia stopover and count data (Scherer, Karpanty), the baywide egg studies paper (Dey et al. 2010), and a recent publication by McGowan et al. (2011) studying survival of red knots. The DBETC used these resources for their source data but did not specifically endorse any particular resource, unless noted below. As part of this meeting, the DBETC also reviewed the Delaware Bay Horseshoe Crab Spawning Survey Report and the Virginia Tech Horseshoe Crab Trawl Survey report. The following report includes the discussion of the data by the DBETC and its report on the data to the Board, in response to their tasking.

Attendees

Technical Committee Members

Jeff Brust (NJ), Chair
Greg Breese (USFWS), Vice Chair
Alicia Nelson (VA)
Jordan Zimmerman (DE)
Steve Doctor (MD)
Annette Scherer (USFWS)
Eric Hallerman (VA Tech)
Kevin Kalasz (DE)
Amanda Dey (NJ)
Mike Millard (USFWS)
Dave Smith (USFWS)
Danielle Brzezinski (ASMFC), Staff

Other Patricipants

Rick Robins (HSC AP)
Sarah Karpanty (SB AP, Chair)
Carolina Kennedy (Def. of Wildlife)
Heather Murray (Def. of Wildlife)
Dave Hata (Virginia Tech)
Dr. James Cooper (HSC AP, Chair)

Shorebird Population Status

The DBETC reviewed available shorebird data updates on the following metrics: Winter counts, Delaware Bay Peak Aerial Counts, Virginia Peak Aerial Counts, Threshold Weight Index, Baywide Egg Survey, and the East Coast counts. A summary of updated data on each of these metrics follows.

Most recent winter count has shown a decline, with most of the decrease (~5,000 birds) occurring in the main wintering site in Chile. The Tierra del Fuego winter count (Figure 1) had decreased since 2000, with a stabilization of the counts from 2005-2010. The 2011 count of 9,850 birds was a significant decrease from 2010. Given other counts of birds, including the east coast population counts, there is some possibility that some wintering locations may have been missed (Dey et al. 2011b). Additional winter counts in other locations have occurred over the years, including Florida's west coast and northern Brazil. These counts have not been as

consistent over time nor have the long time series as the Tierra del Fuego counts. The current population estimates put the shorebird population around 25,000 knots.

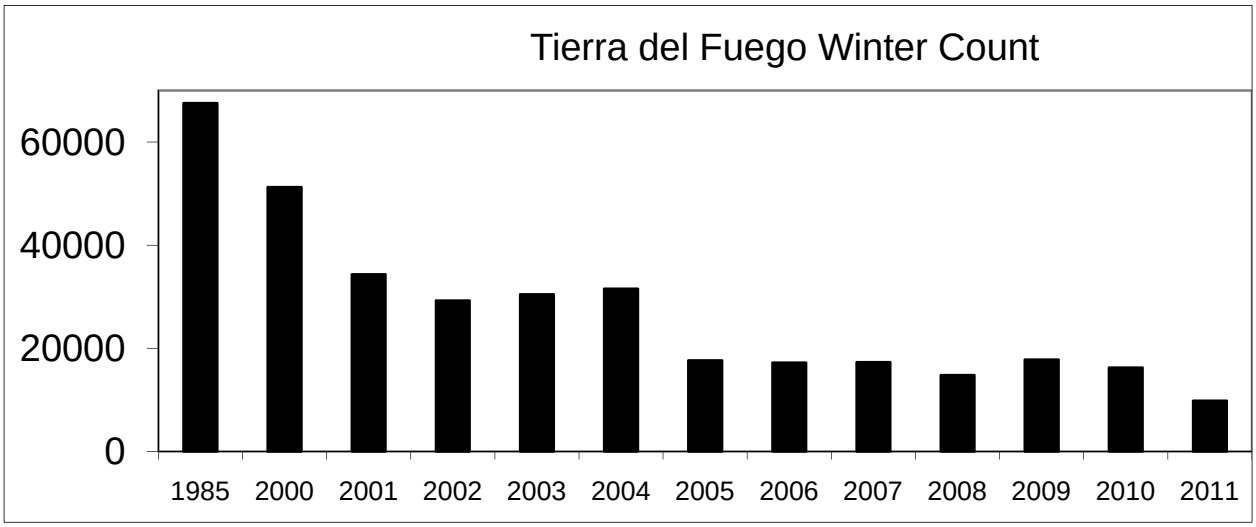

Figure 1. Number of birds cited in Tierra del Fuego winter counts. Note that year corresponds to the January-February year of the count. Example, 2011 refers to the 2010/2011 winter count.

Delaware Bay peak counts showed similar results in 2010 as compared to most of the last decade. The peak counts in Delaware Bay have been traditionally done via aerial counts in the past with the same counters and methods up through 2008 (Dey et al. 2011b). In 2009 the survey was modified by changing from counting all species to only counting red knots and ruddy turnstones, and also using new observers. In addition, the aerial survey was supplemented with ground counts. These changes were implemented in order to better capture the level of birds in Mispillion Harbor, as well as potentially provide a correction factor for the aerial survey. However, mechanical issues and bad weather prevented aerial counts during the recognized peak of bird use in 2009. Thus, only a ground count was used in 2009, most of which was attributable to Mispillion Harbor. In 2010, a new observer was used for the aerial surveys. The 2010 aerial counts were similar to counts from 2003-08 (Figure 2), with no real increase or decrease observed. The 2009 high count may have been due to a particular staging event or other factors, but should not be considered evidence of a population spike in 2009 followed by a drop in 2010. The DBETC raised some concerns about the level of uncertainty and error within these and other data, especially with the change in methods and counters.

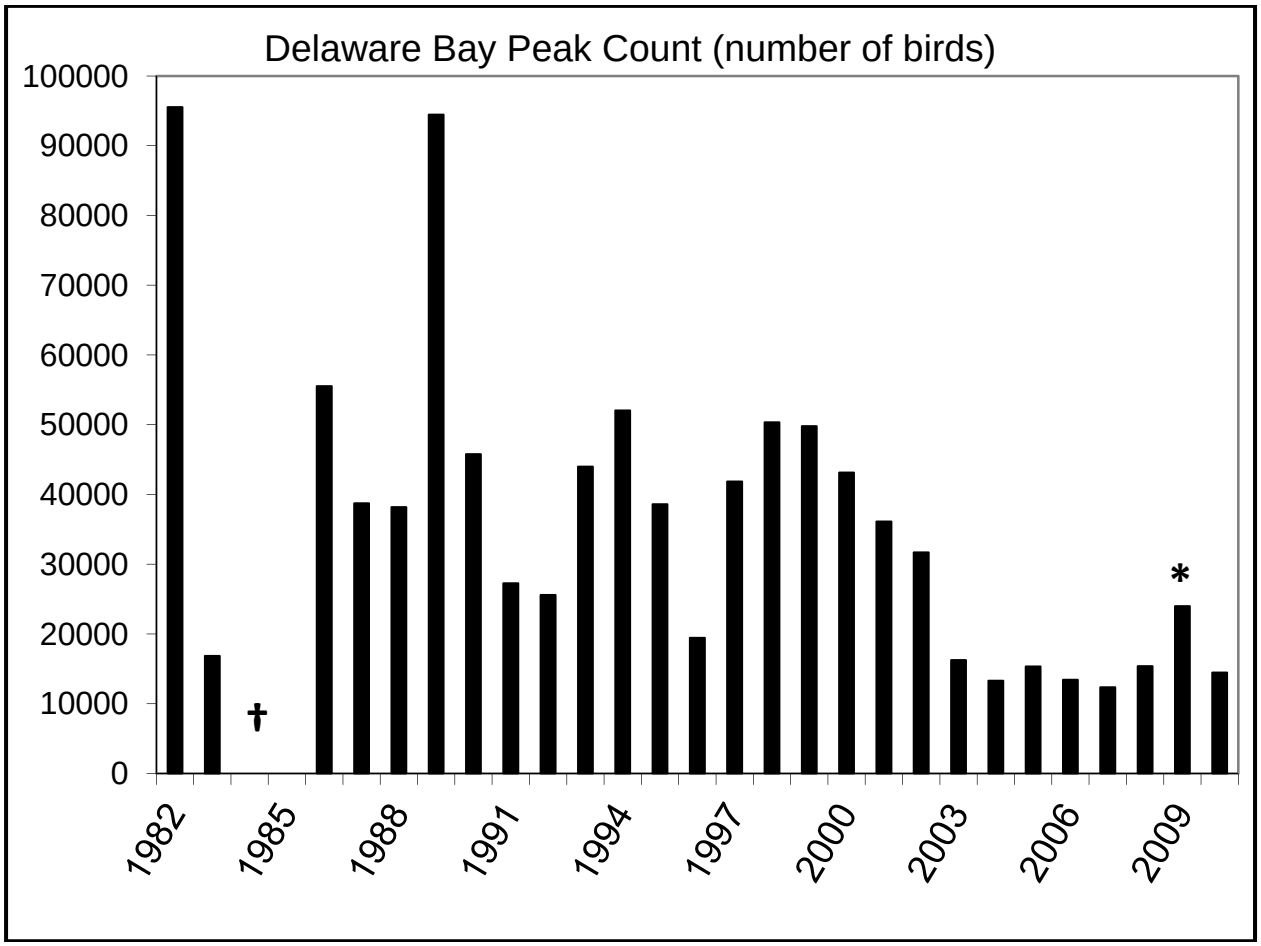

Figure 2. Peak aerial counts within Delaware Bay since 1982. *Due to mechanical problems and weather issues, there was no aerial count in 2009; a peak ground count from 26 May, 2009 is used (Niles et al. 2010). † No data available from 1984 or 1985.

Virginia peak stopover counts had good correlation between ground and aerial counts, and showed an increasing trend in red knot stopover over the past six years. Dr. Sarah Karpanty of Virginia Tech University, who is also the Chair of the Shorebird Advisory Panel, offered data on the counts done in Virginia over the past years (Figure 3). The increase correlates with a rise in appropriately-sized purple mussel for red knot prey. Re-sighting data suggests a larger level of movement within season between Virginia and Delaware Bay than formerly thought, and the DBETC encouraged further collaboration between the Virginia and Delaware Bay scientists and **recommends that the Virginia data be included in reports on shorebird status to the Board.**

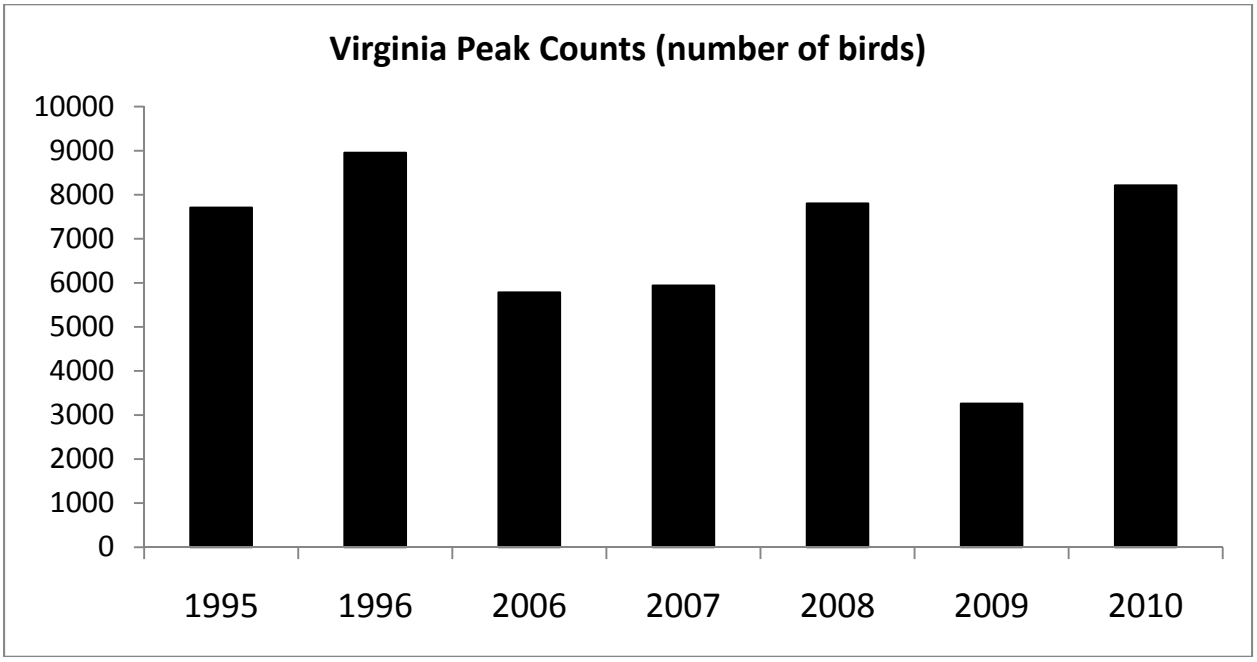

Figure 3. Peak counts of birds stopping over in Virginia. Starting in 2006, these counts are based on a 2-day coastwide count.

The proportion of red knots in the "fat" category, over 180 g body-mass, continued to show an improving trend in 2010 as in 2009. Both 2009 and 2010 showed increased proportions of red knots that had obtained the threshold mass near the target departure dates (Figure 4). Good weather during the month of May likely contributed to favorable spawning conditions for crabs, and thus likely better feeding conditions for birds. In contrast, the nor'easter in 2008 disrupted and lowered the normal spawning activity in May (Michels et al. 2010), likely leading to poorer feeding conditions, which likely was reflected in only 14% of birds achieving 180 g.

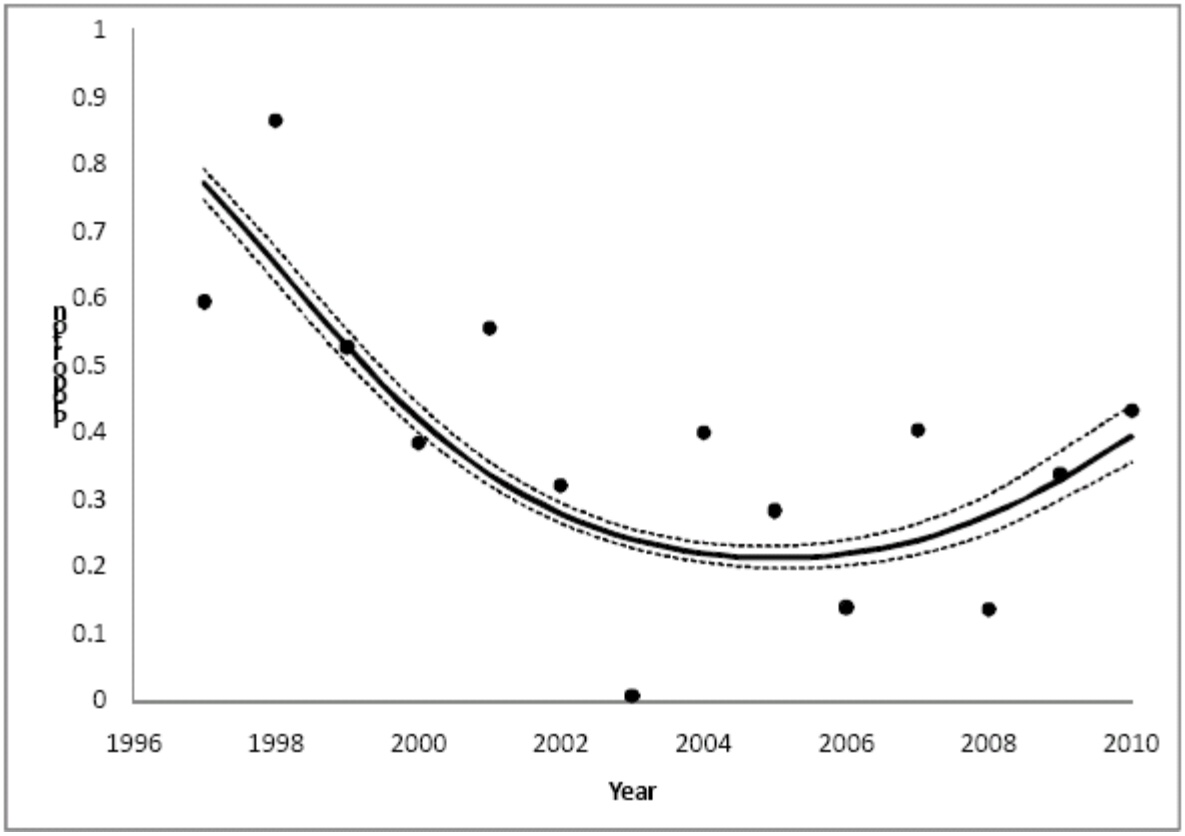

Figure 4. From Dey et al. (2011b), Figure 3. Proportion of red knots in the > 180 g body-mass category in Delaware Bay near the usual departure time each year (26-28 May) over 1997-2010. The line shows a significant quadratic trend over 1997-2010 (the trend line (± 95% confidence intervals in respect of the line, not the variation in the data) was fitted using binary logistic regression of body mass > 180 g (1 = yes, 0 = no) on year (negative, $p < 0.001$) and year^2 (positive, $p < 0.001$)). The strength of the quadratic trend owes much to the very low proportion recorded in 2003, but it is still significant if the 2003 data are omitted.

The McGowan et al. (2011) paper showed a clear connection between female horseshoe crab abundance during the stopover period and the ability of red knots to obtain 180 g. Survival of red knots was most dependent on Arctic snow depth, and to a lesser extent, on obtaining the target mass. The DBETC agreed that the study should be included in the report to the Board, as it provides further evidence that red knots' status is linked to the presence of spawning horseshoe crabs and egg availability (Figure 5). The DBETC also felt it was important to point out that this study also suggests additional environmental factors, such as the Arctic snow depth (Figure 6), outside of Delaware Bay that have high potential to impact the rebuilding success of red knots. Further, the point was made that, as with other migratory shorebirds, population productivity is dependent upon multiple factors and conditions aligning to provide a successful year. Continual mismatches over the years could hamper recovery of a species, if conditions are not suitable enough in all stopover and breeding areas.

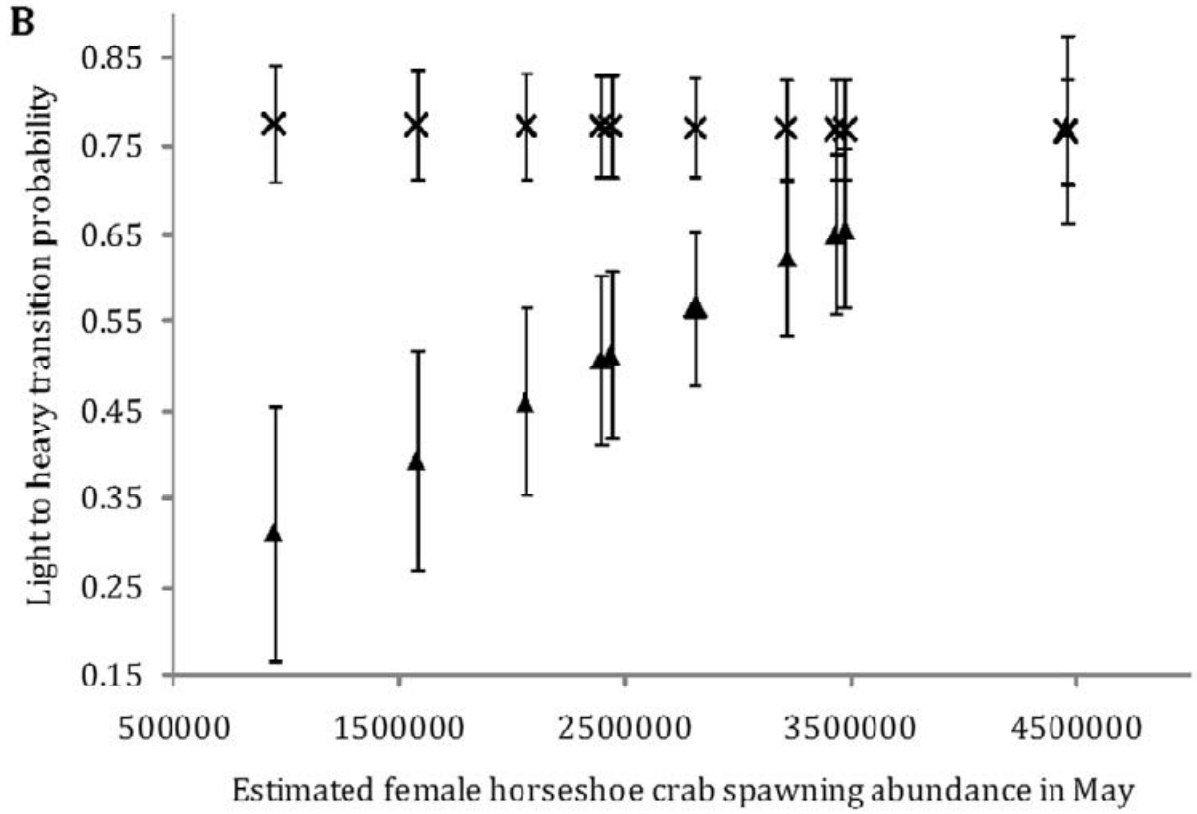

Figure 5. From McGowan et al. (2011), Figure 2b. Model-averaged estimates of transition probabilities (± 95% C.I.) from light to heavy mass classes (period 1-2 [from May 1-19 to May 20-25] transitions represented by X's and period 2-3 [from May 20-25 to May 26-June5] transitions represented by triangles) for red knots stopping over in Delaware Bay plotted against estimated female spawning abundance during the month of May (HSC1), from Hata and Hallerman (2009) and S. Michels (Delaware Division of Fish and Wildlife, personal communication), 1999-2008.

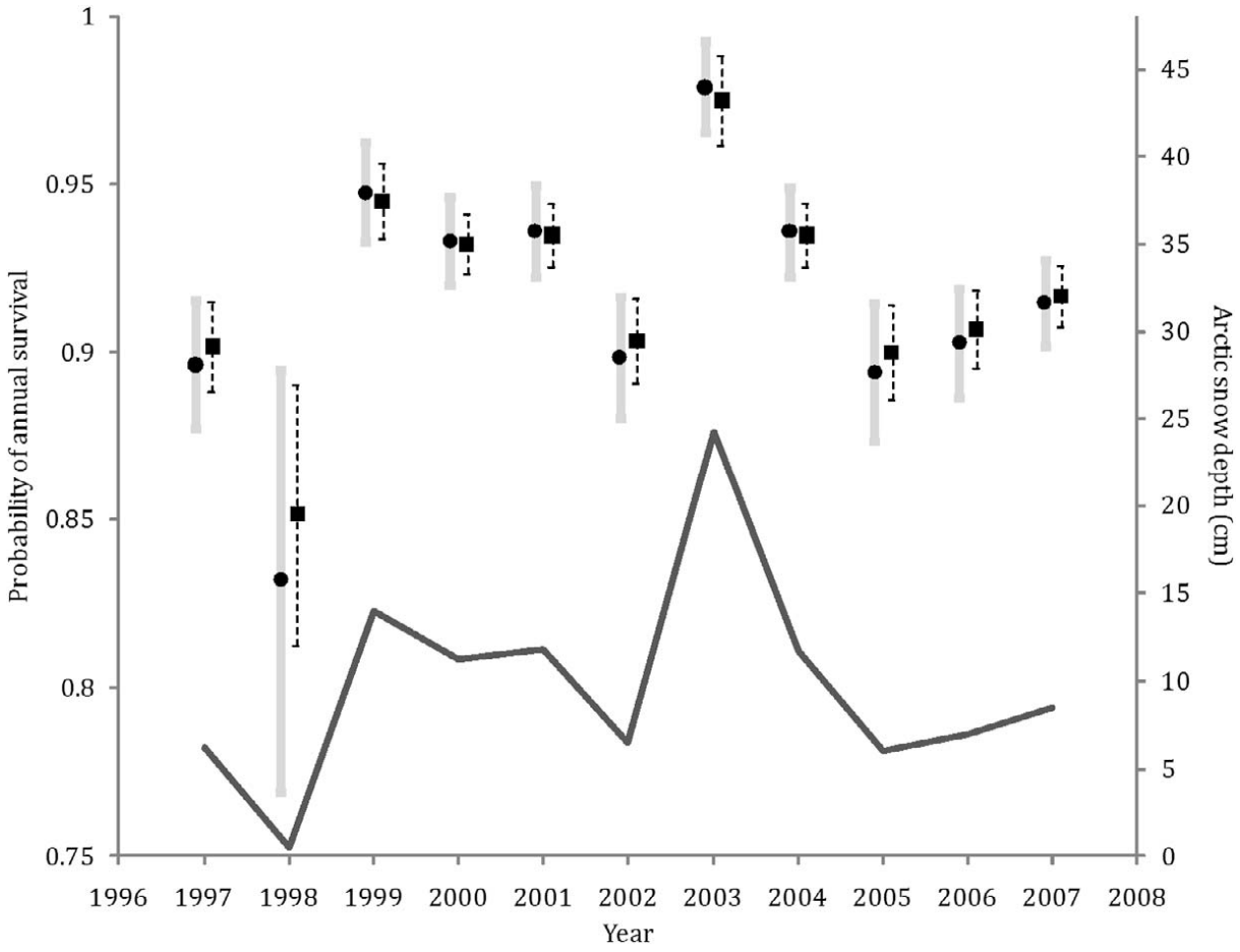

Figure 6. From McGowan et al. (2011), Figure 1. Model-average estimates of annual survival of red knots in heavy (sold square) and light (solid circles) mass classes (± 95% C.I. in thinner dashed or thick light gray lines) at time of departure from the Delaware Bay stopover site related to average snow depth (solid dark gray line) from four weather stations at time of arrival in the Canadian arctic breedings grounds, 1997-2008.

No trend is evident in the egg counts across the Delaware Bay, but counts rose in 2010 to near 2005 levels and Mispillion Harbor showed extremely high levels of egg abundance. Egg abundance levels, excluding Mispillion Harbor, had shown lower levels since 2005 when the baywide sampling using the core method began (Figure 7). The lack of a trend may seem to contradict the better weight gain by birds in recent years. One explanation could be that large levels of eggs in Mispillion Harbor and the likely utilization of Mispillion at some point by every stopover knot, could help drive the better mass gains seen yet still reflect a lack of an overall trend in egg abundance. Also, samplers have seen a broader distribution of eggs over the beaches, with more beaches being used not only by spawning horseshoe crabs but also by feeding birds. Finally, surface egg abundance more directly impacts shorebirds, as these eggs are the ones accessible to them. Surface egg abundance is notoriously variable depending upon the spawning activity and weather, which can bring earlier-laid eggs to the surface, and other beach conditions. The DBETC noted that the egg survey may not be sensitive enough, due to the

variability in surface egg densities, to reflect the level of increase that can promote sufficient weight gain in the birds.

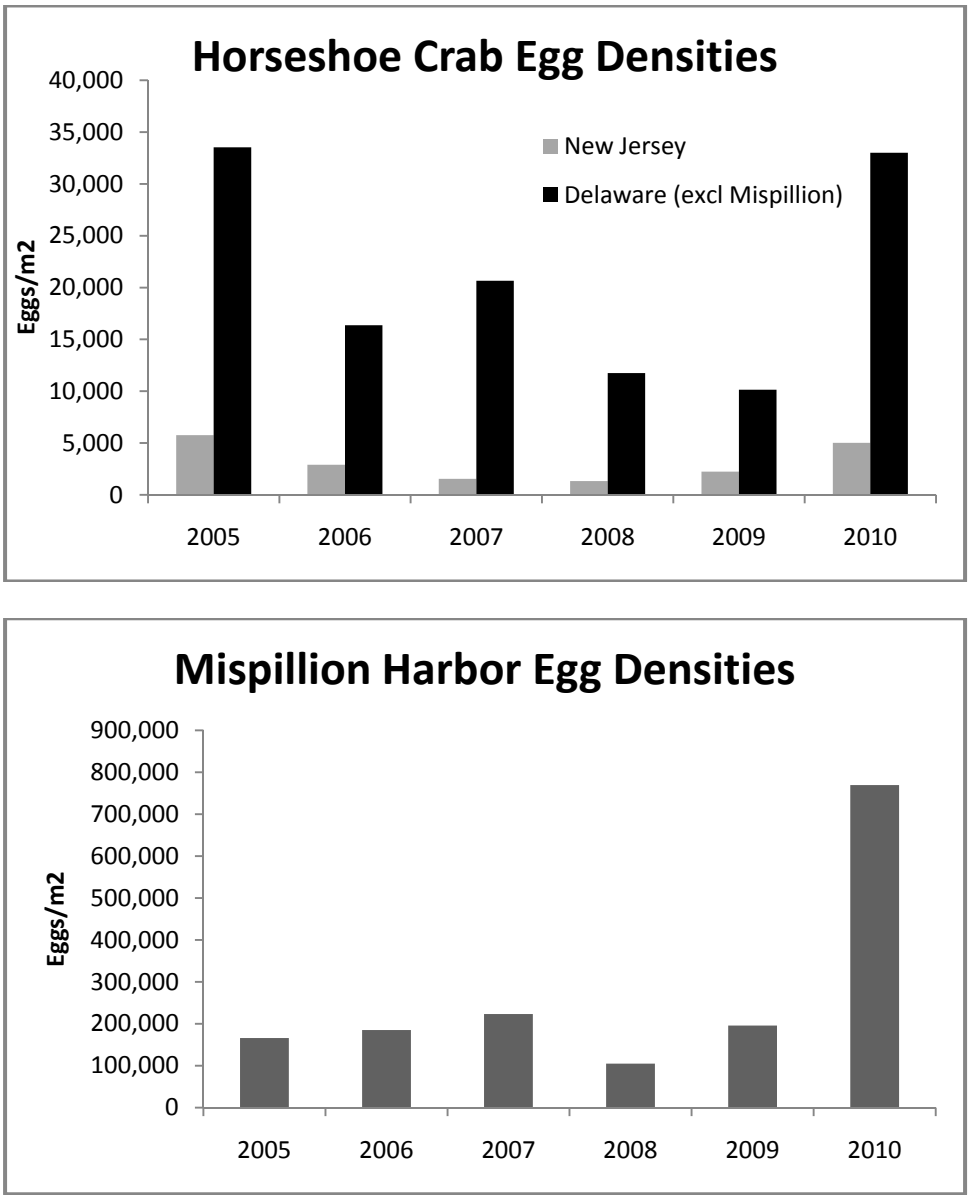

Figure 7. Egg densities with Mispillion Harbor excluded. Note the difference in scales (from Dey et al. 2011a)

Update on proposed Federal Endangered Species Listing of the Red Knot
Annette Scherer (FWS) gave an update on the proposed listing of red knot under the Endangered Species Act. She will begin work on the listing determination for the *rufa* subspecies of red knot (*Calidris canutus rufa*) in August 2011. As part of the listing determination process, a Proposed Rule to list the species as either threatened or endangered will be prepared for publication in the Federal Register by late 2012. If prudent and determinable, proposed Critical Habitat will also be published in the Federal Register at that time and the public will be afforded an opportunity to comment on the proposed listing/proposed critical habitat. After review of any new information provided during the public comment period, if the Service determines that listing remains warranted, a Final Rule and Final Critical Habitat Designation will be published. It generally takes one year after the Proposed Rule to review public comments and publish the Final Rule, with the effective date of the official listing usually occurring thirty days after the Final Rule is published. Development of a recovery plan for the red knot will begin shortly after publication of the Final Rule. She will keep the DBETC apprised on any further developments.

Delaware Bay Horseshoe Crab Spawning Survey, 2010
Jordan Zimmerman and Dave Smith presented the 2010 Spawning Survey Report. The report's publication was delayed due to software incompatibilities with new updates, which have been resolved. There is still no trend in spawning females, while spawning males continued to show a positive trend. The DBETC noted that, despite the male-only harvest within Delaware Bay since 2007, the sex ratio has shown no change.

Virginia Tech Horseshoe Crab Trawl Survey, 2010
Eric Hallerman and Dave Hata presented the trawl survey report. Eric noted that the past increases in smaller horseshoe crabs were not as prevalent in this past year's survey. He also noted the inclusion of the lower Delaware Bay in the 2010 survey, although cautioned any assumptions from the one year's worth of data. Rick Robins, a member of the Horseshoe Crab Advisory Panel, brought up the concern that the current survey does not estimate catchability, which leads to increased uncertainty and variability in population estimates. Eric acknowledged this need and the team's willingness to work on addressing this need with others familiar with these issues going forward.

References

Dey, A., K. Kalasz, and D. Hernandez. 2011a. Delaware Bay Egg Survey: 2005-2010. Report to the Atlantic States Marine Fisheries Commission's Delaware Bay Ecosystem Technical Committee (June 9, 2011). 27 pages.

Dey, A., L. Niles, H. Sitters, K. Kalasz, and R. Morrison. 2011b. Update to the status of the red knot *Calidris canutus* in the western hemisphere, April 2011. Report to the Atlantic States Marine Fisheries Commission's Delaware Bay Ecosystem Technical Committee (June 29, 2011), 14 pages.

Hata, D. and E. Hallerman. 2009. Evaluation of the coastal horseshoe crab trawl survey for estimating juvenile recruitment and mortality: Supplemental report to the Atlantic States Marine Fisheries Commission Horseshoe Crab Technical Committee. Virginia Polytechnic Institute and State University, Blacksburg, Virginia, USA.

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Niles, L., H. Sitters, A. Dey, N. Arce, P. Atkinson, V. Ayala-Perez, A. Baker, J. Buchanon, R. Carmona, N. Clark, C. Espoz, J. Fraser, P. Gonzalez, B. Harrington, D. Hernandez, K. Kalasz, R. Matus, B. McCaffery, C. Minton, R. Morrison, M. Peck, W. Pitts, I. Serrano, and B. Watts. 2010. Update to the status of the red knot *Calidris canutus* in the Western Hemisphere. April 2010.

Horseshoe Crab Delaware Bay Ecosystem Technical Committee – Minority Report

July 29, 2011

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The report of Horseshoe Crab Ecosystem Technical Committee (hereafter the Ecosystem TC) was crafted mostly without the benefit of shorebird experts as a result of the disbanding of the Shorebird Technical Committee. The Ecosystem TC will help shape ASMFC management of Delaware Bay's breeding horseshoe crab population which, in turn, affects the status of migratory shorebirds including the *rufa* red knot. The majority report submitted by the Ecosystem TC does not reflect key relationships between horseshoe crabs, eggs and red knot migration ecology critical to understanding the condition of the *rufa* red knot population and the recovery of the Delaware Bay shorebird stopover. The key points of this report are:

1. Originally, the Horseshoe Crab Fisheries Management Plan was developed with the input of both shorebird and horseshoe technical committees that allowed technical input from each group. The current structure, changed in 2010, is dominated by fisheries biologists with little expertise in migratory shorebird ecology.
2. Shorebird biologists believe the Delaware Bay remains the key spring stopover for shorebirds in the Western Hemisphere including *rufa* red knots.
3. There are two population segments of the *rufa* red knot, a long-distance migrant group wintering in southern South America and a short-distance group wintering in the southeast US and the Caribbean. The Delaware Bay is critical to the long-distance knots that have suffered the bulk of population decline. Other coastal stopovers, like the barrier islands of Virginia, are less important to long-distance knots which must make rapid weight gains in a short period achievable only with abundant horseshoe crab eggs.
4. The numbers of adult female horseshoe crabs and egg densities have not increased over the period of several important surveys, including the Virginia Tech Benthic Trawl, the Delaware Bay Spawning Survey and the Baywide egg survey, which were designed or sanctioned by Horseshoe Crab Technical Committee members.
5. The Adaptive Resource Model (ARM) confirmed the relationship of female horseshoe crab abundance and the migratory condition of red knots, prior to their spring migration to the Arctic.

One of the primary misconceptions of the Ecosystem TC is the role of the Delaware Bay migratory stopover. Data from many different studies have shown that red knots can be divided broadly into two subgroups. The first group is long-distance migrants, which includes the majority of the *rufa* red knot population that winters in Tierra del Fuego. This group relies more heavily on Delaware Bay to replenish fat after ≥ 8,000 km non-stop flights. The main impact of low egg densities on Delaware Bay fell on long-distance birds who arrive in depleted condition and have a shorter period within which to achieve adequate weight (≥180 grams). Only abundant eggs provide the capacity for rapid weight gain by long-distance migrants. The second subgroup are short-distance migrants that winter in the southeast US and Caribbean and also use Delaware Bay and

other stopovers, including Virginia, on northward migration. Short-distance migrants build adequate weight over a longer duration on hard-shelled prey (clams, mussels) and are less reliant on abundant crab eggs in Delaware Bay to reach adequate weight. The short-distance migrant population may be stable although the data are conflicting. Recent work in Virginia may show significant exchange of marked red knots between Delaware Bay and Virginia stopovers. This is likely a consequence of reduced egg densities on Delaware Bay and increased hard-shelled prey in Virginia in recent years. It should be noted that mussel and clam populations, of the appropriate size for red knots, vary naturally and are abundant in some years and not in others.

The key data is the 30% decline in the long-distance migrants (wintering in Tierra del Fuego) documented in 2011, an event that now brings the population, which numbered >56,000 in 2000, down to a dangerously-low 9,850. The winter population number is more important than counts in Delaware Bay or Virginia because these stopover counts are influenced by short-distance migrants and the arrival and departure of individuals. This distinction is not made in the majority report and is somewhat mischaracterized as an increasing trend of red knots in Virginia.

The Delaware Bay is important to long-distance knots, and the density of eggs on Delaware Bay beaches is a critical measure for recovery. The current egg survey was designed by US Geological Survey and state agency biologists on Horseshoe Crab Technical Committee. The egg densities on Delaware Bay have not improved over six years of the baywide survey. This is very likely a result of no improvement in adult female horseshoe numbers, as documented by Atlantic Coast benthic trawl. This is corroborated by the Delaware Bay spawning crab survey, which has not shown improvement in adult female spawning density over its 12-year history.

The majority report also points to a paper developed by the ARM Committee led by Dr. Conor McGowan. This paper was controversial because the main authors declined to re-examine flaws in the shorebird data and the model, which ended in the withdrawal of three prominent shorebird researchers including Allan Baker, the primary author of the only other paper on red knot survival. Moreover, the paper drew an unverified statistical connection with Arctic snow depth not justified by field experience or the scientific literature. However, the paper was clear about the caveats of this connection, and dismissing the influence of horseshoe crab abundance, as indicated in the majority report, was clearly not the intention of the authors and remaining co-authors, including myself. The paper remains controversial, and the model has yet to undergo rigorous long-term scientific testing.

Finally, the allocation method, being proposed by the Ecosystem and Horseshoe Crab Technical Committees, will fundamentally redefine breeding origin of horseshoe crab populations without rigorous data or testing. The consequence may be an increase in the harvests of horseshoe crabs that breed in Delaware Bay. The model that justified the redefinition relies on genetic samples from only a few actual harvests and a lack of baseline genetic information for characterizing Delmarva coast spawning populations in Maryland and Virginia (i.e., non-Delaware Bay origin). Moreover, the allocation method has been accepted by the technical committees without the stated intention to conduct more rigorous genetic sampling from harvests, and additional baseline work, to clarify the Atlantic coast distribution of Delaware Bay origin and non-Delaware Bay origin crab populations. This is critical to understanding how many Delaware Bay origin crabs are harvested annually.

The majority report does not reflect a willingness to consider the consequences of the data accumulating from shorebird studies and those designed by the Horseshoe Crab Technical Committee which suggest no improvement in *rufa* red knots, female horseshoe crab abundances or egg densities. Over the last ten years, shorebird and horseshoe crab biologists agreed to a framework to assess the health of the Delaware Bay stopover for shorebirds. At this point, all indications are negative and the Adaptive Resource Model suggests heavy restrictions for the foreseeable future. The interpretation of data to suggest the opposite is inexplicable.

The dismantling of the Shorebird Technical Committee removed a useful counter-balance to these kinds of problems. It also suggests the diminution of a risk-averse strategy to recover the Delaware Bay stopover for shorebirds. This was a problem in the past leading to federal candidate status for red knot and now the commencement of the federal listing proposal in August 2011.

The Shorebird Technical Committee should be reestablished and populated by shorebird experts from within and outside state and federal agencies.