PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

HORSESHOE CRAB MANAGEMENT BOARD

Crowne Plaza Hotel Old Town
Alexandria, Virginia
February 3, 2010

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Dan McKiernan, MA, proxy for P Diodati (AA)
Bill Adler, MA (GA)
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Tom O'Connell, MD (AA)
Russell Dize, MD, proxy for Sen. Colburn (LA)
Jack Travelstead, VA, proxy for S. Bowman (AA)
Kyle Schick, VA, proxy for C. Davenport (GA)
Ernest Bowden, VA, proxy for Del. Lewis (LA)
Willard Cole, NC (GA)
Louis Daniel, NC (AA)
Robert Boyles, SC (LA)
Malcolm Rhodes, SC (GA)
Patrick Geer, GA, proxy for S. Woodward (AA)
John Duren, GA (GA)
Jessica McCawley, FL (AA)
William Orndorf, FL (GA)
Brian Hooker, NMFS
Dave Perkins, USFWS

(AA = Administrative Appointee; GA = Governor Appointee; LA = Legislative Appointee)

Ex-Officio Members

Mike Millard, Technical Committee Chair

ASMFC Staff

Bob Beal
Vince O'Shea
Brad Spear
Kate Taylor

Guests

Dave Smith, USGS
Conor McGowan, USGS
Yong Chen, Univ. of Maine
Arnold Leo, East Hampton, NY
Annette Scherer, USFWS
Kristoffer Whitney, Univ. of PA
Eric Hallerman, Virginia Tech Univ
Rick Robins, Suffolk, VA
Chip Lynch, NOAA
Bob Ross, NMFS
Tom McCloy, NJDFW
John Sweka, USFWS
Wilson Laney, USFWS
Darin Schroeder, American Bird Conservancy

The Horseshoe Crab Management Board of the Atlantic States Marine Fisheries Commission convened in the Presidential Ballroom of the Crowne Plaza Hotel Old Town, Alexandria, Virginia, February 3, 2010, and was called to order at 8:30 o'clock a.m. by Chairman Robert H. Boyles, Jr.

CALL TO ORDER

CHAIRMAN ROBERT H. BOYLES, JR.: Good morning, everyone. I have 8:30 so I would like to get started. My name is Robert Boyles; I'm filling in today for Spud Woodward, who was elected as vice-chair under my chairmanship of the Horseshoe Crab Management Board. Spud has got other business to attend to back in Georgia.

APPROVAL OF AGENDA

CHAIRMAN ROBERT H. BOYLES, JR.: On the agenda you'll note that we do need to nominate and elect a chair. Speaking of the agenda, I would like to call your attention to it. It was in the briefing book. I would like to ask if there are any additions to the agenda. Seeing none, the agenda will be approved by consent.

APPROVAL OF PROCEEDINGS

CHAIRMAN ROBERT H. BOYLES, JR.: Next we need to approve the proceedings from the August 2009 meeting of the Horseshoe Crab Management Board.

Are there any changes, additions or corrections to the minutes? Any objection to the approval of those minutes? Seeing none, those minutes will stand approved as submitted.

PUBLIC COMMENT

CHAIRMAN ROBERT H. BOYLES, JR.: Next is the time on the agenda for public comment for items that are not on the agenda of the management board. I do know that we do have one person who has expressed an interest in making public comment, and I would like to Rick Robins and welcome him to the Horseshoe Crab Management Board, Chairman of the Mid-Atlantic Fishery Management Council.

MR. RICK ROBINS: Thank you, Mr. Chairman, and good morning. I'll be addressing you today as an advisor to this board and not in any other capacity. I appreciate the opportunity to speak. You all received a comment letter in your briefing book about the ARM process. There was a claim in that that the process was somehow neither transparent nor participatory in terms of allowing for stakeholder input.

I will take exception to that characterization of the process. I did have an opportunity, as a result by action by this board, to serve on the ARM Development Group. I would point out that there was stakeholder involvement. The fishing industry was represented, the biomedical industry was represented, and similarly the shorebird advocacy community was represented.

The technical committees that were involved were both the Shorebird Technical Committee and the Horseshoe Crab Technical Committee. The Shorebird Technical Committee does include members of the NGO community, their profession staff, their technical staff, but they are members of that community.

I think the record would indicate that in fact the process itself was entirely responsive to the values and interests of the stakeholders. At several points modifications were proposed to the model. Those modifications were often value-based. I think if you look through the results of how the model was amended as we went forward, options were added in terms of harvest packages at my request and similarly from the shorebird community there were recommendations that the highest harvest packages be deleted, and those packages were deleted.

So, again, the process was extremely responsive to the input of stakeholders. At several points the parameters were made more conservative in response to a preference for risk aversion, and that reflected largely a values-driven process. I think in fact, again, the results, if you simply look at where the model went through the course of its development, reflects the fact that it was very responsive to stakeholder input.

If anything, if that input was asymmetrical, it was in the other direction. I think what you have is a very conservative model now that reflected ample input from the different stakeholder communities, so I would take exception to the characterization that somehow the commission's process was unfair or lacked transparency.

I would also like to commend the commission. This is truly groundbreaking work. There is often a very big divide, as you know, between fishery science and ecology, and this is a very robust effort to bridge that gap. I think it has put the commission really on the cutting edge of ecosystem-type management.

I think this has a lot of potential in terms of potentially applying structured decision-making to other intractable problems that we experience in the management community. Again, I would like to commend the commission and the leadership of the ARM Group and the modeling team that was committed to professional excellence throughout the course of developing this model, and I think is reflected in the results. Thank you.

CHAIRMAN BOYLES: Thank you, Rick, we appreciate your being here. For the management board, I would just refer you to the last two attachments in the briefing book, the USGS response to the letters of concern as well as our own letter that was signed by the executive director. Roy.

MR. ROY MILLER: I just wanted to take this opportunity to add that I also reflect Rick's comments in regard to the ARM process. When I was Horseshoe Crab Board Chair, I had an opportunity to sit in on that process for one day, and I was very impressed with the inclusiveness of it. Thank you.

NOMINATION AND ELECTION OF HORSESHOE CRAB BOARD CHAIRMAN

CHAIRMAN BOYLES: Thanks, Roy. Any other public comments for items that are not on the agenda? Okay, I don't see any. What we would like to do next – and, actually, folks, I misspoke, we are next on the agenda to nominate and elect a chair and vice-chair. It is my understanding that there was an expressed interest in someone serving as vice-chair and that someone had cold feet; so with your acquiescence maybe we could hold off on nominations for vice-chair unless, of course, the board would wish to go down that road today. Terry Stockwell.

MR. TERRY STOCKWELL: **I would like to nominate Tom O'Connell as Chair**.

CHAIRMAN BOYLES: I've got the nomination of Tom O'Connell as chair; is there a second? Seconded by Pat Augustine.

MR. PATRICK AUGUSTINE: I would like to second it and make a move to close nominations and cast one vote for Mr. O'Connell.

CHAIRMAN BOYLES: Okay, there is a motion made and a motion to close nominations and elect Tom O'Connell by acclamation**. Any opposition to the motion? Seeing none, Tom, congratulations**.

MR. THOMAS O'CONNELL: Thanks a lot. It's going to be interesting. It was more than a decade ago as a Maryland biologist that I was working on horseshoe crabs and then was on loan to ASMFC to initiate the plan, so I'm looking forward to it.

CHAIRMAN BOYLES: Fantastic! You can start today, if you want, you know. (Laughter)

MR. O'CONNELL: I'm not looking forward to it that much.

CHAIRMAN BOYLES: We do have, as I said, a need to nominate and select a vice-chair. Again, we can do that at this meeting if we would like or if the board wishes, we can ruminate on it a little bit and deal with this at our next meeting presumably in May, Brad. What is the pleasure of the board? May we wait on this one? Okay, we'll move right on, then, to Agenda Item 5. We will go to Dave Smith and we're going to talk about the **ARM Model**.

2009 HORSESHOE CRAB STOCK ASSESSMENT AND ARM MODEL REPORT

DR. DAVID SMITH: I'm here to present the Stock Committee Report which went to the peer review in November. This is the third assessment the horseshoe crabs have gone through, the Horseshoe Crab Committee has gone through. It has been over a decade since the FMP was written.

STOCK ASSESSMENT REPORT

The first assessment was kind of rapidly put together in response to declining horseshoe crabs and alarm about the declining shorebird populations as well. It was coastwide. It was a trend analysis. Since then, in 2004 there was a recognition that the coast-wide population needed to be regionalized; and between the first and second assessment there was a stock assessment model proposed, catch survey model that would utilize data from a benthic trawl survey that was begun by Virginia Tech and is still ongoing and is a very critical piece to this assessment.

In 2004 we still relied largely on trend analysis. Currently we're still using trend analysis, so that is carrying through to the present assessment, but also in the interim a lot of modeling has been initiated and developed, and so this last assessment includes, in addition to the trend-based assessments, also includes a surplus production model and catch survey model, which we finally have sufficient data to fit and make use of. We'll talk about that, too.

In addition, what we're really moving towards in Delaware Bay is what we refer to as ARM or the adaptive management framework, which that presentation will follow mine. Just briefly, the key life history traits, we need to keep in mind when doing this assessment, horseshoe crabs are a difficult species to assess because have a long time to maturity; sex-specific, males, nine to eleven year old; females ten to twelve year old before they mature. They have migratory behavior that is triggered in part by abiotic factors.

They spawn on beaches, which makes them pretty unique, and makes them both accessible to humans but also to other species, so they have large key ecosystem function. They have size-dependent fecundity. They bury their eggs; but when they reach sufficient densities, those eggs come to the surface, and then they are consumed by other species such as the shorebirds.

They molt until maturity, and they don't have any hard structures that we can use to age, so there is no successful way to age them. As adults they're bivalve predators, and they have high early life history on life stage mortality but then relatively low as adults. They're important because there are significant fisheries on them, both for bait and their blood is harvested for limulus amoebacyte Lysate, which is used for a pharmaceutical product to test for bacterial contamination, and migratory shorebirds most notably rely on their eggs during their migration in the Delaware Bay.

The bait history, we have reported landings and you can see a big spike in the nineties; and then following the FMP, a steady drop in harvest. These are coast-wide landings. Prior to '98, though, reporting was not mandatory, so we don't really know what happened back then. We have a partial picture, but we do know that the rise was largely due to harvest for whelk bait during the nineties.

The fishery-independent data, we have a fairly large suite of surveys that encounter horseshoe crabs, but only a couple that are really directed to sample horseshoe crabs, but we tried to use all data that were available to us. There were nine in the New England Region, six in the New York Region, eleven in the Delaware Bay Region and five in the southeast, so those are the regions that we assessed within.

Those regions are based on empirical evidence from tagging data, from genetic studies, from life history aspects of the species. The larvae do not disperse and they are reared mostly close to the spawning beaches. We've observed local declines, indicating they should be managed at a local regional level. There are difference in fishing pressures, habitat quality, prey availability and other stressors that lead us to regionalize the assessments.

Those are the regions and the states that we place within those regions in the current way that we break up the coast. Then on the map you can see the scope of the surveys. The models that we used for a coast-wide analysis – again, we're limited largely because of lack of a way to age the animal. We're relying on trend analysis coastwide.

We're continuing kind of the basic approach that we started ten years ago, but we've also added, for this time, auto-regressive moving average type modeling, but in the Delaware Bay Region, where we have the best data, we have also been doing some surplus production model and catch survey model. We will go through those one at a time.

The trend analyses were used in previous assessments. It is just basically fitting straight lines from a reference year to the present. The reference year we chose was 1998, which was the implementation of the fishery management plan. To summarize the following results, New England and New York, there was evidence for declining trends. In the Delaware Bay there was evidence for stable or increasing trends, and in the southeast there was evidence for increasing trends.

Using the moving average type approach, using that technique you can estimate the probability that recent years are below or above some reference year; for example, 1998 again, although we could look at other times. In New England, again, two out of three were below the '98 level and New York one out of five was below the '98 level. Delaware Bay, five out of eleven was below the '98 level; and the southeast, zero out of three were below the '98 level.

It is always better to kind of picture what we're talking about, so these are the New Jersey Surveys that we used. These are just a small subset, just showing them as an example of the data that we might have used in New Jersey. We had an ocean trawl survey here showing a decline. This is a surf clam, these encounters in the surf clam dredge, showing an increase; and then the New Jersey Bay Trawl, which shows an increase.
The blue line is the '98 level, so you get this kind of mixture of some going up and some going down. One thing I wanted to show was if we decompose this Delaware Trawl Survey, we see this pattern. If

you look at different ages and sexes, this is adult females, adult males and juveniles. This is typical of we're seeing this in other surveys as well.

For example, the Virginia Tech Trawl Survey shows this as well. In the juveniles we have been seeing a significant increase that began earlier, 2001 or something like that. The males, which recall they mature earlier, that is followed with adult males starting to increase. Females, you could say they haven't increased or there is some evidence that have, depending on the survey. But that pattern of juveniles first, then adult males and females is exactly what you would expect to see in a recovering horseshoe crab population.

Now we will focus on the Delaware Bay Region specifically where we had better data to focus on. The surplus production model aggregates the ages so that helps us. It has some assumptions about maturity, which gives us some caution in interpreting these results. With this model we can estimate biomass and fishing mortality rates.

The estimated biomass decreased from '91 to 2000 and then has increased since then to the present based on this model. The current biomass is similar to what we would have seen in the mid-to-late nineties, I guess, closer to mid-nineties. The fishing mortality rate currently is closer to the early ninety level.

The catch survey model was really what we had proposed ten years ago, that this would be the preferred single species stock assessment model, and we have just gotten enough data based on the Virginia Tech Trawl Survey just this year to fit the model and it fit pretty well. From that we can estimate stock size and harvest rate.

As you can see on the graph, the results indicate this is the harvest rate declining as harvest regulations were put in effect, bait was used more efficiently, mandatory bait reductions and so on, you're getting a decline in harvest rate, as you would expect, from something around 15 percent – this is the harvest rate scale over here – 15 percent down to 1 percent currently. The stock size, based on females, we see an increase starting a few years ago to the present. This is the adult females.

Just in summary, what are the broad strokes? The majority of the evidence to us indicates increasing abundance in the southeast and the Delaware Bay Regions; declining abundance in New York and New England. One major conclusion we drew was that continued precautionary management is recommended coastwide, particularly to anticipate redirected harvest from the Delaware Bay into outlying populations, so greater attention needs to be given in the future to that potential effect.

In the Delaware Bay Region the single-species approach we've always thought was not meeting the needs and there was a need for multispecies management because the horseshoe crab eggs are essential for migratory shorebirds. The way we were able to connect the horseshoe crabs and the shorebirds, the red knots in particular, in the past have really been qualitative. Is one going up and the other going up; is one going down and the other going down, that sort of thing.

A couple of years ago we saw a need to formally link those species to achieve management for multispecies objectives. That really leads us to this adaptive management framework. I think the single-species stock assessment has really come pretty far since Tom O'Connell started us off. I hope he would agree. Really, I think the action is in the adaptive work that we have been doing for the past couple of years.

CHAIRMAN BOYLES: Thanks, Dave; any questions for Dave? Jim.

MR. JAMES GILMORE: Great presentation, Dave. Well, the question I have is the recommendation that I guess the other regions continue to somehow limit their harvest or whatever is something we have been doing in New York, and we plan to continue to do that. In fact, we had an industry meeting last night, and we're I think between 60 and 70 percent of our quota that we're voluntarily restricting.

The problem we're running into is that doesn't seem to be enough for some groups. I guess the general recommendation is fine, but what we really are missing, at least for New York, which would be helpful, is that the management approach in the Delaware – let me back up. To take this simplistically, if you look at the numbers you can say that Delaware, we did a moratorium or a male-only harvest and guess what, the population is going up; and in New York and New England, well, the population is going down, so the simple conclusion from some are, well, let's just have a moratorium on the coast.

Obviously, from our experience we believe it is the poaching that is going on because we've restricted our harvest quite well, and we've had essentially triggers built into it, and we're doing very well at

managing, but the poaching is still a problem; because as our budgets are shrinking, our enforcement ability is becoming more and more reduced.

What would be very helpful is if we could have some sort of an analysis that would really look at the management in the Delaware, how that is affecting the adjacent regions and if there are recommendations we could come out with that would maybe get us some ammunition to say moratoriums on the coast are not the best thing to be doing.

It is something I learned in fisheries management and graduate school; moratoriums you should be very careful about them, especially on populations that are harvestable. This is played out right now, but every year we seem to be getting reduce more, reduce more without anything really to back us up on.

MR. AUGUSTINE: Excellent report, Dave. To follow on with what Mr. Gilmore said, there is no question that we have sales to those states of horseshoe crabs for commercial purposes going from New York to the other states. Interstate commerce, you can't very well block that. Again, along with what Jim said, why are the populations in New York going down?

It is pretty obvious to us guys on the inside of the state is that they're being transferred out and transported out and they're being sold. I would almost open the debate to talk about what the states who have had the moratoriums on? Isn't it about time those states went back and took a look at the negative effect that is being created in those states that have open seasons for horseshoe crabs?

I know there has been a tremendous cry out there to protect the horseshoe crabs in particular that it will protect the shorebirds. The bottom line is somebody better take a look at the mix of the shorebirds. The mix of the shorebirds consists of a hell of a lot of blackback and herring gulls. I have mentioned this over the last two or three years.

When the landfills were closed in Staten Island, where the hell did they go? They went to Delaware Bay, and who competes for the horseshoe crab eggs for red knots and shorebirds other than blackback, herrings and so on. If the Shorebird Technical Committee wants to do something, take a look at the impact of the race for food, if you will, and the effect on the smaller species that have used horseshoe crab eggs forever as their food supply in their migratory flight.

I guess the question would be do any of the states – and it is not to be answered; it is just putting it out on the table – are any of the states that have a moratorium ever going to consider opening up their horseshoe crabs for commercial purposes again? If not, then we in New York and other states that still have open commercial fisheries are going to see a continuing decline of our horseshoe crab population. I put that on the table as food for thought. Thank you, Mr. Chairman.

MR. PETER HIMCHAK: Just to comment on the potential for redirected effort, when we put a moratorium in, the issue was, well, can you not just have a moratorium in Delaware Bay and not on the Atlantic coastal bays where there are small pockets of horseshoe crabs spawning? Our argument was that, well, they would be annihilated in short order, so we're very cognizant of the fact that redirected effort – I can't give you an answer.

Our moratorium was put in by legislation, and it has certain metrics that need to be met in order to consider reopening of the fisheries. Perhaps maybe with the ARM modeling process, maybe we can begin to address those metrics and at least get the discussion started. That's all I can promise.

MR. O'CONNELL: Just to continue with that discussion for a second, I guess my question for New York would be it seems like there is an enforcement problem. It seems like the answer to the enforcement problem is open up other fisheries, but my question would be it sounds like a poaching problem and is the penalty severe enough, is there action being done to try to address that problem rather putting pressure on other states to open up their fisheries.

MR. GILMORE: Last year, Tom, we actually had some, for lack of a better term, SWAT teams. We had helicopters or whatever, because the nice thing about horseshoe crabs is there are some peaks in their spawning. It is just that the price per crab now has gone up so much, even though we have increased the enforcement in some cases, it is a very easy fishery to get into. Most guys already have their four-wheel drive pickup truck and a chest freezer. It is all over the place.

We've had some very front-page Newsday cases where we had guys that were stockpiling them, whatever, and it didn't deter anybody. Even though we've done these efforts, it really comes down to the economics of it. I think when we started this it was twenty-five cents a crab a few years ago and now we're up to a couple of bucks a crab.

Because of the economy, that's a very easy way to make money and we just can't catch enough of them. I think if we tripled the enforcement, which isn't going to happen with the 70 percent reduction we just got in our budgets, I don't even think that is going to help.

MR. HIMCHAK: As a followup on the enforcement issue, with a moratorium in New Jersey, you can possess horseshoe crabs to use in our conch or eel fishery. You must have documentation of point of sale. The penalty for a first offense is $10,000, so it is rather a stiff deterrent. We do require who you bought them from, when you bought them or date. We can ask our enforcement guys to be a little more vigilant on checking receipts to see what is coming out of New York and then possibly matching it up with does this particular person have a horseshoe crab permit in New York.

MR. JOHN DUREN: Dave, this may not be the right question for the stock assessment committee, but was any attempt made to look at the egg densities during the spawn season in 2009?

DR. SMITH: The stock assessment committee, a few years ago, decided that the inherent variability in the egg-density data and the long time between eggs and recruitment into the spawning stock indicated to us from a single-species perspective that we would not utilize egg densities in our assessment.

CHAIRMAN BOYLES: Any other questions for Dave?

DR. SMITH: Mr. Chairman, could I make a quick comment. In response to something that had been said earlier regarding the response of the population to moratorium, I just wanted to point out moratoriums were initiated in 2007. What we're seeing in the Delaware Bay population, the rise of the juveniles, the adults and following with the females, this is a long-lived species, long-time maturity, it doesn't turn on a dime. What we're seeing didn't happen because of that moratorium from a biological point of view.

CHAIRMAN BOYLES: Thanks, Dave. Next we will go and get a presentation on the ARM Model from Conor.

PRESENTATION ON THE ARM MODEL

DR. CONOR McGOWAN: Good morning. Thank you for the time to come and present this work to you today. I'm happy to be here and I'm excited to show this to you. I'm here to talk about the adaptive management modeling work that we've been working on with the Delaware Bay Adaptive Management Working Group. I don't know if that is our official name, but that's what I have come up with at this point. It sounds good to me.

We are trying to implement an adaptive management paradigm to managing horseshoe crab harvest in the Delaware Bay Region specifically. This diagram here we call the double-loop learning diagram of adaptive management. This is really where we're trying to direct horseshoe crab management in the Delaware Bay Region.

It is a two-phase process. The first step is called the set-up phase up here at the top. In that phase we bring together the stakeholders. We work with stakeholders to delineate or define management objectives, what do we want to achieve with our management decision-making. We've developed a set of management alternatives that are achievable, doable, but also politically palatable to the stakeholders.

With that in mind, we have developed a set of models to try to make predictions about how those management alternatives are going to affect the system we're managing but also to try and encompass the various scientific hypotheses that exist regarding how the system functions; so in our case, how these two species, the horseshoe crabs and the red knots, interact ecologically.

Then from there we developed the monitoring plan to assess the system each year to help make decisions about what harvest should be based on abundances of these two species, but also to help inform our decision-making in terms of which of these hypotheses, these models that we've developed are making the best predictions, and maybe we can improve decision-making in the future by honing in on one model that is making a better prediction than others.

From there we move into the iterative phase where we actually make decisions, implement management actions, monitor the system and then follow up with assessments so we can assess the models and see which predictions matched up with observed data, re-evaluate our models and make a new decision; again, monitor, assess, decision, monitor, assess.

Every so often we can kick out of this iterative phase and move back up here to the set-up phase where we can again address things like objectives, perhaps new

stakeholders have emerged, we can include them in the process; maybe new hypotheses have emerged, we can incorporate new models into the system.

We can also use our monitoring plans in the initial set-up phase to direct model improvement in the future, so we can identify points of uncertainty or perhaps points of model weakness that we know. We just don't have good parameter estimates, for example, of horseshoe crab adult survival and we can direct research and monitoring to reduce that uncertainty and improve the models in the future.

The key benefits of adaptive management, as we see it, are that we are explicitly incorporating uncertainty about the system that we're trying to manage into decision-making. We have to make decisions in the face of uncertainty. Uncertainty will always exist no matter how much research and how much monitoring we do, and so incorporating that uncertainty into your decision-making explicitly is really important.

The double-loop learning process is specifically directed towards reducing that uncertainty, systematically addressing uncertainty and trying to improve our knowledge of the system to hopefully improve decision-making in the future. The last really key benefit here is that stakeholder involvement is key to the whole process.
The objectives that we're trying to achieve through management are based on stakeholder interests and stakeholder objectives. The models and the alternatives are all based on stakeholder input, and so stakeholders play a really key part of what we are trying to develop. A little bit about our process, the Adaptive Resource Management Team meets about every two months. We have meetings at Patuxent, we get together, we discuss modeling approaches.

We discuss literature parameter values, we discuss estimation efforts. We also discuss monitoring plans and so on and so forth. We take that discussion and those products, and we take them to the joint Horseshoe Crab and the Shorebird Technical Committees, who meet at least over the last year and a half to two years about six months.

We report to them, we get feedback, we get criticism and then we try to incorporate that feedback and criticism into our models and into our adaptive management framework. Then every so often I come to these meetings and present our progress to you, the management board. The place where we are right now is right there at the end of the set-up phase, and we think we're think we're ready to move into the iterative phase where we're making decisions based on the models and on the objectives and everything that we have set up.

For the next few slides I'm going to walk you through a little bit about each part of the set-up phase that we have worked on. You have seen some of this work before. Some of it has changed since I was here in May to present some of the details in the modeling. I provided a report at that point about some of the details in the modeling. Some of that work has changed in large part.

We have evolved our framework in response to technical committee input. There have been a number of significant changes to things like the objective function. How we're deciding when and how female or male harvest is valued has been altered based on technical committee input. We have new fecundity estimates for red knots. We have new survival estimates for red knots based on updated and new analyses that we have done. We have modified the list of management alternatives.

Those are the major points but the list also goes on beyond that, again, in response to technical committee input. With that, I will begin to present some of the details on what we're doing. This is what I call the qualitative objective statement. This is sort of the overarching guiding statement of what we're trying to achieve.

The technical committees and the ARM committees have all agreed upon this statement as adequate to capture our objectives; "manage harvest of horseshoe crabs in the Delaware Bay to maximum harvest, but also maintain ecosystem integrity and provide adequate stopover habitat for migrating shorebirds."

Now, this is a fine statement and it really captures what we're trying to do, but it is not a very good scientific or management-based objective statement because there are very few measurable attributes in that statement. We have translated this into something that's a little bit more quantitative and measurable.

The technique we have used is to apply management thresholds to constrain horseshoe crab harvest by what we think are the ecological integrity measures of the system by applying a threshold of red knot abundance and said that we're going to maximize horseshoe crab harvest as long as the red knot population abundance exceeds 45,000 individuals. That was settled on by the technical committees essentially along discussion that said what is the

minimum number of red knots you're willing to accept in the Delaware Bay?

However, we've also added the additional components to that threshold which says if female horseshoe crab abundance continues to grow but red knot populations do not respond, at some point we will horseshoe crab female harvest when horseshoe crabs have reached 11.2 million crabs. That is about 80 percent of predicted carrying capacity.

The belief is if red knots do not respond but horseshoe crabs continue to grow, at some point we can accept that perhaps horseshoe crabs aren't the limiting factor on red knot populations and therefore harvest should be okay. We have an additional utility or objective statement which says that as long as the horseshoe crab population is growing as fast as it can, then male harvest would be okay.

This is males that are in excess of what is needed for full fertility of eggs on the beaches, male harvest should be allowed. We have created a fairly complex statement that says some partial value will be applied when the sex ratio is two to one on spawning beaches, increasing up to three to one to try to capture some uncertainty on what that sex ratio relationship should be.

From there we moved on to management alternatives, and all of our management alternatives have focused on horseshoe crab harvest. Since we're working with the ASFMC Board, we can't really implement things like global warming management actions or beach renourishment. We focused entirely on harvest management here.

Our initial list looks something like this. It had seven alternatives ranging from a full moratorium to half a million males and 330,000 females, but again in response this is one way that it is easy to show how the technical committees have influenced this process. This list has been altered by eliminating that very, very high half a million males and 330,000 females because it was politically unpalatable to the technical committees.

We have eliminated one of the lower male-only harvest actions because it was never really coming up as an option in our modeling and in our optimization efforts, and so we eliminated it from consideration and included this very high male-only harvest. From there we have our predictive models about how the system functions.

We have what are essentially two species' models that interact in three different ways. We have a horseshoe crab stage-structured model based on John Sweka's published age-structured model. It is slightly modified to fit computing restrictions in the adaptive management framework. That relates to the red knot population in three different ways.

There is no-limiting model which says that horseshoe crabs have very little effect on red knot populations. There is an intermediate effect model which says that horseshoe crab abundance has small effects on red knot survival and fairly large effects on red knots' ability to reproduce. Lastly, we have an extreme effect model over here on the right which says that horseshoe crabs are extremely limiting for red knot populations. Their survival and their fecundity are greatly affected by horseshoe crab abundance.
We think that his captures the three primary hypotheses about how the system functions. Again, this list was compiled and developed with technical committee input. One of the key ecological relationships is how red knot populations are affected by horseshoe crab populations. As a committee and with other colleagues at Patuxent Wildlife Research Center, we have really focused a lot of effort and energy in trying to quantify that relationship, using the mark/recapture data base that has been collected on the birds in the bay since the late 1990's.

It is fairly complex and I won't get into the details, but I'll tell it is called the multistate robust design analysis, and what it does is it allows us to track weight gain of individuals in the bay and predict the probability if a red knot is going to transition from below 180 grams to above 180 grams whilst in the bay, stopping over during migration.

If you recall, the 180 gram threshold is key, it is in a lot of the literature out there. That is the weight that they need in order to survive the migration from the Delaware to the Arctic. We can predict the probability of transitioning from below that weight threshold to above that weight threshold and we can relate that to environmental variables like horseshoe crab population abundance, which is what we've done here.

On the X-axis down here is female horseshoe crab abundance. That is the raw abundance taken from the Virginia Tech Trawl Surveys. On the Y-axis is the transition rate. There is a pretty clear positive relationship there that as horseshoe crab female abundance increases, the probability of these birds gaining weight and exceeding that weight threshold increases.

The next real question is whether or not that translates into a demographic effect. We're determined the physiological effect of do skinny birds, birds below the 180 grams, have a lower probability of survival than heavy birds, birds over 180 grams. The short answer is in some years, yes, that on average there is a measurable difference.

The skinny birds on average survive at about 0.90 probability each year whereas heavy birds survive at 0.92. That doesn't sound very dramatic, but in some years we see very large differences in survival. In the solid lines here is the skinny bird survival; and the heavy birds, the dotted line, is their survival.

We can see, for example, here in 1998 skinny birds survived at about 73 percent that year; whereas, heavy birds survived at nearly 90 percent that year, and that's a dramatic difference. We have actually been able to relate that to Arctic snow covariates. In years where there is heavy snow, all the birds seem to do a lot better; and years where there is little to no snow, the skinny birds seem to suffer pretty dramatically.

The compounding effects of arrival conditions, Arctic snow conditions combined with stopover conditions in the Delaware Bay could be a major driving factor of annual survival for these birds. What we're trying to do, then, is we're going to use those population estimates and those population parameters to develop our estimates that go into this model or these models that we're using for the adaptive management framework.

From there we want to do a unified decision analysis with all three models as part of our decision. The way that works is some fairly complicated computer programming and what is called adaptive stochastic dynamic programming. I'm not going to get into the details of that today. I'm sure no matter how much coffee we've had it will put us mostly to sleep. I will say how this works is that each model has a weight or a confidence value; and those models with higher confidence values have greater influence on the decisions we make or what recommendations we make.

What we can do is compare observed data with model predictions and update these weights each time we make a decision and implement a decision; and so hopefully through some analyses and computational work, we can update these weights at each step, the true weight on to the one model that is making the best predictions and then use that model to guide our decision-making in the future.

The last step in this process is to develop a monitoring plan. We have written – it is in your documentation I believe for this meeting – an 80 or 83 or so page report to describe the models and describe our process for developing those models. Part of that report is a monitoring plan, and it actually takes up about 18 or 20 pages of that report, so the monitoring is really a key part of what we're trying to do, again, because it informs model updating.

It helps us focus on that one important model, but it also helps us to improve the models as we move into the future. We have made a number of recommendations, and I'll just highlight a couple today. For example, we think that a mark/recapture based abundance estimation approach for red knots in the Delaware Bay would be a more informative and a more useful approach to estimating abundance than an aerial survey that has been conducted in the bay for the last ten or twelve years, I think.

We think continuing the horseshoe crab spawning and trawl survey is really a key to helping us maintain our knowledge and improve our understanding of the system. We've made recommendations to initiate a mark/recapture analysis to improve horseshoe crab survival estimates that go into these models. As I said, there is a whole 20 or so pages of additional recommendations that go into that report.

The final process here, the output that we've already compiled is an optimization output table. The table is gynormous. It is 700 megabytes in size. What it does is it walks us through – it has all these columns and it walks us through state variable in the system. The most state variables are abundance estimates for each population parameter, juvenile horseshoe crabs, pre-breeding horseshoe crabs, adult female horseshoe crabs, adult male horseshoe crabs, juvenile red knots and adult female red knots.

It also gives us a weight or a confidence value for each model in our system; Model 1, Model 2 or Model 3. Then on the right-hand side it gives you a policy recommendation. What this tells us is that what we have to do is estimate the state of the system, measure the number of juvenile horseshoe crabs, pre-breeders, adults, the number of red knots, figure out where we are in our model confidence values and look to the right and evaluate what is the best management action based on our adaptive management process.

If we were to go out and measure that we had 12,000 adult female red knots, 10,000 juveniles, 12 million

breeding male horseshoe crabs, 4 million breeding females, so on and so forth, and we had this amount of model uncertainty, Policy 3 from our set of actions would be the best; whereas, if we had 18,,000 adult female red knots and 10,000 juveniles and 12 million males and 4 million females, so on and so forth, Policy 6 would have been our best option. Of course, six has been removed from the action table.

As simple as the output is, all this complex modeling simply gives you a policy table with recommendations; if you have this many crabs and this many red knots, this is what we think the best action would be under those conditions.

This is how we envision the annual cycle going from this system. In the spring the red knots travel through the Delaware Bay. We go out, we collect data, we try to do the mark/recapture work, to use that data in estimating abundance for that year. We can, at the same time, conduct a horseshoe crab spawning survey, which will help us improve our estimation and help us improve our models in the future.

Horseshoe crab harvest kicks in at some point in the summer, it carries on through the fall. Horseshoe crab data collection then begins in the fall and into the winter. That is the benthic trawl survey. We can analyze these data to assess our model performance, update our model weights and re-optimize our analysis, and then at some point in the late winter we can come out with a harvest recommendation based on this framework. That's all I have to present this morning.

CHAIRMAN BOYLES: Conor, thank you. What kind of questions do we have for Conor?

MR. AUGUSTINE: My brain is on overload; a lot of information. What happens to the other locations outside of the Delaware Bay area? What happens to the horseshoe crabs in New York and other landing spots or other areas where horseshoe crabs and shorebirds have decided to land along the flyaway, whether it is North Carolina, South Carolina and so on? Is your model sensitive to that? It's just a bunch of questions; if you can answer them, fine.

The other part of it is how sensitive is this modeling to what happens in the overall flyaway with red knots beginning at the southern most point? You have addressed the Antarctic part of it but not the other. Then I guess the final question would be why does this whole effort on control of horseshoe crab harvest center around the survivability red knots? That is a hard question.

I'm not necessarily a bird lover nor a hater, but I do find it very interesting that we've gone to such great levels to support a bird without any comments coming from this survey – as I indicated earlier in one of the other comments that I made was what is being done to support or to make those eggs available to shorebirds in terms of controlling the herring gulls, blackback and herring gulls – I have not heard one single control point put out by Audubon, put out by any organization saying that we have an overabundance of those creatures that are, in my mind, like vultures to protecting these shorebirds, but we have gone to the enth degree, if you will, to protect the population of horseshoe crabs for the red knot.

There seems to be a disconnect here. It seems like you've put a tremendous amount of effort – the modeling is great. I'm shaking my head saying this is great for Delaware Bay; how about the other areas, how about New York? It is an interstate problem because we have to control the number of horseshoe crabs that are leaving New York for commercial purposes. That's an interstate problem. It just seems to me that all these models that have come out here, fantastic work, absolutely – I'm mindboggled by it because I'm a simple person. If you can answer some of those questions, it would enlighten us a little bit, and let's see where we can go from there.

DR. McGOWAN: Thank you for your question, I think.

CHAIRMAN BOYLES: Conor, let me help you. There is a lot of time of for us to talk about next steps down the road. If I could, perhaps, help our presenter out by – if we could just keep the questions related the presentation, if we could, there is going to be a lot of time to discuss where we go from here.

DR. McGOWAN: I'm happy to respond to some of that, if you'd like. A lot of our efforts have been focused on relating these two species together, horseshoe crabs and red knots, because we're working with – our stakeholder group is basically the Horseshoe Crab Technical Committee with some industry representatives and the Shorebird Technical Committee, and so our objectives and our models and everything that we're working on comes out of those stakeholder groups.

Now, New York has representatives on the Horseshoe Crab Technical Committee, but it has primarily been focused on the Delaware Bay because that is where the majority of the stopover occurs for these shorebirds, and it has become, I guess,

increasingly apparent that shorebirds are – particularly the red knot are using other portions of the coast, and that may be something to consider on the double-loop time scale, incorporating some considerations for a certain percentage of the population not using the Delaware Bay, stopping over in other locations.

One of the problems that we face that there is a lot of computing limitations. It is a big word, adaptive stochastic dynamic programming. It is also computationally very complex, and we had to make some decisions about limiting our scope of the problem in terms of geography and numbers of species that we're considering simply because of computational efforts.

We're viewing the red knot as sort of, at least from the shorebird perspective, an umbrella species. If we can make things okay for red knots, the turnstones, the sanderlings, the other shorebirds that use the bay will probably come along with them. That may answer some of your questions.

The other thing that you talked about, the other species, the gulls and whatnot, we have restricted all of our management actions specifically to harvest issues because we're working with this board to implement horseshoe crab harvest. I guess I was operating under the assumption that this board can't make decisions about how to manage gulls and whatnot. I know there are conversations about other management actions that could be taken outside of this specific process, but they haven't advanced as far as horseshoe crab management is concerned.

MR. WILLIAM A. ADLER: Before we leave this, I just wanted to second what Pat had talked about with the birds. The other thing I just wanted to throw in was on the red knot, they must have some other type of food besides horseshoe crab eggs to survive, so maybe somewhere down the road that question could be asked if you meet a Shorebird Technical Committee guy, what else do they eat? I just wanted to connect this with Pat rather than later in the meeting.

CHAIRMAN BOYLES: Thank you. Jim.

MR. GILMORE: Just a quick question; how difficult would it be to adapt the adaptive model to another region; just a generality, but if we could do that, that would be helpful.

DR. McGOWAN: I think the framework is applicable in almost any resource management case. The models might be different for the northeast versus Delaware Bay. There is probably different links between the shorebird concerns and the horseshoe crab populations. There are probably different parameters of it going to a horseshoe crab population.

It would take some effort and some serious thinking about horseshoe crab population dynamics and how those relate to shorebird dynamics specific to each region, but the overall framework and the concepts of trying to manage these two animals or even the shorebirds as a group and the horseshoe crabs together I think is widely applicable. I would encourage thinking in that direction.

DR. MALCOLM RHODES: I wanted to thank you. This is interesting to see a very dynamic process that corrects itself, hopefully, where we can take uncertainty out year to year, effort to effort, series to series, so I applaud that part and all the work you all have done with it. I did have one question.

It seemed like there is a lot of weighting placed on mark and recapture of the red knot or potentially is. When we look at fisheries, we have to look at morbidity or mortality associated with sampling. The one part being a 2 percent decrease or change by weight; has the Shorebird Committee looked at mortality or morbidity associated with the capture and recapture? I'm sure there has be some; and if we're making a big distinction for 2 percent with 180 grams, is that going to be affected in the capture and recapture also? You may not be able to answer, but the Shorebird Committee might.

DR. McGOWAN: For our analysis I think what we have done is assume that there is no effect – well, I guess we have to assume that there is no effect of marks on the animals. We have very low rates of mortality in the nets and in capture and whatnot, but following the birds after release I don't know that of any work that has been done to follow that.

There has been work showing that they have weight issues immediately following capture, so there is a two or three day delay in getting back on track to gain weight. Our analyses have made some assumptions about post capture survival not being any different from a bird that wasn't captured. I don't really know if that work has been done in any official sense.

MR. MIKE MILLARD: Thank you, Conor. It's the third or fourth time I've heard that now and it is starting to sink in, finally. Early on one phrase,

though, that concerned me was I heard you say some management alternatives had been deleted or altered because they were politically unfeasible to the technical committee.

The phrase "politically unfeasible" to a technical committee concerns me as the Chair of the Horseshoe Crab Technical Committee. As the Chair I guess I've strived to keep the Horseshoe Crab Technical Committee on task being a technical committee and let the folks, the board, deal with the political ramifications. That is their job. I have been around a little bit and I understand there may have been alternatives that were just way out there and just not worth wasting your computational or brain power on, but at some point the alternatives may have been scientifically valid; politically maybe not, scientifically maybe; I don't know. I was concerned by that and I don't know if you have a comment if you would wish to expound upon that, but I lay that concern on the table.

DR. McGOWAN: I think Dave wants to comment here as well, but I'll start by saying that the management alternatives are not based on science; they're based on what the stakeholders see as possible and feasible and agreeable to the people that are involved in the set-up phase of the process, and so our action recommendations are going to be optimal with respect to what were the possible actions included in the analysis in the first place.

From sort of a more adaptive management philosophical standpoint, the management actions are not necessarily globally optimal in terms of everything that is possible. They're optimal in terms of what the stakeholders are willing to enact and do in the process. I will turn the Mike over to Dave, if you will want to have a comment.

DR. SMITH: I guess just to add to that, this process is a constant balancing not only between stakeholder interests but also computational demands, as Conor already mentioned, so it was the combined decision the technical committee advised the working group that level was not feasible in their opinion, and it was beneficial to reduce that set of alternatives so that we could use the available degrees of freedom to incorporate uncertainty elsewhere in the model, so it was both a technical and a stakeholder input motivation to do that.

I just want to emphasize that the working group is getting input from the technical committee and incorporating that. Now the interaction between the technical committee and the board is kind of above our pay grade.

MR. AUGUSTINE: I don't know if I want to enter into this fray, but I'd like to say the following. As far as this management board is concerned, whatever information you folks put forward as recommendations for us to do things – and I'm going to go right at what Mike was saying versus what you were saying – the problem we're having, and any of the decisions and information that comes forward, if we're looking at information that is involved with stakeholders to the point that their interest overpowers the management decisions that this board has to make, no matter what the species – and in this particular case it was shorebirds and horseshoe crabs or whatever – I think our technical committee – and not defending either group or throwing stones at another group – I believe our technical committee has the responsibility of presenting – asking questions and presenting information to this board so that we can make rational decisions to do what we have to do to protect the species.

I was taken a little aback as a part of your presentation, when you did talk about stakeholders' concern and interest – I'm not sure the word was "interest", but whenever we have working groups that I've participated in, I find that sometimes there is more political impetus put in certain people's comments; and if they speak louder than others with a big stick or have a financial or other backing behind them or have a very loud clapping noise, they get the attention.

I'm not sure that I'm making my point clear, but the point is I think, from what I understand, the technical committee did their job, you did your job from what you've perceived to be your role. All I know is that what came out of what I've seen today was a lot of information, as Malcolm has said, extremely well presented, giving us different approaches to addressing this particular issue. It did raise other questions. Again, as far as the technical committee is concerned, I think their responsibility appears to be one of questioning any group as to whether or not you're meeting the requirements that we have laid on the technical committee as terms of reference to get their job done. I think we have said enough about that. Thank you, Mr. Chairman.

MR. GIL EWING: I guess I look at it a little different than most of the table that I've heard here today. I've looked at the decline of horseshoe crabs strictly as a decline in horseshoe crabs, and I have not really been overly concerned, if you will – and I say

that with tongue in cheek about the birds. I've been concerned about the fact that the horseshoe crabs have declined over the years.
Because of the work that New Jersey has done since the early nineties, the horseshoe crabs have started to come back, as I understand it. There were trawl surveys done and they showed a male-to-female ratio of approximately one to one in the trawl surveys. When you look at the beaches, the male population increases somewhere eight to one or something like that because the males tend to stay on the beach and the females spawn and leave.

Since there has been a male-only harvest, have you noticed any significant difference in the mature male ratio to mature female ratio in the trawl surveys since this male-only harvest has taken place? Thank you.

DR. SMITH: No, there hasn't been a decline in male-to-female ratios, and in the beaches we're noticing somewhat of an increase over the past couple of years, and what it reflects is the recruitment of these adult males in what we perceive as a growing population. The sex ratio in the population is slightly male biased in the trawl surveys.

It is not one to one. It is one to one as juveniles. In the adults it is male biased, and we see that in unharvested populations as well. We think it in part as a function of the males maturing earlier and living as long or longer than females, perhaps, and so you end up stockpiling males. Then , as you pointed out, the behavioral aspects on the beach which cause you to have biased male ratios on the beach, but the direct answer to your question, no, we have not seen a decline yet.

CHAIRMAN BOYLES: Any other questions for Conor? All right, seeing none we will move on. Conor, thanks for your presentation. Next we will go to the presentation of the Review Panel Report, Yong Chen.

PEER REVIEW PANEL REPORT

DR. YONG CHEN: Good morning. I'm making this presentation on half of the Horseshoe Crab Peer Review Panel, which the panel consists of the four members listed on the board, Dr. Michael Jones from Michigan State, and his expertise is in adaptive management modeling and stock assessments; Dr. Erica Nol, of Trent University, Ontario, Canada, and her research field is in migratory shorebird ecology; and Dr. John Tremblay of DFO, Bedford Institute of Oceanography, whose expertise is in crustacean biology; and myself from the University of Maine, and my research area is in stock assessments and population modeling, and I do a lot of lobster stock assessments.
Okay, the panel finds that the Horseshoe Crab Stock Assessment Committee has done an excellent job in their 2009 stock assessment, which has significantly improved the stock assessment approach and yielded some scientifically sound results about the status of the stock and provided solid scientific foundations for coast-wide management of the horseshoe crab resources.

Other methodologies developed and the data compiled in this assessment actually set up a very good stage for fishery development and improvement of analytical tools for fishery assessments. This slide shows you the panel's comments on models used in the assessment. This is for a single-species stock assessment.

The first two approaches used in coastal wide stock assessments, they are a trend analysis and the ARIMA Model. They are very simple and straightforward and pretty effective in estimating the temporal trend of the horseshoe crab stock trends, but given the limitation of the data outside of the Delaware Bay area, those two approaches are probably the only two approaches that can be used for assessing horseshoe crab stocks.

The panel believed that a trend analysis is largely superceded by ARIMA, so in the future maybe you will consider using the ARIMA Model to run this assessment. A surplus production model has been developed based on the recommendations from the last stock assessment peer review panel. The initial goal I believe is to apply this approach to all the four assessment regions and to generate some their use for management reference points.

However, the panel believed that more studies need to be done to evaluate the impact of some unrealistic assumptions associated with this model. We also believe that the data quality and the quantity may not be enough for this model to be used outside of the Delaware Bay area. The catch survey model has also been developed based on the recommendations from the last peer review committee.

This panel believed that this approach is promising and suitable for the Delaware Bay stock. This model, however, needs to know the natural mortality value and also we need to know the ratio of our survey catchability values of recruiting horseshoe crabs and the recruited horseshoe crabs in the survey, and right

now that ratio is assumed to be two, so this needed to be tested in the future.

The ARM modeling framework has also been developed since the last assessment, and this approach provides an excellent framework to link exploitation of the horseshoe crab and the red knot conservation and allows for input of stakeholders of contrasting interests in defining model inputs. The panel commends all the effort to develop this multispecies modeling approach.

The panel believed that approach needs to further developed to resolve model complexities and explore alternative models for describing horseshoe crab dynamics and their interactions with red knots. The panel also recommends the management strategy evaluation, MSE, be developed and incorporated into this framework.

This slide shows you our comments about the data used in the assessment. The data, of course, requirements differ greatly among different models. For a single-species assessment, abundance data derived different fisheries-independent surveys were used in the trend analysis and ARIMA for the coastal wide assessment. Currently all the surveys are considered the same. They all have the same weight regardless of their design, regardless of their survey time or location.

Catch data were used in the surplus production model and the catch survey model in the Delaware Bay area. The biological data, although we have a lot of biological data, but most right now are not used in the assessment, so that probably calls for the development of a more biologically realistic model to describe the horseshoe crab stock assessment.

For the ARM Model, the objective function can be parameterized with the input from the stakeholders with contrasting interests and also the information about the red knot population and live history parameters and the same for horseshoe crab and their interactions, too. Now, given the unrealistic assumptions associated with the surplus production model, the panel advised against adoption of biological reference points developed from the production model.

We suggest that other model-based biological reference points be explored. It is also critical to clearly define limit target biological reference points for stock biomass abundance and for fishing mortality. Empirical reference points are used in ARIMA right now in the analysis of a coastal wide assessment and we believe historical reference points are more appropriate than quantile reference points that are currently used in the assessment, which suggests that the development of a multiyear average for historical reference points be used instead of just based on a single year.

For example, we can use the reference point for a high abundance period as a target and a low abundance period as a limit reference point. For the status of the stock, no overfishing or overfished status were determined in this assessment because we don't have a limit or target reference point developed in the stock assessment.

However, based on the data analysis, the panel concurs with those conclusions presented in the stock assessment report; that is, for New York and the New England Region the stock abundance showed a declining trend, but the exploitation rate is unknown. For the Delaware Region stock abundance appears to have increased but is still below the 1998 reference point and the level of the early 1990's.

The recent exploitation rate appeared to be low in the Delaware Region. For the Southern Region stock abundance appears to be stable, but the exploitation rate is unknown. There is no estimate for the exploitation rate. This slide shows you some challenges facing a single-species stock assessment.

The first challenge is related to the data quantity and the quality, as always for most of the stock assessments. Current stock assessments mainly depend on fisheries-dependent data and very little information collected from fisheries-independent programs has been used in the assessment; however, data collected from surveys that are not designed to target horseshoe crab.

Okay, horseshoe crab basically is a bycatch in the survey. Understanding of the spatial or temporal coverage of horseshoe crabs is also very limited in the survey, which makes it hard to evaluate effectiveness of different surveys in sampling horseshoe crabs. There is insufficient data outside the Delaware Region for a formal stock assessment, so for long term we probably will have to depend on trend analysis or the ARIMA Model, a time series analysis.

We also believe that there is some quality issues related to the fishery-dependent data; for example, catch statistics is probably not well qualified and the stock composition of the catch is not well quantified. It is also clear that not all the data available are used

in the assessment, which may call for development of a more complex model, as I said before.

The model performance for the production model and for the catch survey model is also unknown, so we need to run some simulation studies to evaluate their performance. Also, right now there is no formal management reference points defined. Neither limit reference points nor target reference points are defined.

I think another challenge I did not list there is this single-species assessment approach does not consider the link between horseshoe crabs and the red knot, so that might be a challenge for the single-species assessment. The panel suggests further development of the catch survey model and improving the estimate of two key parameters for the Q-ratio and the natural mortality.

The panel also suggests that a Bayesian inference be used in the model estimation for the catch survey model to incorporate uncertainties associated with data and parameters. The panel also suggests to develop habitat models to relay the spatial variation in horseshoe crab survey abundance, to examine those variables and such range of such model would allow us to develop potential habitat models to describe horseshoe crab spatial distribution.

The panel also made the following suggestions; conducting some experiments to estimate a relative Q for different development stages for horseshoe crab in the Virginia Tech Benthic Trawl Survey so that the parameter using the catch survey model can be better quantified, estimating spatial and temporal coverage of the Delaware Bay horseshoe crab stock by the Virginia Tech Survey; and, finally, developing a monitoring program to cover the whole range of horseshoe crab distribution.

That probably is a long-term goal because it would be very expensive to have a coastal wide survey target of horseshoe crab. The challenges the ARM Model faces are listed in this slide. Current model complexity really limits the number of simulation scenarios that can be evaluated, and changes need to be made to overcome this problem.

The performance of some models may not be known and are needed to evaluate assumptions associated with the horseshoe crab staged-based model and the red knot multistage capture/recapture models. Those assumptions include across the population, same capture and recapture probability among red knots, no tag loss, and constant ecosystem conditions for projections. These are assumptions that needed to be evaluated in the future.

We recommended developing a new or further developing existing models to explore horseshoe crab population dynamics and horseshoe crab interactions with red knots and explore the uncertainty in the data and the models and cover a wider range of policy options in simulation studies.

We suggest to improve the data quality and quantity – it is very easy to say but it is very hard to do – to test the effectiveness of digital photographs to remotely identify lean and the fat red knot to improve two-stage models, transition models, and to improve the life history parameter estimates for the red knot and horseshoe crab population dynamics model; and to improve the understanding of links between the two species.

To analyze the ARM Model sensitivity to egg survival model and to operational sex ratio threshold and age zero survival rate and lean adult red knot and juvenile survival and incorporate more models in determining uncertainties. We suggest developing a management strategy framework to simulate an assessment process to implement management procedures and to quantify system dynamics.

Okay, then based on the developed MSE Framework; to evaluate alternative management policies and the source of uncertainty and the value of this information in reducing uncertainty in the decision making. Thank you.

CHAIRMAN BOYLES: Yong, thank you for that presentation. What kind of questions do we have for Yong Chen? Pete.

MR. HIMCHAK: I guess I should have brought this up following Conor's presentation. Again, I'm trying to understand how the model will be used, and I have a question on past management measures. I'm not a modeler, obviously, but my understanding of this model is that you will decide upon a – you will look at a suite of potential management harvest levels, so many males, so many females, and I assume this would be for the New Jersey/Delaware/Maryland, part of Virginia, part of North Carolina – I don't know, but the Delaware component of the horseshoe crab population.

If these measures are implemented, then you measure the effect on the Virginia Tech Trawl Survey, the number of birds reaching, what, 180 grams by a certain date and the spawner index, those three

checks on the numbers you pick to front load the model, how they affect those three monitoring programs; am I right so far, to an extent?

DR. McGOWAN: The monitoring is going to be used to evaluate whether or not we're achieving our objectives and how the models are performing, but we are only going to be using abundance of the two species, so red knot abundance and horseshoe crab abundance in those four age classes to evaluate the model performance.

I want to make sure I emphasize that it is plural. There are three models of the system and each of them make a prediction about how the system will respond to any given management action. We will evaluate the resulting abundance estimates to see which model of the set made the best prediction.

We are not using horseshoe crab egg data in our evaluation, and we're not using spawning survey information in our evaluation. The spawning survey we think is important to continue because of its forming of the parameterization, the multi-state work that we did for the spawning survey – sorry, the mark/recapture work that we did, the spawning survey was a key environmental covariate.

The egg survey data we're not using in our models and we're not using it in our monitoring plan, although there is some interest in continuing to use that, I guess it would be an independent verification of whether or not our paradigm is working. Does that answer your question?

MR. HIMCHAK: Yes, thank you.

DR. DAVID PERKINS: First, I have a question for Dr. Chen. There was a lot of information presented here. With any complex modeling approach, there are lots of things that we can look at to improve and validate and so forth and that's why we do modeling, partly.

I was trying to get the overall sense and impression of the peer review panel, and I wanted to kind of confirm, so I was looking at the introduction of your report where the panel said it was impressed with the ARM and endorsed the approach towards moving in this direction and this management strategy. I just wanted to kind of come back around to sort of the big picture of what the peer review panel thought.

DR. CHEN: Well, I think the peer review, we had a lot of discussion about the various approaches used in the process. We really like the ARM Model and we really think that this is the way to go. Of course, the ARM Model still has a lot of space for improvement, and especially right now I think an ARM Model is limited by its complexity.

It's too complicated to run a lot of scenarios in I think the 72 hours – I cannot remember the exact time, but you run a scenario, you know, it takes a lot of time, so that really limits the number of policy options that can be evaluated. The panel suggested to incorporate a management strategy evaluation approach, which allowed – incorporating into that framework which allowed to relatively easily evaluate more management options.

I think overall the panel thinks this is the way to go and eventually, hopefully, when we have enough information lead the assessment effort, I think. This is a really nice model. We were very excited – everybody excited on the panel on that.

MR. AUGUSTINE: A follow up to Dave's comment; there was a recommendation made by this group. Would it be required of us to make a motion and take a position to support it or are we just going to accept the recommendations without taking any action on this. I had a sense that maybe Dave was going to make a motion or something.

CHAIRMAN BOYLES: I will tell you after discussion I would be looking for a motion to accept the benchmark stock assessment, the ARM Model, the peer review with perhaps a recommendation that we submit it to the technical committee for them to take a look at the recommendations. That's what I'm looking for.

MR. AUGUSTINE: To that point, Mr. Chairman, I would move that we accept the stock assessment and accept the recommendations as put forth – I don't think there were any suggestions or recommendations to change any of those, so that would be my motion, Mr. Chairman.

CHAIRMAN BOYLES: There is a motion by Pat Augustine; is there a second? Second by Dr. Rhodes. Any discussion? The motion is move to accept the Horseshoe Crab Benchmark Stock Assessment, the Adaptive Resource Management Model and the Peer Review Report. Pat was that to include a technical committee review?

MR. AUGUSTINE: Yes, that appears to be correct, Mr. Chairman. I think it is all there.

CHAIRMAN BOYLES: All right, we'll wait we get that motion on the screen. Motion by Pat Augustine; second by Dr. Rhodes.

MR. AUGUSTINE: I think that is correct, Mr. Chairman.
CHAIRMAN BOYLES: Any discussion on the motion? Pete.

MR. HIMCHAK: Mr. Chairman, perhaps one perfection; that should read "technical committees" so that it includes both the Shorebird Technical Committee and the Horseshoe Crab Technical Committee.

CHAIRMAN BOYLES: Pat, do you accept that?

MR. AUGUSTINE: Yes, with that correction, please.

CHAIRMAN BOYLES: Dr. Rhodes? Okay, Pat, would you read that please.

MR. AUGUSTINE: **Move to accept the Horseshoe Crab Benchmark Stock Assessment, ARM Model and Peer Review Report, and have the Horseshoe Crab and the Shorebird Technical Committees review the recommendations presented in the Peer Review Report.**

CHAIRMAN BOYLES: That's the motion; any further discussion on the motion? Is there any opposition to the motion? **Seeing none, that motion carries**. We are down now to the technical committee report. Mike, I think you're on the agenda to give it, but I think we're going to turn it over to Brad; is that correct? Brad.

TECHNICAL COMMITTEE REPORT

MR. BRADDOCK SPEAR: The Technical Committee Chair was not able to attend our last meeting, so I'll give a brief report from that meeting. The technical committee heard a presentation of the single-species stock assessment from the subcommittee and provided its comments and feedback back to the stock assessment subcommittee. As you heard, those comments were addressed in the final report.

With that, the technical committee accepted the report to send it forward for peer review. The other big agenda item for the technical committee in October was review of a North Carolina quota transfer request. Just a little bit of background; North Carolina went over its quota in 2007 and 2008. At the last board meeting in May, it asked states if a state would voluntarily transfer quota to North Carolina.

As is permitted under Addendum II, you may recall Maine offered to transfer that quota to North Carolina and submitted documentation to the technical committee. Following the recommendations in Addendum to strive to transfer quota within the same regions, the technical committee asked North Carolina to reconsider its transfer request to look for a source of crabs closer to its state.

Now North Carolina is requesting quota transfer from Georgia, and that request will then go back to the technical committee and the advisory panel, and then we'll bring that report back to the board in May.

CHAIRMAN BOYLES: Thanks, Brad. Any questions for Brad on the technical committee?

MR. PATRICK GEER: I just have a quick comment. Georgia is endorsing transferring 11,600 horseshoe crabs to North Carolina from part of our quota.

CHAIRMAN BOYLES: Thanks, Pat. Any other questions or comments on the technical committee report? Okay, seeing none, we will move on. Where do we go from here? Brad, do you want to bring us up to speed on where we are timing-wise with horseshoe crab management.

DISCUSSION OF NEXT STEPS IN HORSESHOE CRAB MANAGEMENT

MR. SPEAR: The board is currently operating under Addendum V, which is set to expire at the end of October of this year. If no action is taken by the board to follow up from that addendum, horseshoe crab management will revert back to Addendum III. If you recall, Addendum III allows a 150,000 crab annual harvest in Delaware and New Jersey, and those 150,000 crabs could be male or female harvest. There are also provisions in Addendum III for seasonal closures.

In order to avoid a lapse in management after Addendum V expires this fall and to allow a normal addendum process to go forward, the board would have to initiate an addendum today. If that were the case, the board would provide staff with directions for options to include in the addendum.

The staff would bring forward a draft addendum in May, which the board would review and approve for public comment, and then, obviously, that would go out for public comment in the summer, come back in August to make a final decision, which would then

allow states time to implement regulations if there are changes by the expiration of the current addendum.

CHAIRMAN BOYLES: Thanks, Brad. What is the pleasure of the board? Jack Travelstead.

MR. JACK TRAVELSTEAD: **Mr. Chairman, since it looks like we need to initiate something today to get us started, I would move that the board initiate a process to do Addendum VI to include at least two options; one, status quo; and, two, management under the ARM Model**.

CHAIRMAN BOYLES: Motion by Jack Travelstead; second by Jim Gilmore. Any discussion?

MR. MILLER: Mr. Chairman, concerning the motion, I certainly understand what Option 1 would have in store for us, but during the development of this addendum, I'm wondering will the ARM advice be truly useful to us during this period or are there additional management runs and additional fine tuning that must take place before the management process will be useful to this board in decision-making?

MR. MILLARD: I think I will defer to the ARM representatives.

DR. SMITH: Thank you for that question. The ARM certainly appreciates the recommendations of the peer review panel and we will follow up on those. Having said that, the ARM Models, the set of models – it's more than one – really includes really all the knowledge that we have about how these two species are related. There may be some tinkering in the short term that we will certainly follow up on. We feel that it is ready; we're at the end of the set-up phase; and we are poised to use the model for harvest recommendations for these multispecies objectives.

Keeping in mind that the philosophy of this approach is not that the models are – we're not saying that the models are now complete and will never change, but the way that they will change depends on making recommendations and seeing how the populations respond to those recommendations.

An important part of learning and improving the models is going to be – it relies on implementation and not just continuing to – it's not just simply analysis. The whole approach is predicated on these models being put to use so that we can see how the populations respond and the models are improved and management is improved in the future as a result.

MR. MILLER: If I may follow up, Mr. Chairman, it struck me that for this board to continue to deliberate status quo at this point in time, the information that has been presented to this board that would be useful to evaluate status quo includes the recent trends in the various surveys, horseshoe crab populations and shorebird populations, as we've had presented today as part of the stock assessment report and so on.

I concede I've had relatively little time to review the ARM Model results, but the mere fact that some of the alternatives were deleted from consideration, I think one of those alternatives includes the present status quo management. Wasn't the 100,000 male harvest scenario struck out of the management alternatives that the ARM evaluated, and that concerns me.

There were a suite of other alternatives. For instance, I think it was – and I'm going from memory here from an hour ago – a 250,000 harvest for Delaware Bay; wasn't that one of the alternatives considered, and neither state is poised to harvest 250,000; because if we reverted to Addendum III we would be back to 300,000; whereas, if we continue status quo it would be 100,000 males only on the Delaware side and none on the New Jersey side. Do you see where I'm going with this? I just am concerned that with just these two alternatives to consider; are we considering the right suite options?

MR. SPEAR: From a staff perspective, the board is a stakeholder in this or represent stakeholders through this ARM process, and their inclusion of management alternatives in the ARM modeling process is part of that process, so I think the general statement in the motion to include ARM in management allows the board to include whatever management options it would like to see in that suite.

CHAIRMAN BOYLES: And just a question for the maker of the motion, Jack, and just to clarify where we are; when we're talking about status quo, status quo is a reversion to the measures under Addendum III; is that your intention?

MR. TRAVELSTEAD: No, status quo would be what we have in Addendum V, the current addendum.

CHAIRMAN BOYLES: Okay. All right, Jim Gilmore, is that your understanding? Okay, I apologize for my misunderstanding, then. Is the board clear on where we are? Status quo as proposed by the maker and seconder of the motion would be to

continue the measures that are in Addendum V that are set to expire in October of 2010. Part 2, as I heard from Brad, this would be a range of management alternatives that would be informed by the adaptive resource management model. Tom O'Connell.

MR. O'CONNELL: Not to interrupt that thought, Robert, but I'm pretty comfortable with the motion. I guess I'm just looking for if there is any advice from the technical committee or the stock assessment committee in regards to the assessment that's showing declines in the New England stock? Continuing status quo in my sense, I'm just concerned that we may not be able to address a situation that is not improving the level of stock up in New York.

MR. MILLARD: I wasn't at the last meeting. We are concerned about the redirection of effort. I don't know that we've taken up a formal decision process, though, on how best to address that. Maybe Brad could expound upon that. I didn't see it in the notes if something happened at the last meeting, but you are correct it does need some contemplation by the committee on how to address that.

MR. O'CONNELL: I think this is something that the board should give some thought to in regards to whether or not there should be some option included to evaluate an alternative to respond to a declining stock up in New England. I'm not sure I have an answer today, but I think that's something we should be aware of so we're not criticized for not responding to that status of stock information.

CHAIRMAN BOYLES: Thanks, Tom. It is my understanding – I'm going to the New England states – it is my understanding there have been some voluntary measures that have been implemented that are not required by the plan necessarily, but the states have gone ahead and done that; not to say that we can't include an option perhaps if we want to move in that direction.

REPRESENTATIVE DENNIS ABBOTT: Staying at status quo which would revert us back to Addendum V --

CHAIRMAN BOYLES: No, sir, my understanding from the maker of the motion is, yes, it would be Addendum V but not a reversion back to Addendum III.

REPRESENTATIVE ABBOTT: A follow up to that; Addendum V, does that have a sunset date in it and would we be considering a new sunset date or would that drop out? What do we do with the sunset date that appears in the addendum?

CHAIRMAN BOYLES: My sense is if we initiate a new addendum, that we could choose to put a new sunset date in there as we did two years ago with Addendum V. Of course, that is up to the board.

MR. BRIAN HOOKER: Just a point of clarification; we've reached that sunset date in Addendum V, so we can no longer do a board vote to – as far as what the options are available to the board; that's no longer an option?

CHAIRMAN BOYLES: That's correct, there was an allowance in Addendum V that allowed us to extend it one year, and we exercised that option for 2010. Any other discussion? Bob.

MR. ROBERT BALLOU: I just want to pick up on a comment that Mr. O'Connell offered, and that is the declining abundance situation in the New England Region. To be comfortable with this motion, I would want to make sure that it would address through the ARM approach the situation in New England.

I believe the question was asked earlier about the applicability of this ARM approach to the New England situation, and the answer was, well, it could apply, it might apply. I didn't find it a very compelling answer, and I'm concerned that we might not be addressing with enough specificity the potential concerns of the New England Region by the limited nature of this motion.

DR. McGOWAN: My comment would be getting the ARM approach to where we are now in the Delaware Bay has taken at least two years of work on developing the models and of working with the stakeholders. It requires a lot investment in time and people and expanding what we have currently to include New England states is going to – I mean, it is possible, but I think it is a longer term kind of thought in that we'd need to bring in stakeholder groups from states like New York and I guess all the New England states or the northeastern states, anyway.

It is not a matter of simply modifying our current model set to include more regions. It is a matter of bringing in a lot more groups and putting a lot more serious thought into how the Delaware Bay spatially interacts with the northeast, how the birds use those northeast regions and the multispecies issues up there. I certainly think that can be done, but I think it

is not going to be done by October or November when this vote would need to take place.

DR. SMITH: Just to follow up that an essential question when asking whether the ARM approach is applicable as it is implemented in the Delaware Bay is whether the management of horseshoe crab harvest in the New England region or the New York region has multispecies objectives, and that is a really important question.

If it doesn't, if it is essentially a single-species management problem, then there are options with regard to life history modeling that might provide some insight and simulation management scenario evaluation, as Dr. Chen mentioned, that would not have all the complexity of a multispecies modeling.

DR. CHEN: Based on the evaluation of data available and the quality and the quantity, the panel I think would believe that for the regions outside the Delaware Bay area and probably we only can use the trend analysis and a time series analysis. The ARM Model and including the production model and the catch survey model, you may not be able to use it because we don't have enough information.

MR. MILLER: Mr. Chairman, with Dave's answer and Dr. Chen's answer, it occurs to me that in our exercise of putting together an addendum we could identify – at least the plan review team could identify some reasonable alternative management options for the New England area and the New York area in the absence of consideration of these areas with the ARM Model at least within the timeframe specified for the development of this addendum.

I think it is reasonable that we have some wording in this motion that folds in the consideration of options for the New England population and the New York population in the absence, perhaps, of an approved stock assessment for those areas; in other words, acting upon the best information available. Thank you.

CHAIRMAN BOYLES: Thank you, Roy, and I agree. I'm going to look to the maker of the motion and the seconder. My sense of things is we do need to give some guidance to the staff and to the plan development team on what kind of options that we would include in such an addendum. We need to give some direction so they know where to go. I would like to those of you in New England particularly. Dan.

MR. DAN McKIERNAN: I would oppose that. The reason is I think there needs to be a lot more dialogue among the New England states about the practical issues facing the fishery such as interstate shipping, compliance, poaching. We've already done a lot – each New England state seems to have its own different set of rules that are somewhat incompatible. I think that is okay because you've got local stocks.

I think a review would be warranted among the New England states to sit around and discuss this, include the Law Enforcement Committee, maybe include the advisors, about what is actually going on in New England. In Massachusetts we are in the midst right now of rulemaking. We're trying to tackle the question of local depletion in our state.

It is a real challenge because we clearly have at least independent groups of horseshoe crabs and a state-wide quota is meaningless in terms of preventing local depletion. I sit in these meeting every three months and the discussion of the Delaware Bay, the problems are fascinating, and we all go home and sort of thank God we're not forced to manage at that level.

The reality is the horseshoe crab fisheries I think need more focus by the New England states, and we really haven't had that opportunity as a group of states. For instance, in Martha's Vineyard one of the dealers who was opposing one of our suggestions, which was going to be a slot limit, talked about all the crabs he imported from New York.

Now, I'm hoping that those crabs were properly documented coming out of the state of New York, but I think those are the kinds of issues I think we need to resolve before we go forward with an addendum calling for different actions in New England.

MR. HIMCHAK: I'm somewhat sympathetic to the concerns of the New England states as far as including options under the addendum. I feel partially responsible for creating some of their headaches with having the moratorium. They have reduced significantly from their reference period landings.

They've gone above and beyond the reductions that the plan initially required. I'm really wondering if there is an enforcement situation where I know at least we could start documenting where all these horseshoe crabs are being bought and then possibly communicating with New York to see if these were

legally harvested horseshoe crabs and cut down on some of the illegal shipments out of state.

DR. PERKINS: It may be just a technical question here, but with the motion I didn't know if it was intentionally trying to leave the door open when it says include at least number one and two, or if that "at least" maybe should be struck to clarify the motion.

MR. TRAVELSTEAD: Well, that is precisely what it was intended to do, to give staff some leeway. My intent was to make sure we have something in place to protect the Delaware stocks when the current addendum expires. I haven't heard enough today from the technical committee with respect to the New England stock to put anything into the motion.

I was intending to leave that to others or if staff, working with the technical committee, could come up with some options, it is fine with me as maker of the motion that it be included in the addendum. We're going to get a couple of more shots to look at that document before we have to make a final vote on it. I think flexibility for staff is in order.

CHAIRMAN BOYLES: Okay, Jim, is that your understanding?

MR. GILMORE: Yes, I think as Dan had said, I don't think we have to add in some new management approach to this. I think the management is working fine. There are some other factors that are going in there, and I think the way the motion is worded gives us the leeway to still address the issue. If we can get at where this problem is from an enforcement standpoint, I think that is the solution.

MR. ADLER: Yes, I agree particularly with Dan because up in New England and in Massachusetts, we have cut the quota like in half. We have even got that Monamoy Island Protection Area, which is there is no horseshoe crab, and then we have the bird reduction program, which is where they're going to put the 140 windmills in the way of red knots. We're taking good care of things.

CHAIRMAN BOYLES: Any other discussion or questions or comments from the board? All right, seeing none, Mr. Leo.

MR. ARNOLD LEO: Arnold Leo, consultant for commercial fisheries, Town of East Hampton. A question that has been bothering me during the discussion this morning; you know, with no definition of overfishing or overfished, the fact that, as in New York and New England, the stock might be showing a decline doesn't necessarily mean that we have a problem.

Without that definition of overfished and overfishing, I'm a little leery of what the results might be just because there is a – in the case of New York a very small decline in the measured stock. Is there any effort ongoing to define overfishing and overfished?

MR. MILLARD: Given the results that we've all just seen from the peer review panel and the stock assessment report, I think the answer is, yes, we are moving towards – in the single-species assessment context we are moving towards biological reference points; and with Dr. Chen's help we now have a little more clear guidance on how to move more efficiently towards them. That is in the single-species sort of traditional fisheries management context.

Of course, the other context is the ARM context where we are doing the multispecies management, and the concept of overfished, as fishery scientists think about it, may be less relevant because we now have a red knot component to worry about, and there will be a new sort of context, the ARM modeling process and the recommendations that would drive our decisions in that context. It depends on which of those management scenarios you're referring to. I took your question to be in the single-species context; and do we have those reference points – no. Are we moving towards them? I believe so.

MR. LEO: Yes, it doesn't seem likely, though, they'll be ready for inclusion in Addendum VI, which is my concern. New York is showing a decline and are we going to be given a reduction in our quota.

CHAIRMAN BOYLES: Thanks, Mr. Leo. We have a motion here before us, and again I want to clarify that the maker of the motion – the status option would be the measures that are currently in place under Addendum V that are set to sunset in October of this year and not status quo reversion to Addendum III, so we're clear on that. Any other discussion on the motion? Seeing none, is there any opposition to the motion? **Seeing none, that motion carries.**

DR. PERKINS: I guess under the category now of looking at next steps in the horseshoe crab management, it occurred to me coming into the meeting and it has been even more confirmed to me that we may be at a point in time where we need to look at the Horseshoe Technical Committee and the Shorebird Technical Committee, how they're

functioning together and maybe what some of the board's really important management needs and information needs are that we are getting from the Shorebird Technical Committee.
The Fish and Wildlife Service established that I think back in 1991. We've achieved a number of different milestones, and I think this ARM modeling process is another milestone that they can be proud contributors to, and now maybe it is time to kind of maybe reassess again what is it that we need from that Shorebird Group in terms of the information needs, advice.

I think we've also heard a little bit at the beginning of the meeting about process issues with the committee, largely favorably here this morning, but perhaps there are some issues that we want to make sure that we are including the stakeholder groups to the fullest extent possible. I'm thinking maybe a focus group, working group of some board members and technical committee members might be useful to get them together and try to clearly articulate what are the highest priority needs of the board.

CHAIRMAN BOYLES: Dave, I think what you're saying is this is a good opportunity for us to take a look at the kind of advice we're getting. 1991, that's a long time ago and it is probably a good time to revisit that. Do we need a motion for us to support or endorse the service's efforts or can we just move that along by consensus? Any discussion on that? Any opposition? By consensus – okay, Dave, I think you've got the blessing of the board to take a look at that.

DR. PERKINS: Okay, thank you, I'll be looking for some participation in that regard.

CHAIRMAN BOYLES: Okay, yes, all those of you who nodded your heads and said, yes, this sounds like a good idea, don't be surprised if you get a phone call from the service on this. Pat.

MR. AUGUSTINE: As a followup, wouldn't it be appropriate to go ahead and come up with a date certain to identify those folks or maybe make a quick report at the spring meeting? In other words, let's capture what we're trying to do here as opposed to saying, yes, we agree, and then let it sit on the table somewhere. Could we do that, Mr. Chairman?

CHAIRMAN BOYLES: Dave, I'm going to look to you; do you think you can make a presentation at the May meeting?

DR. PERKINS: Yes, definitely.

CHAIRMAN BOYLES: Okay, so be it. Pete.

MR. HIMCHAK: Mr. Chairman, I'm a little confused here about what Dave's presentation would be. I was under the impression that the peer review, the models, the assessment, everything is going to both technical committees to comment on and come back to us in addition to drafting up an addendum, so are they not already assigned the task to come back to us in May?

DR. PERKINS: I'll try t o maybe clarify a little bit. I think not so much tied with those things but looking beyond that, going into the future what information do we want the Shorebird Technical Committee to be focusing on that we want to be receiving as the management board as well as the technical committee.

Even some of the things that were brought up today I think by New York; what percentage of red knots are using other parts of Delaware Bay, is that something that we want to look at more closely and incorporate into models; other food sources, is that something important; have we already discussed that, is that something we want to get more information from the shorebird folks on; the bird issue; other gulls and things competing – you know there are other bird-related issues that we now need to maybe focus on as well as there may be other things we've already been asking for and looking for as far as the indices, different bird indices and things like that. Does that help?

MR. ROBERT E. BEAL: Just to make sure that staff knows exactly where to move on this one, we'll work with you, Robert, as Chair of the Commission, and Tom as the new Chair of the Horseshoe Crab Board and the Fish and Wildlife Service and select a subset of the board members. We will follow up on the tasking as Dave just described it, and we'll bring back a report at the May meeting; is that the idea; a subset of the board, and maybe the leadership of the current Horseshoe Crab Technical Committee and the Shorebird Technical Committee, something along those lines.

CHAIRMAN BOYLES: Yes.

DR. CHEN: If you look at the peer review report and the appendix, the last page almost, there is a table that actually listed all those key parameters that they needed, and all those relevant monitoring programs that need to be established in order to collect this information. There is an appendix and there is a table

that is actually very detailed information that is needed by the ARM Model.

CHAIRMAN BOYLES: Okay, we'll look forward to that discussion and presentation at our next meeting in May. The next item on the agenda is the Virginia Tech Benthic Trawl Survey Funding Update**;** Eric Hallerman.

VIRGINIA TECH BENTHIC TRAWL SURVEY FUNDING UPDATE

DR. ERIC HALLERMAN: Mr. Chairman and members of the board, I'm grateful for a place on the agenda for today's meeting. The Horseshoe Crab Research Center at Virginia Tech has contributed to the work of this management community regarding the horseshoe crab resource. Our contributions include the trawl survey which has provided the data to develop the population dynamics model; the adaptive resource management model; a bycatch study; a population genetics study to help define the management units; a mark/recapture study helping to determine whether spawning assemblages in coastal bays are part of the larger Delaware Bay stock; and studies of the red knot, especially the understudied Virginia Coastal Subpopulation.

This work has been supported by congressional earmarks since 2002; however, support for the Center was not included in the Omnibus Appropriations Bill approved by congress and signed by the President in December. This may be a consequence of the retirement of Senator John Warner of Virginia, but the upshot is that we have operations dollars for 2010 but not for afterwards.

The continued operations of the Horseshoe Crab Research Center and our contributions to the community of managers are at stake. In particular we face the loss of the time series of data of relative abundance of crabs that is so critical for continued use of the ARM Model. We're attempting to find a stream of funding.

We have two tacts as we're going forward. One is to find a new congressional sponsor. For those that are interested I can pass out a synopsis of our request. We note, however, that our congressional liaison has asked us not to simply ask for support for the horseshoe crab survey, but also to broaden that and so we are requesting support for a marine stock assessment with a major project concerning the Horseshoe Crab Trawl Survey.

Coming really to the heart of why I asked for a spot on this particular agenda, I ask two things from individuals or organizations in this group. First, for those willing, I would ask for letters of support from the committee, as appropriate, your agency, from commercial crabbers and from the environmental community.

Secondly, I would like to interact with you and receive suggestions of where else we might seek support for the trawl survey narrowly or for that broader plan of work that I've just described. Thank you for hearing me and I look forward to your suggestions.

MR. BILL COLE: Mr. Chairman, it is very clear that this is an essential – we've got to have it. I mean, we cannot move forward with Addendum VI without it. I have a motion**. I'm going to move that the ISFMP Policy Board include the Virginia Tech Benthic Trawl Survey in the prioritorized list of projects needs to the National Marine Fisheries Service for FY 2010**. If there needs to be an adjustment in the 2010 Budget, I would be very amendable to it.

DR. HALLERMAN: That will be 2011.

MR. COLE: **All right, 2011, thank you**.

CHAIRMAN BOYLES: Eric, this is no reflection to where you are and certainly the importance that we place on that trawl survey. Bill, I'm inclined to rule you out of order. This is not the ISFMP Policy Board; it is the Horseshoe Crab Board. If you would like to perhaps amend your motion that we recommend to the ISFMP Policy Board something.

MR. COLE: I thought that is what I had said, but that was my intention, move that we refer this to the – thank you. Have we got it right? Thank you, that is where I was trying to go, Mr. Chairman.

CHAIRMAN BOYLES: Okay, there is a motion; is there a second? Second by Pat Geer. Any discussion? Ritchie.

MR. G. RITCHIE WHITE: I guess I just have a concern making this decision without seeing what would fall out of the queue. In other words, if there is something that this is going to replace, I guess I would want to make that decision at the time we're replacing it. I support it; this is important, but I don't know that I can support it without seeing the rest of the story.

CHAIRMAN BOYLES: Any other questions or comments? I will say, Ritchie – and, again, Bill and Eric, this is no reflection on our view of the trawl survey, but in this era of declining budgets, I think it is prudent that we take a look at all available resources, all available projects and priorities. For me, I think we are going to talk about these kinds of issues at the policy board in any case. Ritchie.

MR. R. WHITE: I would certainly support a motion that conveyed the importance of this to the policy board and maybe not mandate a priority, but say this is extremely important and that this policy board consider this.

CHAIRMAN BOYLES: Bill, would you consider that a friendly amendment?

MR. COLE: Yes, I would. The policy board has got to get a prioritorized list, so however we get it up there to them and whatever importance we need to emphasize in this motion, let's do it.

CHAIRMAN BOYLES: Pat, do you agree? Okay, we've got a friendly amendment. Let's take a moment to digest this. The motion is move that the Horseshoe Crab Management Board recommend that the ISFMP Policy Board consider inclusion of the Virginia Tech Benthic Trawl Survey in the prioritized list of project needs to the National Marine Fisheries Service for Fiscal Year 2011. Motion by Mr. Cole; seconded by Mr. Geer.

Any further discussion? Any opposition to the motion? **Seeing none, that motion carries**. Dr. Hallerman, thank you for being here and we will see what we can do to help you. Dan.

MR. McKIERNAN: Before Eric leaves, I think his second question was he was seeking recommendations for alternative funding. I'm wondering if in the research set-asides that NMFS has put out as a call for proposals, if there would be any opportunities there?

CHAIRMAN BOYLES: And I know very little about RSAs, so I'm going to look to other members of the board for comments on the RSAs. Is there a potential there? Pat.

MR. AUGUSTINE: If you're talking about the research set-aside we're using through the Mid-Atlantic, it would have to come before the Research Set-Aside Committee as a project. The process in this case it would take another year to even get on the docket. If we're interested in following through with it, I don't see any reason why we couldn't get it on as long as it has a positive effect along the coastline and the council system, if you will.

EXECUTIVE DIRECTOR JOHN V. O'SHEA: Mr. Chairman, I think one of the other realities of research set-aside programs is their major focus is to do research on a particular species that are made available within the program. Now, I think we've succeeded in piggybacking other species in the same cruise, for example, and collecting information, but I think that is another difficulty.

If, for example, you were going to go into the Mid-Atlantic Research Set-Aside Program, it is kind of tough convincing the guys that are giving up fluke quota that is being used for horseshoe crab research. The flip side, though, may be whether or not there is some mechanism to raise money through some special treatment of horseshoe crabs to generate money, but the reality is I think the earmark on – the Virginia Tech earmark I think was around $600,000.

DR. HALLERMAN: Early on it was that high; it latter years it has been more on the order of $400,000.

EXECUTIVE DIRECTOR O'SHEA: Okay, it seems kind of hard that we'd be able to take a percentage of horseshoe crabs off the top somehow and convert that into a much higher value to raise that kind of money.

DR. HALLERMAN: Let me add one other piece. The trawl survey component costs about $250,000. We had a shorebird project as well that I'm not addressing today.

EXECUTIVE DIRECTOR O'SHEA: So, Mr. Chairman, if you'll let me talk about two more minutes, I'd probably get this down to $60,000.

MR. GILMORE: Just to echo Vince's comments, I think on paper the RSA Program could work. However, as one of the states who has implemented a lot of the RSA Program in terms of projects, there is a lot of stiff competition for that money, and we have been getting a lot of negative feedback about using it not specifically for the species.

As Vince has said, a lot of it is fluke; and even using it for NEAMAP we've been getting a lot of flack about it, so I don't want to give any false impressions that it is available because I don't think it is going to make the cut. Thank you.

CHAIRMAN BOYLES: Thanks, Jim. And, again, I think this is the reality that we face and we will need to address this. We have had extensive discussions about this for the past several years in the executive committee of the commission and something that we just need to pay attention and be deliberate about. Eric, I appreciate your being here.

We're certainly sympathetic and we will do what we can to offer moral support if nothing else. We appreciate your being here, recognizing the great work that you all have done at Virginia Tech and how it has contributed not only to our programs but other resource management efforts as well.

MR. HIMCHAK: Mr. Chairman, I think we would be remiss if we didn't acknowledge Dr. Millard's patience and guidance through this joint technical committee process with the ARM group. I know we asked him to stay on board as technical chair beyond his two years to see this through fruition. He has paid his dues. I don't know where he is going from here, but we thank you.

ADJOURNMENT

CHAIRMAN BOYLES: Absolutely, we salute you. (Applause) Any other business to come before the Horseshoe Crab Board? I believe we will stand adjourned.

(Whereupon, the meeting was adjourned at 10:55 o'clock a.m., February 3, 2010.)