Revised Agenda
Sustainable Fisheries/Ecosystem Management Committee

Gulf of Mexico Fishery Management Council

Golden Nugget Casino Hotel
Grand Ballroom A,B,C
Biloxi, Mississippi

Monday, March 30, 2015
2:00 p.m. – 3:30 p.m.

I. Adoption of Agenda **(Tab E, No. 1)** – Riechers

II. Approval of Minutes **(Tab E, No. 2)** – Riechers

III. Action Guide and Next Steps (**Tab E, No. 3**) – Atran

IV. NOAA Climate Change Strategy (**Tab E, No. 7a**)
   a. SSC comments (**Tab B, No. 13**) – Patterson
   b. Draft climate change comment letter **(Tab E, No. 7b)** – Gregory
   c. Committee recommendations – Reichers

V. National Standard 1,3 and 7 Proposed Revisions
   a. Review of revisions **(Tab E, No. 4)** – Alan Risenhoover
   b. SSC comments **(Tab B, No. 13)** – Patterson
   c. Committee recommendations – Reichers

VI. Final Action - Categorical Exclusion – Charter/Headboat Decals
   a. Review of proposed action **(Tab E, No. 5a)** – Rindone
   b. Draft Codified regulations **(Tab E, No. 5b)** - NMFS
   c. Committee recommendations – Reichers

VII. Ecosystem SSC Report
   a. EBFM working group report (**Tab B, No. 6a**) – Kilgour
   b. Ecosystem SSC Summary (**Tab E, No. 6b**) – Wei Wu

VIII. Other Business – Riechers

Members:
Robin Riechers, Chair
Leann Bosarge, V. Chair
Roy Crabtree/Steve Branstetter
Harlon Pearce
John Sanchez
Greg Stunz
David Walker
Roy Williams

Staff: Steven Atran

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GULF OF MEXICO FISHERY MANAGEMENT COUNCIL

SUSTAINABLE FISHERIES/ECOSYSTEM MANAGEMENT COMMITTEE

Marriott Beachside Key West, Florida

June 25, 2014

VOTING MEMBERS

John Greene.....Alabama
Leann Bosarge.....Mississippi
LCDR Jason Brand.....USCG
Dale Diaz (designee for Jamie Miller).....Mississippi
Harlon Pearce.....Louisiana
Patrick Riley.....Texas
John Sanchez.....Florida
Roy Williams.....Florida

NON-VOTING MEMBERS

Kevin Anson (designee for Chris Blankenship).....Alabama
Martha Bademan (designee for Nick Wiley).....Florida
Doug Boyd.....Texas
Glenn Constant.....USFWS
Roy Crabtree.....NMFS
Pamela Dana.....Florida
Dave Donaldson.....GSMFC
Myron Fischer (designee for Randy Pausina).....Louisiana
Campo Matens.....Louisiana
Corky Perret.....Mississippi
Lance Robinson (designee for Robin Riechers).....Texas
Bob Shipp.....Alabama

STAFF

Stephen Atran.....Population Dynamics Statistician
Assane Diagne.....Economist
Doug Gregory.....Executive Director
Karen Hoak.....Administrative and Financial Assistant
Morgan Kilgour.....Fishery Biologist
Ava Lasseter.....Anthropologist
Mara Levy.....NOAA General Counsel
Phyllis Miranda.....Document Editor/Executive Assistant
Emily Muehlstein.....Fisheries Outreach Specialist
Mark Mueller.....GIS Analyst
Charlene Ponce.....Public Information Officer
Ryan Rindone.....SEDAR Coordinator
Charlotte Schiaffo.....Research & Human Resource Librarian
Carrie Simmons.....Deputy Executive Director
Andrew Spaeth.....Intern

OTHER PARTICIPANTS

Pam Anderson.....Panama City Beach, FL
Billy Archer.....Seminole Wind
Tom Ard.....Orange Beach, AL
Jeff Barger.....Ocean Conservancy, Austin, TX
Randy Boggs.....Orange Beach, AL
Steve Branstetter.....NMFS
Jim Clements.....Carrabelle, FL
David Cupka.....SAFMC
Tracy Dunn.....NOAA OLE
Chad Hanson.....Pew Environmental Group
Bill Gibson.....Key West, FL
Gary Jarvis.....Destin, FL
Bobby Kelly.....Elbert, AL
Mike Mastry.....St. Petersburg, FL
Sharon McBreen.....Pew Environmental Group
Bart Niquet.....Lynn Haven, FL
Chris Niquet.....Lynn Haven, FL
Kelli O'Donnell.....NOAA Contractor, Key West, FL
Dennis O'Hern.....St. Petersburg, FL
Bonnie Ponwith.....NOAA Fisheries
Mike Schirripa.....
Phil Steele.....NMFS
Thad Stewart.....Orange Beach, AL
Melissa Thompson.....FL
Steve Tomeny.....Golden Meadow, LA
Bill Tucker.....Dunedin, FL
Russell Underwood.....Lynn Haven, FL
David Walker.....Andalusia, AL
Daniel Willard.....EDF, Austin, TX
Bob Zales.....Panama City, FL

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The Sustainable Fisheries/Ecosystem Management Committee of the Gulf of Mexico Fishery Management Council convened at the Marriott Beachside, Key West, Florida, Wednesday afternoon, June 25, 2014, and was called to order at 2:00 p.m. by Chairman Johnny Greene.

ADOPTION OF AGENDA AND APPROVAL OF MINUTES

CHAIRMAN JOHNNY GREENE: I would like to call the Sustainable Fisheries/Ecosystem Management Committee together. Mr. Robinson is here and Ms. Bosarge and Jason Brand and Mr. Diaz and Harlon and Patrick and John Sanchez and Roy Williams are all present.

Moving adoption of the agenda, are there any changes, additions, or deletions? It's been moved to adopt and do I hear a second? All right. Approval of the Minutes, any changes or additions there? Is there a move to adopt? Do I hear a second? We have a second. All right.

Action Guide and Next Steps is Tab E, Number 3. It's pretty straightforward and extremely useful to me and so I appreciate that. With that, we will go into Item Number IV, which is Gulf of Mexico Ecosystem Assessment Status Report Presentation, which will be Tab E, Number 4. Mr. Schirripa, if you're ready.

GOM ECOSYSTEM ASSESSMENT STATUS REPORT REPORT PRESENTATION

DR. MIKE SCHIRRIPA: Thank you, Chair. What I want to talk to you about this afternoon is the progress and the vision so far for the Gulf of Mexico Integrated Ecosystem Assessment Program and specifically, what I would like to talk with you about is how the IEA program has made efforts to address and work with the council agenda in trying to provide some tools and guidance relative to the council's management objectives.

I am going to start with a very brief introduction. NOAA's IEA program is not specific to the Gulf of Mexico and in fact, every large marine ecosystem in the United States has an IEA program, all the way from Hawaii and Alaska and the Pacific Northwest and the Northeast and so on.

The Southeast is concerned mostly with the Gulf of Mexico and we also would be in charge of the South Atlantic as well as the Caribbean, but given the funding for the IEA and the lack of maturity, we are focusing on the Gulf of Mexico for right now and, in fact, for the next three years, you will see that we're going to be focusing on the west shelf of Florida.

This is a NOAA-wide program and as a NOAA-wide program, one of the directives was that we work together across NOAA line offices. This was made very clear right from the beginning and large, ambitious goals usually require that people work together.

We are working not only across NOAA line offices, but we are also working with universities, the University of South Florida University of Miami, University of Florida Northern Gulf Institute, Sea Grant, and so on. This is a very large effort drawing upon motivated people from each of these different groups to try to come together with their various expertise in a

multidisciplinary fashion to try to create this IEA program.

On March 28, 2013, at the Standing and Ecosystem SSC meeting, two recommendations were passed. The first recommendation was passed by a vote of eighteen to zero that the Standing and Ecosystem SSCs recommend that the Gulf of Mexico IEA program work with state academic partners and continue to work with the Gulf Standing and Ecosystem SSCs to expand the integration of ecosystem components into the assessment and management of the fishery resources in the Gulf of Mexico. This is exactly what we've been trying to do for the past year.

The second recommendation, also passed by eighteen to zero, was that the IEA program develop products that integrate ecosystem analysis into the SEDAR stock assessments and so one of the things I would like to include in this talk for you today is some of the products that the Gulf IEA program has developed in addressing these issues.

The Gulf Council is not a stranger to the ecosystem management issues. I am sure that some of the members that are here right now remember ten or fifteen years ago when this was taken on before. The difference this time is I think we have a little more momentum and I think we have a little more impetus. We have more cooperation across groups.

We also have the potential for changes in the Magnuson Act that are going on right now that may require that the councils take a little bit more of a careful look at ecosystem considerations. They may be asked to develop fishery ecosystem plans that describe ecosystem conservation goals and objectives for multiple fisheries, include ecosystem-level optimum yield that takes into consideration the ecosystem, and identify indicators to measure the achievement of ecosystem conservation goals.

These are really what's going to be the focus of this talk. You are going to hear me say over and over again management goals and objectives. Before the IEA can do anything for the council, the council has to help us identify what the management goals would be of a fisheries ecosystem plan in the Gulf of Mexico and we are willing to help the council do that and work with you on that.

Now, many regions already have defined ecosystem objectives, many in the United States and some internationally. The Pacific Coast Fishery Ecosystem Plan from the Pacific Northwest is one example and the North Atlantic, the North Sea in the Atlantic, also is an example and the Hawaiian Islands, Antarctica, and,

finally, the Aleutian Islands. This is not a new idea and this is not necessarily groundbreaking from a nationwide view, nor is it groundbreaking from an international point of view.

This is a movement, if you will, that is gaining momentum and the utilities and the benefits of this type of approach are being appreciated around the world.

The first example I want to -- What I want to do is I want to introduce to you some possible management objectives that the council may want to consider as some ideas. It's difficult. We know it's difficult to come up with ecosystem management objectives.

We have them for single species assessments and it's really pretty easy. It's not to be overfishing and not to be overfished and we have benchmarks for those and we have indicators that tell us where we are relative to those benchmarks. What we need is some guiding principles, from an ecosystem point of view, to give us something along those same lines.

What I would like to show you here is an example from a couple of these that might be a good first step to defining management goals and objectives. For instance, the Western Pacific Regional Fishery Management Council, their FEP is for the Hawaiian Archipelago and one of their objectives is very simple. It's to provide flexible and adaptive management systems that can rapidly address new scientific information and changes in environmental conditions.

Now, how might we in the Gulf of Mexico use that or how might the IEA program be able to help formulate a Gulf of Mexico version of this?

Just a few weeks ago at the Standing and Ecosystem SSC meeting in Miami, the SSC recommended that the Gulf of Mexico IEA program work with the Gulf Standing and Ecosystem SSCs to evaluate the current red grouper harvest control rule to determine if it is robust to possible future changes in intensity and frequency of episodic events and non-fishing mortality.

To the best of my knowledge, the P* harvest control rule has never been simulation tested yet and so, consequently, it has never been simulation tested to ask will it bring us the management goals and objectives that we seek in the event of things like more frequent red tides and possible spillage of

petroleum products and things of that nature? Is it robust enough to those?

That was one of the things we recommended and also recommended was that the Gulf of Mexico IEA work with the Standing and Ecosystem SSCs to investigate the human dimension of long-term ecological implications to the current shallow-water grouper harvest control rule and various catch limits.

What we're trying to do here is we're trying to couple our direction in the Gulf with an example of an objective, as shown before, and so what we're proposing to do and what we are actually underway of doing is doing a management strategy evaluation for red grouper and asking should red tides occur more frequently and more intensely than they have or should spikes in natural mortality, for whatever reason, is the P* harvest control rule doing its job in that regard?

One of our number one goals in our three-year plan is to test the P* harvest control rule with a single species model of red grouper and test for the efficacy of this rule to make sure that it is robust to these changes.

The second management objective example that I would like to discuss then is that of the North Sea and their fisheries ecosystem plan. Their objective is to sustain robust marine food webs to ensure long-term abundance of all species.

I refer you to the ecosystem status report that we recently published, which has a collection of ecosystem indicators. With the objective of to sustain robust and marine food webs, the ecosystem status report gives us examples of what we might use for indicators.

In this case, it is the trophic level of the catch. Trophic level is an indicator of how robust the marine food webs are and so we have these indicators and you can think of these indicators much like you might a graph of spawning potential ratio, of SPR. You are concerned about the direction and you are concerned about the magnitude of it.

If we did adopt this objective of sustained robust marine food webs, we could use things like the ecosystem status report to give us a position of where we are now relative to where we might want to be or simply the direction of these indicators. If we don't know exactly where we want to be, simply knowing that an indicator is declining might be objective enough to stop the decline in certain indicators or stop the increase in the

indicator, depending on what it's indicating.

The third example is from the North Pacific Fishery Management Council, from the Aleutian Islands FEP. Their objective is to account for uncertainty in ecosystem factors when setting harvest levels.

We actually have already conducted things of this nature with the gag grouper assessment and we intend on doing the same thing with the red. The objective then would be to account for ecosystem in setting harvest levels and we did this by -- Rather than maintaining a constant natural mortality like we always have in most of our assessments, for the gag we actually changed the natural mortality for gag. We let it change year-by-year according to a red tide index.

It improved the model fit very much and we all saw a big decrease in CPUE in 2004 that was unaccountable for by any other means, but when we put the red tide index in there, we could address -- We actually got a much better model fit. The model now had a means to account for this big decline rather than fishing mortality.

We all know that natural mortality affects a lot of the shallow-water grouper complex, but by allowing natural mortality to vary year to year with an index, such as red tide, we are accounting for the ecosystem in setting our harvest levels.

The next example I want to introduce is the Commission for the Conservation of Antarctic Marine Living Resources and their ecosystem monitoring plan. An example of an objective the Gulf Council might consider adopting would be to preserve sufficient prey population to sustain healthy predator populations, including cetaceans and finfish.

Most of the fish that we manage in the Gulf of Mexico are predators, but rarely do we consider managing the prey items as well and so one example might be menhaden. The objective could be to preserve a sufficient prey population and with the tools that we have at hand, such as Ecopath with Ecosim, we could then discover and investigate how the menhaden fishery is impacting some of the larger predator species that use the menhaden as a forage base and so another example objective could be to preserve sufficient prey populations.

Mind you, these are very broad objectives, as they should be at this point. The idea would be to start broad and then eventually work our way down into more and more precise

technical guidance on what exactly these objectives are.

The next objective example would be from the Pacific Fishery Management Council and their objective is to improve assessments on how fisheries affect and are affected by the present and potential and future states of the marine ecosystems.

An example of this is what we tried to do for red snapper. What I am showing you up here is assessing the impact of future impact ecosystem status and the map on the left is a map of the projected larval dispersal of red snapper, based on oceanography.

By knowing the state of the ocean and by knowing the current rate and speed near real time, which we can do now, we can address issues of what might this year or last year's recruitment of red snapper be before they enter the fishery.

Instead of trying to pick the most recent recruitments off a stock recruitment curve or average survivorship or stuff, we can actually use these ecosystem tools to drop these simulated eggs right where we know red grouper spawn and let the currents take them and we can discover things. How many end up in Mexico or how many end up going around Florida and into the South Atlantic? Could we expect a good recruitment year, if they're being evicted onshore into good habitat, or could we expect a bad year, if they're being evicted offshore?

We did this with red snapper and, again, we found a very nice correlation between some strong year classes and what looked to be favorable oceanographic conditions and so this is one more way that we can bring ecosystem indicators into our stock assessments to help improve our forecasting and our precision about the forecasts in the future.

What I want to try to get across to you then is the steps that we need to take to do this are very simple actually. The fisheries management body sets the ecosystem objectives and that would be the Gulf Council.

We need to start with where we want to be. For the analogy in single species assessments, we don't want to be overfished and we don't want to be prosecuting in an overfishing manner. Those are our objectives.

We need something similar for the ecosystem, so we can work toward those goals. If we go down the box, the appropriate tool chosen or developed and what I want to get across here is we

don’t come up with a bunch of tools and ask what we can do with them. The main focus of this entire talk for you today is to realize that we have to come up with our management goals and objectives first and we will build the tools.

We will build the tools necessary to address these management objectives, but it is reverse engineering to think that we can just develop a bunch of tools and throw them in the middle of the room and say now what can we do with these? That is not the approach that we’re advocating.

Management objectives and goals come first. We design and build the tools around that and we give the advice to meet those stated management objectives and goals.

Also, last week, at the Biltmore, by unanimous vote, the SSC recommended that the council ask the Ecosystem SSC, in cooperation with the Standing SSC, to develop a set of suggested goals and objectives of an ecosystem-based fisheries management plan complete with measurable targets.

Now, we know that sounds like a tall order, but this is not a document we would expect to be produced overnight, nor is it a document that would have a defined beginning and end. This obviously would be an evolution and a document that would need tweaking and rebuilding from time to time.

What I want to go through now is three slides to show you our basic three steps that we want to do for our three-year plan and how we’re trying to evolve from the way we’re doing business now to introducing ecosystem considerations into our single species assessments.

Step two is trying to gain efficiencies, and I want to emphasize this, but trying to gain efficiencies in our assessment process by doing multispecies approaches and then, finally, graduating to a true IEA, where all ecosystem services are captured in the assessment.

Number one, Tier 1 ecosystem products are designed to specifically support single species assessment efforts by bringing ecosystem considerations and this is what we’re doing right now by bringing in the red tide and by bringing in our CMS model into larval projections and sea surface temperature and things like that.

We are trying to increase the precision of our answers that we give you. We are trying to improve the assessments by realizing

that there is more than just the fishery operating on the fish. There is the environment as well.

Our goal towards this first step then would be to use a management strategy evaluation to ask if the current harvest control rule, P*, is robust to more frequent and/or more intense episodic events that could affect natural mortality, such as red tide. We are going to be trying to present that with the red grouper assessment for SEDAR-42.

Tier 2 products are going to be let's take what we did with red grouper and let's ask, does P*, the way it's operating right now, is it effective for the shallow-water grouper complex as a whole? What we want to do is -- We have red grouper up here, but we also have gag and black grouper and scamp and the rest of the shallow-water grouper complex.

Right now, the P* is very much focused on only the three species, the black, the gag, and the red. The rest of the ABC is really based on historic landings and so by bringing all these species into the shallow-water grouper complex on a backdrop of the forage fish, the menhaden, the sardines, the anchovies and so on, is the P* still effective in the shallow-water grouper complex?

How can we best utilize this complex and, most importantly, can we assess these as a whole, as a complex, so we don't have to keep doing single species assessments for each of these three or four over and over again and keep running in a cycle. Maybe we can be doing this simultaneously, at the same time, and bring in any ecosystem considerations.

We are working not only on a management strategy evaluation, but we're also going to be working on a model-free harvest control rule that simply asks if the catch rates are going up in these species, perhaps we can adjust TAC based on the slope of the CPUEs.

If they're flat, the TAC stays the same and if they're increasing, we simulate and discover a formula about how much we can raise TAC based on how much the CPUEs are going up and if the CPUEs are going down, we develop a formula, based on the slope of the last three years, that suggests how much we would have to reduce catch.

We really need to think about efficiencies here. We don't need to do ecosystem management instead of single species or instead of assessments. We can bring them together.

Finally then, for year three, if everything goes well, we are going to try to move to our Tier 3 management strategy evaluations, which takes into account not only the fisheries as a whole and not only the reefs, but also things like oysters and marine mammals and hurricane preparedness and energy exploration in the Gulf as well, as examples.

What these MSEs will tell us -- We won't be telling the council how to manage, but we will take our models, our Atlantis-type models and our ecosystem-type models, and say that in, for instance, this blue ecosystem-based fisheries management plan, if you implement Plan A, you might benefit reefs and oysters, but you might not be doing so much for mammals or the oil industry.

On the other hand, Management Scenario B, the red one, might do great for mammals and hurricane preparedness and oil, but it might not do much for these and so the definition of a management strategy evaluation is assessing the consequences of a range of management options and making obvious the tradeoffs in performance across the range of management objectives.

Finally, I want to reiterate that the IEA is not a field of dreams. We do not envision this as we are going to build it and hope that you come. We want the Gulf Council there at the very, very beginning, the SSC and the advisory panels.

We need to know what the goals and objectives are before we can continue with this IEA. Otherwise, there's just too many -- It's not going to work. It's not going to work unless we start with the goals and objectives first.

I was prepared to tell you what I think, the group thinks, about what we think would be a next practical step in defining the goals and objectives and I think a very practical step that I would like to leave you with is to form a multidisciplinary group of different people from the various advisory panels, a couple of people from the Socioeconomic Advisory Panel, a couple of people from Ecosystem, a couple of people from Standing, the different species ones, and council members and come together in a multi-advisory panel group and start either using these examples that we've given them, but start coming up with what everybody, all of the people involved, think are reasonable ecosystem management goals and objectives that we can start working toward and, at the same time, use these to maybe start thinking about a fisheries ecosystem plan for the Gulf of Mexico. Thank you.

CHAIRMAN GREENE: Thank you, Mr. Schirripa. Any questions?

MR. ROY WILLIAMS: Mike, that's a nice presentation and I will tell you, I think the brain surgeons and rocket scientists and particle physicists have it easy compared to what you guys work on.

You are creating such complex models and trying to integrate those things and get answers and I don't really understand how you get the statistics out of it to see how a red tide is affecting red grouper recruitment or gag grouper recruitment. It must -- I guess you just stick numbers in there and start trying things until you find something that works, but the models are really complex and I don't envy you, but I'm glad you guys are doing and I'm glad you didn't present it in a way that was so complicated that we couldn't understand it at all.

MR. CORKY PERRET: Again, like Mr. Williams said, thank you for your presentation and it's an indeed complex issue. About ten years ago, I attended I think it was the first NOAA whatever it was called, but workshop in Charleston, South Carolina relative to ecosystem modeling.

In two days, all the brainpower in the room couldn't decide on what was an ecosystem, but at least you're talking Gulf of Mexico and that's good. My question is or my comment is, in my experience, factors beyond the geography of the Gulf of Mexico play extremely important parts in what is happening in the Gulf and that's the Mississippi River and the dead zone is a very good example. My question is ecosystem of the Gulf of Mexico, would that also include the drainage basins from the land area?

DR. SCHIRRIPA: Absolutely. Absolutely. One of the projects that we're eyeing right now -- Again, I don't mean to keep beating this into the ground, but we do have limited resources, but one of the ideas that we think could make our West Florida Shelf IEA less fish centric is the oyster beds off of Apalachicola Bay and the drainage that affects those.

We are in contact with a colleague who actually has a model for oysters and if we have a model in place that has freshwater input, we are way ahead of the game. Yes, is the answer to your question.

MR. PERRET: Well, I think one of the next major battles is going to be the freshwater wars. I think there is already some lawsuit between Florida and Georgia is taking all the water for

Atlanta, or trying to, and those sorts of things. We, the experts, may develop the greatest plan in the world and we're going to follow it, but when human growth reaches a point, like Atlanta, for example, that may change the whole drainage thing, unfortunately, and I think it will be really important that we can say, wait a minute, guys, yes, your human population growth is such and such, but, look, you're impacting the entire system and the oysters are worth this and the fishery is worth this and so on and so forth.

I think as much as we can document not only the ecological importance of the Gulf of Mexico, but the economic importance, because, hey, let's face it. The dollars are what drives things, in most cases, I guess.

DR. SCHIRRIPA: On that note, the three steps that I laid out, those last three slides, single species, shallow-water grouper -- When we get to that full IEA, that is where that challenge really comes into play, because we're not just dealing with the Gulf Council now and we're not just dealing with the Gulf States Marine Fisheries Commission, but we're dealing now with a true ecosystem-based, where the management of what we're trying to do is out of the reach of the people in this room necessarily.

Thankfully, the governor appoints the councils and so we could still go back to the governors in that nature when we get to that point and yes, it's going to be a challenge at that point.

DR. BOB SHIPP: Hi, Mike. Welcome back to the Gulf Council. I guess this is kind of a rhetorical question/comment, but in a paradoxical way, it seems to me that this couldn't have come at a better time.

You mentioned limited resources, but since the spill, there are literally hundreds of millions of dollars going into ecosystem-based resource and the Gulf of Mexico Research Initiative and NRDA and the RESTORE, all of those things.

I guess the reason my question is rhetorical is because I know the answer, that you guys certainly are going to coordinate with some of these groups to maximize both the goals and objectives as well as the funding sources.

DR. SCHIRRIPA: Two-part answer on that, Bob, and thank you for welcoming me back. It's nice to see you again as well. One of the things that may not be as strong -- Are these groups cooperating? Are they taking a unified approach or are they doing single studies, one over here and one over, or are they

doing a whole unified type of study?

I think one advantage we have in the IEA is we are trying to take a holistic approach and design studies that complement other studies within the IEA and not just ask single questions unrelated to other ones and I'm not accusing anybody of doing that at all. I am just saying that I don't know where the -- I think we might have an advantage, because we are trying this unified approach, where everything should fit into an overall picture.

The other thing is I am hoping that by the time our three-year plan is done that -- Because right now, there is a lot of money that we as NOAA and NMFS employees can't utilize right now. I am hoping that at the end of this three-year study, this three-year initial IEA, that we will be in a position to where we will be one of the few groups that is taking this fully unified approach.

Our model is going to be built and we could show success from our three years in this and really be a standout bunch, to say if anybody deserves this extra funding, it would be this group over here, because look what they've produced in the past three years and look at this holistic approach that they've taken, I hope.

MR. GLENN CONSTANT: Along those lines, the Department of Interior, USGS, and Fish and Wildlife Service, have developed this kind of integrated ecosystem assessment before the oil spill, but certainly those resources that Dr. Shipp mentioned are going to come into play in the next three or four years or so, but climate science centers and landscape conservation and cooperatives, have you guys been engaged with those efforts, which are much more aligned with the kind of integrated approach that you've taken?

DR. SCHIRRIPA: More along the lines of estuaries and wetlands and things of that nature. Getting way up into the terrestrial stuff, time and resources and people have not allowed us to go that far. About as far as we've been able to go are the estuaries and marshes and stuff and even that -- The Northern Gulf Institute we're working closely with and they've actually done work in various bays and so we're trying to get -- We are working with them as one example, but -- We've also been involved a little bit with the Open Ocean people too and there's just so much to do.

MR. CONSTANT: I appreciate that and I think what you mentioned

earlier about having the oyster model as being a great benefit. If there's something built already, that can be a great asset and I think part of what they're doing in those cooperatives and in the climate science centers are seeking the development of those kinds of things and so I think it could be beneficial and I understand tying things together right now is a very time-consuming endeavor, but maybe tomorrow when we hear about the RESTORE Act stuff, there might be a better connection. I think in the process of developing the science behind how to invest these resources that there probably is.

CHAIRMAN GREENE: Okay. Anybody else?

MR. DALE DIAZ: Thank you for coming and I appreciate your presentation. I am just trying to think through on a timeline. If everything went forward and you all was able to be productive, what kind of timeline do you think we would be on in the Gulf of Mexico to have an ecosystem model that could produce results that would be useful for management at this point?

DR. SCHIRRIPA: Our three-year plan is designed on the Florida west shelf. However, we are already talking about how we are going to the next plan is going to expand to the entire eastern Gulf and then around the entire Gulf. It all depends on how much money S&T and NMFS is going to give us or everybody -- How much money they get for IEA and that's a big driving force.

The good news is that one of our colleagues, Cam Ainsworth, has a Gulf of Mexico Atlantis model, the entire Gulf of Mexico, and he started this about two years ago. I am on the committee of several of his students and that model is coming together nicely.

Because we are so spread out and have so many colleagues with us, it's not all on us. Our colleagues are doing this as well and so we actually -- I think Cam has about three or four students working on this model and I just got an email this morning saying that people are going to start looking at management strategy evaluations very soon with that model and so progress is being made on an entire Gulf Atlantis model, which is, as you probably know, probably the most sophisticated modeling platform for ecosystems right now, because it includes human dimensions and because it includes runoff and because it includes the fishing industry and employment and things of that nature.

CHAIRMAN GREENE: Anybody else? Any more questions? Thank you, sir. We're going to move on into the next agenda item, which

will be --

MR. WILLIAMS: Before we go, he did have some recommendations that came out of the SSC and I think we ought to at least consider what those recommendations were and possibly offer some motions.

MR. STEVEN ATRAN: The next agenda item is to go over the SSC Recommendations and, Dr. Schirripa, what happened -- The SSC had a three-day meeting and the first half-day was for the Ecosystem SSC and the Standing SSC to meet and get the presentations from Dr. Schirripa and his colleagues and develop some recommendations and three of the committee recommendations, the SSC recommendations, were developed while Dr. Schirripa was there.

On the third day, Dr. Schirripa was not there, but we had asked the Ecosystem SSC folks to stay over through the presentations of the gag and greater amberjack stock assessments, so they could see how a stock assessment is done, and then, with that knowledge behind them, have all of the SSCs get together and discuss ways to try to integrate ecosystem considerations into the assessment process.

There were two other motions that were made after Dr. Schirripa left and one of them is very, very similar to a recommendation that he made right at the end of his presentation and so it might be worth it if I just very quickly go through that.

MR. WILLIAMS: We're going to see those then in this next section?

MR. ATRAN: Yes.

MR. WILLIAMS: Okay. That's all I need.

CHAIRMAN GREENE: Go ahead.

SSC RECOMMENDATIONS

MR. ATRAN: As I said, there was two parts to the ecosystem portion of the SSC meeting three weeks ago and the first portion had to do with Dr. Schirripa's presentation and the recommendations that came out of that and there were three SSC motions that Dr. Schirripa went through and I will just read them over. He already explained the rationale behind them and this is on page 3 if you want to follow along, the bottom of page 3.

The first one is by unanimous vote, the SSC recommends that the council ask the Ecosystem SSC, in cooperation with the Standing SSC, to develop a set of suggested goals and objectives of an ecosystem-based fisheries management plan, complete with measurable targets. If you approve this, this would be making a charge to the Ecosystem SSC.

MR. WILLIAMS: Mr. Chairman, that happened to be one of the ones that I was going to make. Mike presented that one earlier and would it be appropriate now to offer a motion following up the SSC recommendation? Okay.

Then I would like to -- We can just copy it. It's recommend that the council ask the Ecosystem SSC, in cooperation with the Standing SSC, to develop a set of suggested goals and objectives of an ecosystem-based fishery management plan, complete with measurable targets.

CHAIRMAN GREENE: We will get the motion on the board here in just a second.

MR. WILLIAMS: You can just copy it where it says "recommend that". Okay, Mr. Chairman, that's my motion.

CHAIRMAN GREENE: Do we have a second? Second by Dr. Shipp. Any more discussion about this? I mean I think it was pretty well laid out.

MS. LEANN BOSARGE: I just had a question for Dr. Schirripa and I had this question during the presentation and I should have asked it then. I especially liked a lot of the things you had to say about incorporating things into some of our models, like the red tide and things. I saw Bonnie shake her head yes during your presentation several times.

On the measurable targets of this motion, can you give us some more information as to what you foresee these measurable targets focusing on?

DR. SCHIRRIPA: I think it's a little premature at this meeting right now to get too finite on those, but measureable targets would generally be something along the lines of either we are at this point now and we want to be at this point or the direction of a particular indicator.

A target might be the trophic level indicator seems to have declined in the past ten years and we don't think that's a good

thing and it's a bad indication and we want a management action that changes the direction of a declining indicator. I say that in lieu of knowing exactly where that indicator should be. If we know it's going in a direction that we don't want, we could at least look to change the direction of that and so I think the measurable targets is something that the group would come up with.

MS. BOSARGE: I will elaborate a little more. The only thing that scared me is I really like what you're doing and I want to encourage it and I want to see it go forward. What I wanted to make sure is that we didn't end up in a situation where we are on a lot of other things that we do on the council, where we have these specific measureable items that are given to us, whether it be in the form of a law or a plan or whatever the case may be, and they are wonderful ideals to shoot for, but because we don't have either the funding or we don't have the data or we don't have the science to support it -- I didn't want to pigeonhole ourselves into a position where we're trying to hit targets that maybe we don't have all the resources we need to truly make an informed decision on it, but yet, we feel like we have to make a decision and that was the only thing that scared me in the motion, was the measureable targets.

I support you fully on the rest of it. We need these goals and these objectives and I saw it more, for the moment, while we're still developing it and getting it to that point, as something to support us in the management decisions that we're making as we go along, so we can be more proactive in those management decisions, but maybe not proactive to the point that we're already setting measurable targets for -- Does that make sense? Are you following me?

DR. SCHIRRIPA: I am following exactly what you're saying and I think you have a valid point, I really do. While you were speaking, I am looking at that sentence, where it says "complete with measurable targets". Would you be more comfortable if it were to say something along the lines of "ecosystem-based fisheries management that considers measureable targets"?

MS. BOSARGE: I love it, considers possible measureable targets. That sounds great. That way, we don't feel like we're forced into a situation where if we don't feel we have all the data we need to hit a target, we can keep working on it.

MR. WILLIAMS: I am fine with that. That's fine. Thanks for making that suggestion.

CHAIRMAN GREENE: The seconder is not on the committee and so we have a motion on the board and it was changed and Roy is fine. Mr. Diaz seconds it. **Any opposition to this motion?**

EXECUTIVE DIRECTOR DOUG GREGORY: Like some of the concern raised earlier, the thing I want to be careful with is that we don't get our SSCs caught up into a major project that's going to take up a lot of time from the things we're already doing with stock assessments and I've got a question for Mike.

This is an SSC motion and so that's what it is, but the way forward, it seems to me, is to incorporate ecosystem-based information in our stock assessments, like we did with gag just now, and to move forward that way, so that we are considering ecosystem concepts and parameters in our management plans that we already have when we do our stock assessments and set our management goals and that's the way I am kind of pushing things here at the staff level, instead of going off on a different direction of creating a management plan.

What scares me is that I think back to the Essential Fish Habitat Plan, when we first tackled it. It was not well defined and it took a lot of time, but this is an SSC motion and so I hope we do move in this direction and whether it's another FMP or we do it in some other way, I think the SSCs can help us decide what direction to go and as we get into it, they may recommend some other way to move forward.

CHAIRMAN GREENE: Any opposition to this motion before we go any further? **Hearing none, the motion passes.**

MR. ATRAN: The next motion is by a vote of twelve to five, the SSC recommends that the Gulf of Mexico Integrated Ecosystem Assessment Program work with the Gulf Standing and Ecosystem SSCs to evaluate the current red grouper harvest control rule to determine if it is robust to possible future changes in intensity and frequency of episodic events of non-fishing mortality.

If you're going to make a motion on here, one suggestion I might have is to also include the assessment scientists on this who are working on the red grouper assessments.

MR. PEARCE: I've just got a question. This is a really big group that met, a bunch of people, and you've got the next three motions were twelve to five and twelve to six and seventeen to four and what was the opposition? Who were the people that didn't like what these motions were? I am just kind of curious

of if it was a block of people that were happy and it seems like a smaller block that's not happy with what's going on and I want to know some rationale as to why. Maybe I'm wrong and maybe it's just people moving back and forth, but it doesn't seem that way. Am I making sense?

CHAIRMAN GREENE: I understand.

MR. ATRAN: I don't know if Morgan can help me out here, but I think at least part of the reason why some of them may have opposed it is the term "harvest control rule" is not a term that we use and so I think there's been some confusion as to exactly what was meant by that.

MR. PEARCE: So it was our SSC members that didn't like what they were hearing here?

MR. ATRAN: They're the ones who voted and I know it was confusing to me what the term meant and in talking with some other folks, I think it was confusing to some of the others as well.

MR. PEARCE: But you've got our Standing SSC and you've got the Ecosystem SSC and you've got the Special Reef Fish SSC and I'm just curious what problems evidently some of them had with these next three motions and what they were.

MR. ATRAN: Another thought, and I am trying to think as we go along, is that having passed the first motion to try to come up with some goals and objectives, I think there might have been a feeling that that's a good enough start for now and let's get those goals and objectives before we move on to the next step.

MR. PEARCE: That's fair and I understand that and that may be exactly what we want to do, is just to figure out -- Get that start and then go from there.

MR. WILLIAMS: Does Dr. Schirripa remember what the dissention was? Do you remember, Mike? You don't? Okay.

CHAIRMAN GREENE: We have an SSC recommendation here before us.

MR. WILLIAMS: The Executive Director weighed in on the previous motion and do you want to weigh in on this one? I'm going to make this motion on behalf of the SSC if nobody -- I am hearing a little bit of dissention over there, but the SSC has made the motion and I'm going to give them a chance to air it if --

EXECUTIVE DIRECTOR GREGORY: No, I think it would be a good project, but one difficult to accomplish though.

MR. WILLIAMS: Well, I mean I think it is, but Mike showed us something he had done with gag grouper and red tide. You had a couple of spikes in there and you showed us something and so they're obviously working on it now and I mean if they think they can do it, I think we ought to ask them to do it.

EXECUTIVE DIRECTOR GREGORY: In their last gag assessment update, we included the red tide event and this was simply more confirmation that indeed it had an effect on the gag population and so it was like a first step forward.

MR. WILLIAMS: Well, the red grouper live right out there where all those red tides occur and so if Dr. Schirripa opposes this, I won't make the motion, but otherwise, I am going to make it.

EXECUTIVE DIRECTOR GREGORY: I am not talking against the motion.

MR. WILLIAMS: Then I would like to make this motion right here that the Gulf Council recommend that the Gulf of Mexico IEA Program work with the Gulf Standing and Ecosystem SSCs to evaluate the current red grouper harvest control rule to determine if it is robust to possible future changes in intensity and frequency of episodic events of non-fishing mortality.

CHAIRMAN GREENE: We have a motion on the board and do we have a second? Seeing no second for the motion --

MR. WILLIAMS: That mystifies me, I will tell you.

CHAIRMAN GREENE: The motion fails for a lack of a second then and we will move on.

MR. ATRAN: The next motion is at the top of page 4 and it's similar, but it looks at the human dimensions. By a vote of twelve to six, the SSC recommends that the Gulf of Mexico Integrated Ecosystem Assessment Program work with the Gulf Standing and Ecosystem SSCs to investigate the human dimension and long-term ecological implications of the current shallow-water grouper harvest control and various catch limits. Again, my suggestion, if you were going to make the motion, since this is talking about the human dimension, is to perhaps include the Socioeconomic SSC in this.

CHAIRMAN GREENE: Okay. We have another SSC recommendation and seeing no activity, I guess you can carry on, Mr. Atran.

MR. ATRAN: The next couple of motions occurred on the third day, when Dr. Schirripa wasn't there. This was after the stock assessments had been given and we got the Standing, the Ecosystem, and the Reef Fish SSCs altogether to talk about integrating ecosystem considerations into SEDAR assessments.

The first motion had to do with a new task force that's just been created. There's a task force that was created by the Lenfest Program to try to develop a blueprint of action for ecosystem-based fisheries management. I have an attachment on the back of the SSC report that has a press release from the University of Washington on this.

This is a group of thirteen scientists who have been appointed to try to work up some standard way of integrating ecosystem considerations into fisheries management. At the moment, all the councils are working in different ways and so they're trying to come up with some guidelines for the councils to work with.

They do plan to create an advisory panel that consists of members and staff of fishery management councils plus staff with NOAA Fisheries. They are not at that stage yet and the thirteen members do include some people who have an affiliation with our council. That includes Lee Anderson from the University of Delaware, who I think was on the Socioeconomic SSC or its predecessor, and Felicia Coleman from Florida State University is a former council member and Kenneth Rose from Louisiana State University was on our Ecosystem SSC and so we do have some representation on this group of thirteen people.

My understanding is when they're ready to start getting the councils involved that they will reach out to us, but the motion that the SSC made is by a vote of seventeen to four, the Ecosystem and Standing SSCs encourage the council to pursue participation in the newly formed taskforce to develop a blueprint of action for ecosystem-based fisheries management.

CHAIRMAN GREENE: Okay. We have an SSC recommendation on the board.

MR. WILLIAMS: I will make it on behalf of the committee. Steve, you said that Ken Rose is on this and Felicia Coleman and who else?

MR. ATRAN: Lee Anderson. He was on one of our SSCs and was he

on -- He still is? The Socioeconomic SSC.

MR. WILLIAMS: Ken Rose used to be on our Reef Fish Committee. He and Jim Cowan were on the Reef Fish Committee at one time.

MR. ATRAN: That's right and he was also on the Ecosystem SSC until a few years ago.

MR. WILLIAMS: I am going to go ahead and hazard a motion then that the council pursue participation in the newly formed taskforce to develop a blueprint of action for ecosystems-based fisheries management.

MR. DIAZ: I will second.

CHAIRMAN GREENE: We have a motion on the floor and it's been seconded by Mr. Diaz and any further comments or considerations? **Any opposition to the motion?**

EXECUTIVE DIRECTOR GREGORY: I was informed that this taskforce has just been formed by Lenfest and they are still getting organized and part of what they are talking about doing is contacting all the councils for us to participate in some fashion and so we don't need to pursue anything, but I think to be receptive to participating or to cooperating with the Lenfest taskforce is, I think, direction to staff.

I don't know if that would involve council members as well, like the Fisheries Forums do and some of the other things that we're invited to participate in. Yes, we will do that, but as far as pursuing it, we will just wait and let them contact us.

CHAIRMAN GREENE: Okay. We will move on, Mr. Atran.

MR. ATRAN: I agree with what Doug Gregory said, but if we were going to do anything, given the very early stage at which this taskforce is at, about the only thing we can maybe do is send a letter to the chairman of the taskforce saying we're aware that your taskforce has been formed and we're very much interested in participating at the appropriate time or something to that effect.

CHAIRMAN GREENE: Mr. Atran has made a recommendation for a letter and does anybody want to move on that idea?

MR. DIAZ: I don't know that it needs a motion, but I think that would be a good way to follow up on this motion that was previously passed, to let them know that we're interested in

participating.

MR. ATRAN: My intent was if the motion passes, that would be our response to the motion passing.

CHAIRMAN GREENE: We have a motion on the floor. **Is there any opposition to passing this motion? Seeing none, the motion passes.** Go ahead, Mr. Atran.

MR. ATRAN: Finally, there was one more motion that was made and you may remember at the end of Dr. Schirripa's presentation, he suggested that we form a multidisciplinary committee composed of members from various SSCs and APs, et cetera, in order to prioritize and identify the information needs for fisheries managed by the council.

The combined SSCs went ahead and made that exact motion. By a vote of fourteen to two, the SSC recommends that the council convene a working group comprised of some members from the Ecosystem SSC, Standing SSC, Socioeconomic SSC, advisory panels, and the Sustainable Fisheries Committee of the council to develop approaches for identifying and prioritizing ecosystem and socioeconomic information needs for the fisheries managed by the council.

CHAIRMAN GREENE: We have an SSC recommendation before us.

MR. WILLIAMS: Could I make a request that Doug and/or Steve comment on this motion? Is it a useful thing to do? It looks fairly -- It's going to have a rigorous group there. There's going to be quite a few people on it and are you all right with it?

EXECUTIVE DIRECTOR GREGORY: I think eventually yes. Certainly it's a working group of the three SSCs and it's going in the direction that I've been wanting to go in integrating the three SSCs. We're the only council that has more than one SSC and this discussion really brings to focus the need to have an integrated SSC structure and so this could be the beginning of that.

I don't know if the three groups with some advisory panel members and council committee all meeting at once or working as one group is the way to go, but it's certainly a direction to go in. I think we take it step-wise and form a working group of the SSC and then incorporate the advisory panel representation and that's something for the council to discuss. We can pass this and then work on setting up the structure of it later.

MR. WILLIAMS: I would be glad to take out the advisory panel and Sustainable Fisheries Committee if that would make it more palatable to you. I think Steve has a comment, too.

MR. ATRAN: I think the idea was to include stakeholders as well as scientists in this. I think though that perhaps if this group is formed that it might need a little bit clearer charge, considering that, as currently proposed, it includes both scientists and non-scientists. I am not sure that simply saying "information needs" really gives us enough of a direction.

EXECUTIVE DIRECTOR GREGORY: Our hesitation is that we've never approached anything this way before. We have our system of the scientists providing the best recommendation they can and it being reviewed by the public, through our advisory committee, and the recommendation coming to the council.

Now, a tweaking of that, our approach, could be in order for this, but I think first -- We have anthropologists and sociologists on our SSCs and so they have socioeconomic information and so, to me, our current way of operating seems to be the best and most efficient way to go.

I was at the SSC meeting, but, unfortunately, I was in a SEDAR Steering Committee webinar when these discussions and these motions were made and so I didn't really participate in their discussion with that, but if you read the report, it does talk about a need to try to integrate the SSCs and so we would have to identify advisory panel members or an ad hoc advisory panel to work with them, but I see it going forward in a step-wise fashion.

MR. WILLIAMS: Don't you think it -- If I were to make this motion, isn't it a little premature to have APs on there? This is going to be fairly technical kind of --

EXECUTIVE DIRECTOR GREGORY: That's what I'm trying to say. It doesn't fit our paradigm of operating and so it feels a little awkward.

MR. WILLIAMS: Mr. Chairman, I am going to go ahead and try a motion. I am not going to include the advisory panel or the Sustainable Fisheries Committee of the council. It seems to me that if the Chairman at that time wants to send somebody, he could always send someone. He or she could always send someone.

I am going to recommend that the council convene a working group

comprised of some members from the Ecosystem SSC, Standing SSC, and Socioeconomic SSC to develop approaches for identifying and prioritizing ecosystem and socioeconomic information needs for the fisheries managed by the council.

CHAIRMAN GREENE: Mr. Williams, is that your motion?

MR. WILLIAMS: Yes, it is.

CHAIRMAN GREENE: Okay. Do we have a second? Mr. Sanchez seconds it and any discussion about this motion? **Any opposition to this motion?**

MR. DIAZ: For discussion, Steve did mention that the charge is kind of weak and that's the only thing that's got me a little apprehensive. I don't mind this group getting together and I think we need to look in this general direction and I'm just wondering if it's specific enough.

MS. BOSARGE: I think Dr. Gregory mentioned one thing that he saw where this could definitely be used maybe more in the short term, while we're working on some longer-term objectives and goals, and that was -- Like I said, I saw Bonnie shake her head yes a couple of times and maybe we could have these SSCs evaluate what we could possibly use to fill in some of the gaps when we look at variations in stocks and what's happening with the stocks.

Where can we use these now as we're getting a longer-term plan for this? That could be one thing that the SSC -- That definitely would be right up their alley, right, Bonnie?

DR. BONNIE PONWITH: I could see as a possible outcome from this an ecosystem contribution to your research needs report, which is a report that you prepare and contribute to annually that helps guide our planning process and traditionally, that report deals with data gaps and where is the biggest shortfall in data for some stock assessment, but you could also include additional information of things you would learn from this exercise, to help deal with those research needs.

CHAIRMAN GREENE: Any other discussion about this motion? **Any opposition? Okay.** We will move on, Mr. Atran.

MR. ATRAN: That concludes the SSC report.

MR. WILLIAMS: Mr. Chairman, I was told that there was -- Along the same lines, somebody sent me a copy of something -- A person

by the name of David Chagaris of the Florida Fish and Wildlife Commission provided to this group. It was apparently one of their background documents.

From what I read here, they are doing something similar on this Ecopath and Ecosim and Ecospace model and they are looking at fisheries on the West Florida Shelf and apparently they have some information.

I mean reading from his summary here, they could perhaps tell us something about gag grouper and how the overfishing of gag grouper or the rebuilding of gag grouper might affect other fisheries on the West Florida Shelf.

I don't want to step on anybody's toes here, but I would kind of like to know -- If they are working on this as well, I would sort of like to know -- I would like to hear more about what the Fish and Wildlife Commission and the Florida Fish and Wildlife Research Institute is doing on this and maybe we could even get a report from them at some point.

If they're working on gag grouper and other shallow-water groupers on the West Florida Shelf, I would like to hear what it is they're doing and what kind of advice they might be able to offer.

MR. ATRAN: Actually, Dave Chagaris works with Behzad Mahmoudi, who was an Ecosystem SSC member until relatively recently, and they have been working on this Ecosim with Ecopath model for several years. I know Dr. Mahmoudi is a real expert on that model.

Back several years ago, our Ecosystem SSC was pursuing a project of trying to demonstrate the feasibility of using an ecosystem approach to some real-world fishery issues and they held a series of workshops in which they looked at how this Ecosim model or a couple of other models might be applied to red tide events and might be applied to interactions between shrimp and red snapper with shrimp trawl bycatch mortality.

They looked at a few other items and this is like maybe eight or nine years ago and the results, in my mind, showed that it was feasible to use ecosystem modeling as an approach to look at some of the fishery issues, but, at the time, a lot of the data inputs were pure guesses.

There was a lot of data gaps and the models were still being developed. They have been working on this for years and they

are probably very much advanced now on where they were and so yes, they have been working very heavily on this.

MR. WILLIAMS: Just a point of information. I hired Behzad Mahmoudi about thirty years ago right out of the University of Miami. Mr. Chairman, toward that end, I would like to offer one more motion, if I might, and I provided it to Phyllis earlier and so perhaps she could pull it up for me.

The motion is simply that the council request SSC feedback on the Florida Fish and Wildlife Research Institute's West Florida Shelf ecosystem model's ability to evaluate gag and other shallow-water grouper harvest strategies and evaluate whether the model can provide information on ecological and economic tradeoffs, in order to help determine best management outcomes, and, if possible, for the council to receive a presentation on the model at the next meeting or whenever is feasible. That's my motion.

CHAIRMAN GREENE: We have a motion on the floor and it's been seconded by Mr. Diaz and is there any more discussion about this motion? **Seeing none, any opposition to the motion? The motion carries.** Anything else before we move on, Mr. Atran?

MR. ATRAN: The motion you passed before about creating this group consisting of members of the Ecosystem SSC, Standing SSC, and Socioeconomic SSC, do you have any recommendations on how large this should be? We could maybe try to get five members from each of those SSCs and that would be a fifteen-member working group. Just a little guidance.

Actually, during the SSC meeting, they were talking about convening the entire Standing, Socioeconomic, and Ecosystem SSC and I looked around the room and with what we had, we already had a huge SSC meeting in Miami and this would have been unmanageable if the entire SSCs met jointly.

EXECUTIVE DIRECTOR GREGORY: The West Florida Shelf model was presented to the Ecosystem SSC a year or two ago, but it's never been presented to the Standing SSC and I know Behzad was on the Ecosystem SSC and he just resigned a week before the meeting and he suggested that Dave be put on to replace him and we said when we go back to reappoint people that we will consider that and we will certainly solicit Dave to apply to be on the SSC, but apparently I think there's some -- Like there are in some institutions, some competing efforts to do modeling and we will do our best to get the groups together, working together, but I think there are two different models and they will operate in

two different ways and so we do need to evaluate the relative utility of each modeling approach.

MR. WILLIAMS: When you're talking about the other, you're talking about the FWRI approach versus the NMFS approach? I am not trying to create any problems here, but I used to work for the Florida Institute and they didn't call them that then, but I would like to hear what they have to say.

CHAIRMAN GREENE: Mr. Atran was looking for some guidance as far as how to put the group together on a motion that had passed about number-wise, Mr. Williams.

MR. WILLIAMS: I would agree that fifteen would be the max, I would think, and even smaller. I would defer to the Executive Director and staff to do something like that, but my opinion would be no more than fifteen.

CHAIRMAN GREENE: I think that's pretty well understood, that you're going to let the staff do it, but it would be no more than fifteen and probably less, if at all possible. Any other questions?

DR. SCHIRRIPA: I feel there's a misunderstanding here that I feel compelled to jump in and I'm sorry if I'm -- There is absolutely, positively no competing efforts going on here and that is absolutely the wrong perception. Nobody is competing for anything.

Rather, we would look at this as a multi-model approach, in fact. In fact, that's our idea, is to use Ecopath with Ecosim and OSMOSE and Atlantis and what you have to understand is that these are simulation models and their results generally don't have formal error and uncertainty around them and so much like hurricane models -- You have seen the spaghetti models and this is the approach we plan on taking.

We are welcoming to absolutely any models whatsoever to put into this ensemble approach of models and say with this set of assumptions you get this and with this set of assumptions, you get that and try to -- If all models are pointing in the same direction, then great. Have at it, but if they're going in different directions with slightly different assumptions, we need to know that as well and so by no means do I think competing or competition is the proper word here. I would say cooperation and all models are welcome.

MR. WILLIAMS: If I said competing, I apologize.

DR. SCHIRRIPA: I heard it a couple of times and whatever, but I am just --

EXECUTIVE DIRECTOR GREGORY: No, that was me.

CHAIRMAN GREENE: Thank you, Dr. Schirripa.

MR. PERRET: Mike, I think two or three years ago, you were chairman of our ecosystem -- No, it wasn't you? Okay. We had a committee and they looked at these ecosystem models and so on and so forth and came back and gave us a presentation. I assume the models today are more refined than they were two or three or four or whatever years ago.

Dr. Crabtree I'm sure will correct me if I'm wrong, but it seems to me in the presentation they gave there was some concern about shrimp trawling and you mentioned the menhaden and the menhaden fishery and the prey. It seems like it came back that, hey, if you didn't have shrimp trawling that your catfish or whatever fish may take over and all that sort of thing and the same thing with menhaden. If you weren't on that committee, was their work made available to you and do you recall any of that?

DR. SCHIRRIPA: Yes, I do recall that and --

MR. PERRET: I'm sure it's clearer than my memory.

DR. SCHIRRIPA: I would implore the group to move beyond the catfish/shrimp story that was told then. It was published in the *Bulletin of Marine Science*, but if you read it carefully and if you take that one sentence out -- Yes, it says that, but if you read the very next sentence or two, it admits that this is not a commonsense answer and that this was an example and this was a demonstration project and that these results should not be taken as a direct management action.

Things evolve and surely in ten years I would like to think that we know a little bit more and not just the models are being more refined, but it's the data, which is just as, if not more, important than the models.

CHAIRMAN GREENE: I don't see anybody else and so I've got one more question and I guess it would be to Bonnie or Dr. Schirripa or somebody, but one of the things that we've talked about throughout the whole course of this meeting is with regard to stock assessments and timing and trying to get stuff done on time.

Moving in this direction and using the spaghetti model approach and everything, is this going to slow down or limit us in the number of stock assessments that we can have in any given time? I know we do a certain number and is this going to really slow this down and how would that part of the program work out?

DR. SCHIRRIPA: The motions, if you read them carefully, were designed specifically to not include the Southeast Fisheries Science Center. It said that the Gulf of Mexico IEA group would do this work and that was done with a very conscious effort that we need to run parallel for now to the single species stuff, so what you're saying does not occur.

In the end, our ideal product would increase the efficiency of our single species assessments, but by not bothering the single species people and letting them take care of those terms of reference. We need a separate group doing this stuff alongside them and that's the approach that we're taking right now, using funding as we can make available, through whatever means, MARFIN or IEA money and so on, to run parallel, so that we do not run into that problem.

I realize, of course, it's on everyone's mind and so we've been in this business for a long time and I know what some of the priorities are and so yes, we're intentionally making that point.

CHAIRMAN GREENE: Thank you and I thought that's what it was and I just wanted to make absolute certain. I think that's everything on this and with that, we will move on to Item Number V, which will be Options Paper for Status Determination Criteria, Optimum Yield, and Red Snapper ACL Designation. That will be Tab E, Number 6, led by Mr. Atran.

OPTIONS PAPER - STATUS DETERMINATION CRITERIA, OPTIMUM YIELD, AND RED SNAPPER ACL DESIGNATION

MR. ATRAN: Thank you. I think it was some time last year that I brought a scoping document on this topic to the committee and it was a very confusing and very technical issue and the committee said that they would like to get it revised and try to make it a little bit easier to read.

I came back and met with our IPT and the IPT recommended that because this document is so technical in nature that if we went out to scoping, we weren't going to get anybody showing up and so they suggested that we go straight to an options paper and

start considering some actual options.

Just to remind you, the reason why we're considering this is because the status determination criteria consists of the maximum fishing mortality threshold, which is necessary to determine if overfishing is occurring, the overfishing limit, which is an alternate way to determine if overfishing is occurring, and the minimum stock size threshold, which is used to determine if the stock is overfished.

We have overfishing definitions for most of our stocks that was adopted in 1999. Most of them, we adopted F 30 percent SPR as the maximum fishing mortality threshold. However, the document where we attempted to do that also tried to set the biomass thresholds in terms of SPR and NMFS at that time said that SPR is not a biomass measurement and couldn't be used to develop the biomass reference points and so they accepted our overfishing definitions, but not our overfished definitions.

Since then, we have started calling our overfished definitions based upon the yield corresponding to fishing at F some SPR and that's been acceptable to the National Marine Fisheries Service, but we have a large number of stocks where we don't have biomass reference points. We have overfishing reference points, but we may want to see if we want to revisit them. I know the council is specifically interested in red snapper in that aspect.

Then, in addition to that, there's a couple of other items here dealing with formally adopting ACLs for red snapper, which we haven't done and I will explain that in a second, and adopting an OFL for black grouper and trying to define the relationship between optimum yield and annual catch limits, which at least to me has been a confusing subject and I'm trying to clear that up.

With that, I will go into this document and we'll start on page 5, which is still in the introduction section, but it has to do with ACL designation for red snapper. Now, the Magnuson Act, when it was reauthorized in 2006, and I believe that was when it was reauthorized last, required that all overfished stocks have annual catch limits by 2010 and then all other stocks by 2012, but it allowed the use of some alternative designation if it was compatible with the objectives of the Magnuson Act and the National Standards.

At the time, we were doing quota changes and management changes through framework -- Well, we called them regulatory amendments. We were advised that a full plan amendment was needed to formally adopt ACLs and so what we did was we set TACs and then

later quotas and we said that the quotas were the functional equivalent of an ACL and that was acceptable under the National Standard 1 Guidelines.

It's acceptable, but it's very awkward to keep having to talk about our functional equivalent of an ACL rather than an ACL itself and so we've been looking for some place in a plan amendment where we can say, no, we're actually going to have ACLs for red snapper and not just the functional equivalents.

At our last IPT meeting, we were informed by our NOAA General Counsel that we didn't actually have to have an action with multiple alternatives since this change does not have any NEPA effects. It won't have any effect on the environment and it's just a technical change.

It means that in the codified regulations there will be a section under the ACL section where we will say red snapper ACLs are as follows. Right now, that's not in there, but there are quotas for red snapper and those quotas are required under the 407(d) section of the Magnuson-Stevens Act.

With this technical change, we will now officially get ACLs in the codified regulations and we can start talking about setting ACLs for red snapper instead of functional equivalents of ACLs. Again, this has absolutely no change to the actual management of red snapper and it's just a technical change so that we can get rid of this awkward wording.

Now we'll get into the action items where we do have some alternatives, which is in Chapter 2, beginning on page 7. The first thing we have is Action 1 and that's to adopt some reference points for maximum sustainable yield.

There is a number of different reference points. We usually adopt 30 percent SPR or, in a few cases, maximum yield per recruit. There are other alternative ways of setting a proxy for maximum sustainable yield, but those are the two most commonly used and so at least for the first couple of alternatives, we are restricting ourselves to those two methods of defining a reference point.

Alternative 1, no action, states that the reference points will remain as shown in Table 2.1, which I bypassed. It lists which species are using 30 percent SPR as the reference point and which are using 26 percent SPR. That would be red snapper. Goliath grouper is using 50 percent SPR for fishing mortality and it doesn't have a biomass reference point and then we have

two species, gag and vermilion snapper, which are using maximum yield per recruit.

The majority of our species are basing our reference points on 30 percent SPR and so Alternative 2 would do that for all of the stocks that don't currently have a biomass reference point. It states that fishing mortality and biomass MSY reference points will be based upon 30 percent SPR and so, in other words, the overfishing threshold would become F 30 percent SPR and the maximum sustainable yield proxy would become the biomass at F 30 percent SPR.

Option a -- These options are not exclusive and they call all be adopted or any combination of them. Option a would apply this to all the stocks that currently do not have a defined biomass reference point and there's a list here of hogfish, queen snapper, blackfin snapper.

I won't go through the whole list, but these are mostly data-poor species that have never had a stock assessment and so there's never been any reason in the past to apply an overfishing or an overfished threshold, but we're supposed to have those for all stocks and so Option a would fill in the gaps.

Option b would add gray triggerfish to all those other ones and the reason why we think gray triggerfish might need to have a change is because right now, the overfishing threshold is based upon 30 percent SPR, but the overfished threshold is based upon 20 percent SPR.

It doesn't make a whole lot of sense and I'm not sure how we ended in that situation, but you really want your overfishing and overfished thresholds to be using the same reference point and so Option b would apply 30 percent SPR to both the overfished and the overfishing threshold for gray triggerfish.

Option c would switch gag from its Fmax, it's maximum yield per recruit proxy, to F 30 percent SPR. Yesterday in Reef Fish Committee, we got a report on the gag stock assessment and basically, rationale was provided as to why maximum yield per recruit is a better proxy than 30 percent SPR for gag and so it might not be a good idea to adopt Option c, but for completeness, it is included in this alternative.

Then Option d, vermilion snapper is also based upon maximum yield per recruit and I believe it was for the same reasons as gag, that if we used F 30 percent SPR that we were going to end

up with an overfishing proxy that was above the model-generated estimates of FMSY, whereas maximum yield per recruit would be a little more conservative.

Alternative 3 is the counterpart to Alternative 2, except it would convert everything to using maximum yield per recruit instead of the F 30 percent SPR. If we did that, then the overfishing threshold would be Fmax and the overfished threshold would be biomass below the biomass when fishing at Fmax.

Option a would apply this change to all stocks that don't have a defined biomass reference point and have the 30 percent fishing mortality reference point and, again, there's a list here of hogfish, queen snapper, et cetera.

Option b would apply it to all the stocks under Option a plus add black grouper, mutton snapper, yellowtail snapper, greater amberjack, tilefish, red grouper, yellowedge grouper, and gray triggerfish and so essentially, all of the species covered in this generic amendment. By the way, this generic amendment covers all of the reef fish stocks plus red drum.

Alternative 4 deals specifically with goliath grouper, because unlike most of the other stocks, instead of using 30 percent SPR on which to base the overfishing mortality threshold, we're using 50 percent SPR and that was adopted based upon a recommendation that came out of an ad hoc panel back in the late 1990s that suggested that goliath grouper may be more vulnerable to overfishing and therefore, a more conservative proxy than what's used for most of the reef fish would be appropriate.

That panel had recommended a proxy somewhere between 40 percent and 60 percent and the council went with 50 percent, because that's the midway point there, but if you want to reconsider that, we have options to set the overfishing and overfished proxies at either 60 percent SPR, 50 percent SPR, 40 percent SPR, or 30 percent, which is what we do for most of our reef fish stocks, or we could also set it at maximum yield per recruit.

At the moment, I don't think we have much biological information to support going to an Fmax policy and the so the question is whether you want to continue with the 50 percent SPR and have a biomass threshold as well as an overfishing threshold, based on that, if you want to get more conservative and go to 60 percent SPR.

40 percent would be less conservative, but still more

conservative than most stocks, but just to put it in perspective, we were told yesterday that gag, where -- Although Fmax was the adopted overfishing threshold, that's the equivalent of F 40 percent SPR in the case of gag and so you might think, as far as 40 percent, do you want the same level of conservation for goliath grouper that you're applying for gag? If so, the 40 percent SPR might be appropriate and if you think it should be more conservative, than the 50 or 60 percent might be appropriate.

Then Alternative 5 deals specifically with red snapper. This was a request that came from the council. At the moment, overfishing and overfished thresholds are based upon 26 percent SPR. The council asked that a switch to Fmax be considered.

The alternatives we have here -- If you don't adopt anything in Alternative 5, we stick with 26 percent SPR. Option a would go to 30 percent SPR and so it would put red snapper on the same proxies as most of the other reef fish and Options b and c would switch the proxy to Fmax, maximum yield per recruit, and there, you have a choice of either basing that on total removals or basing it on retained yield and there is a slight difference.

The equivalent SPR, if you based it on total removals, would be 20.4 percent SPR and if you based it on retained yield, it would be 22.4 percent SPR. Again, to put this in perspective, prior to 1996, a 20 percent SPR was the overfishing and overfished threshold for red snapper.

We went to 26 percent SPR because the available scientific information supported that as being closer to what the true MSY might be, but 20 percent is below those recommendations.

The next section deals with setting maximum fishing mortality threshold and it is on page 13 and that's Action 2. Alternative 1 would be no action and the existing maximum fishing mortality thresholds would be retained and that would be 30 percent SPR for all stocks except gag and vermilion snapper, which use Fmax. Red snapper uses F 26 percent SPR and goliath grouper uses F 50 percent SPR.

Alternative 2 would use whatever proxy was adopted in Action 1 and set the maximum fishing mortality threshold to whatever proxy was adopted in 1. For most stocks, that would either be F 30 percent SPR or Fmax, but it wouldn't be necessary to list the individual species here, because they're already listed in Action 1.

Alternative 3 is similar to Alternative 2, in that it sets FMSY or its proxy based upon the proxy that was adopted in Action 1, but it adds another line. It says the maximum fishing mortality threshold is equal to F rebuild for stocks that are in a rebuilding plan.

The reason why this was added was because of an issue that arose last year when we were setting red snapper catch limits and quotas. The SSC had been basing the overfishing limit on the F rebuild level, which is more conservative than FMSY, but we were told that OFL, by definition, is the yield when fishing at the maximum fishing mortality threshold, or FMSY.

We had to go back and recalculate OFLs based upon the higher F rate. The problem is that on a rebuilding stock if you base the rebuilding, the OFL, on FMSY, you're never actually going to get to your target level. You will approach it on an asymptotic basis, but you will never actually get to it and so this corrects what we saw as an issue for rebuilding stocks and it makes sure that overfishing occurs if fishing is occurring at a higher rate than is consistent with rebuilding the stock.

At the bottom of page 15, there is a section titled "Discussion of Overfishing Limit" and OFLs are also a status determination criteria, but we don't need to define how they're calculated, because, as I mentioned before, it's already defined in the National Standard Guidelines.

OFL is the yield when you're fishing at FMSY or your FMSY proxy. That's pretty automatic once you've determined your proxy. However, when we put together our Generic ACL and AM Amendment in 2012, that's where we assigned OFLs and ABCs and ACLs and ACTs to most of our stocks and we had several species complexes where we were assigning OFLs and ACLs and whatnot, deepwater grouper and tilefishes and amberjacks other than greater amberjack and certain snappers, which we called the mid-water snapper complex, and shallow-water grouper other than red grouper and gag.

That other category included black grouper, along with yellowmouth, yellowfin, and I don't recall the other one. The problem is that we have a stock assessment on black grouper and so we have an OFL for black grouper, but that OFL covers both the South Atlantic and Gulf regions, because that stock moves across the jurisdictional boundaries.

The way in which we were determining OFL for our complexes was to add the individual OFL values for each stock together to get

an OFL for the entire complex. If we did that for the other shallow-water grouper complex, we would have been including some black grouper that are in the South Atlantic side that we really shouldn't be counting.

I wasn't quite sure how to handle that at the time and so for purposes of getting that amendment completed and implemented, we said that OFL was undefined for the shallow-water grouper complex.

Since then, we've determined that we can determine an OFL component for the Gulf side. There was an allocation or an apportionment formula that was developed as part of the Generic ACL and AM Amendment for dividing up the ABC between the Gulf and the Atlantic and I believe the Gulf side got 53 percent of the black grouper ABC and the South Atlantic got the remainder.

We can take that formula and apply it to the OFL as well, so we just have a Gulf portion of the OFL. Then we can add together all those other species' OFLs and come up with an OFL for the complex. At the bottom of page 14, if we do that, we get an other shallow-water grouper OFL in the Gulf of Mexico for 2014 of 800,876 pounds gutted weight. Then for 2015 and beyond, it's 798,828 pounds gutted weight. I don't think we've come anywhere close to this, but it allows us to put an OFL on the books for the complex so we have a measurement to determine if the complex has entered an overfishing state.

I didn't feel that this needed to be an action item with alternatives, because we're using already established methods for setting OFL and just determining that we can use the apportionment formula to determine how much of the black grouper OFL to apply to the Gulf side and so this, like the red grouper ACL adoption, is just a statement of here's what the OFL is for the shallow-water grouper complex.

The next section is Action 3 on page 15, which is setting minimum stock size threshold, which is the third and last status determination criteria.

Alternative 1 is no action and right now, for several of our stocks, we don't have any biomass threshold for minimum stock size threshold and the council's approach has been to adopt them on a case-by-case basis as needed. The problem with that -- That's what Alternative 1 would do.

The problem with that is if we get a stock assessment for the first time on a stock, the assessment does not have any

information on what the overfished and what the overfishing limits are.

The assessment scientists have to pretty much make a guess at what they think the council is going to adopt and then use that guess in order to evaluate the status of the stocks and the council most of the time goes along with the SSC, but they may not and so it would be better to have these thresholds in place before the assessments ever get done.

What we do for most of our assessments is what Alternative 2 would so. It sets maximum stock size threshold based on the formula one minus M times BMSY and M is the natural mortality rate and so if we're talking about a stock that has a natural mortality rate of 0.2, the stock would become overfished when the biomass levels drop below 80 percent of the MSY level and this is what we've done for pretty much all of our stocks and it's a fairly conservative reference for declaring a stock overfished.

The National Standard Guidelines allow that threshold to go down to as low as 50 percent of BMSY and that's what Alternative 3 would do. If you were to adopt Alternative 3, there would be a lot more leeway to managing a stock and trying to correct declines before it actually enters an overfished state and so in that respect, it's more flexible than our current strategy.

However, if the stock does get below 50 percent of its MSY biomass, you would probably need a very restrictive rebuilding plan in order to rebuild the stock in ten years or whatever timeframe you are given and so those are the tradeoffs. Table 2.2 on page 16 -- I went to the websites for all of the other councils and looked at some of their fishery management plans to determine what thresholds they're using for MSST and it looks like six of them are using this formula, the one minus M times BMSY formula.

Three of them are using 50 percent of BMSY and two of them are using different approaches, depending upon what stocks. Both of these approaches are currently in use and, as I said, Alternative 2 represents what we're applying on a case-by-case basis now and this would just apply it to all of the stocks.

The last action item is on page 18, Action 4, optimum yield. I included this because up until the 2006 reauthorization of the Magnuson Act, we had two reference points that we were targeting for management, MSY, which we didn't want to exceed -- We wanted to be at least at the MSY level for our stocks and then optimum

yield, which was MSY as reduced by relevant sociological, ecological, environmental factors, or due to international treaties. That is not the exact wording, but I think it's close to what's in the Magnuson Act.

At any rate, we had two reference points. When the Magnuson Act was reauthorized in 2006, the Act added ACLs and the National Standard Guidelines added ACTs and OFLs and we have a whole bunch of different reference points.

Basically now, we are managing to try to reach an annual catch limit, an ACL, which is calculated based upon the ABC plus management uncertainty, but we still are required, under National Standard 1, to achieve optimum yield, which is based upon MSY as reduced by these relevant factors.

When the calculations are done, because different formulas are used, we get different numbers for what our target should be if we're going to fish at optimum yield versus what our target should be if we're going to fish at the ACL level and I was trying to figure out how could we resolve this what to me appeared to be a conflict.

What I did was come up with a couple of alternatives. Alternative 2 states that when we have s tock assessment that defines a maximum fishing mortality threshold, optimum yield is the annual yield when fishing at 75 percent of MFMT.

If we don't have a stock assessment, a data-poor species, where perhaps all we have is an estimate of OFL based upon recent catches, then OY is 75 percent of that OFL and this is basically what we've been doing anyway.

What's added to this is that for stocks in a rebuilding plan, OY is the yield corresponding to the rebuilding plan and so we wouldn't go over that level and then what's added to try to reconcile using both an OY and an ACL, the last line in this alternative states that in all cases the stock ACL may not exceed the equilibrium optimum yield or the ABC and so there could be situations -- Equilibrium OY is, over the long term, if everything else remains constant, what the yield would be for the stock, but everything is not constant.

We get strong year classes and weak year classes and when we get a strong year class, it may be possible that we could fish the stock temporarily at a level higher than OY and we would be fishing the stock down to its OY level, but then when we get a weak year class, we would have to put some restrictions in in

order to get the stock back up to its OY level and so this would try to stabilize the fishery by setting some maximum level that we could not go above.

Alternative 3 is very similar, only OY would be defined as at equilibrium each year rather than the annual level of OY and so we would never be able to go above the equilibrium level under Alternative 3.

It would provide a little bit more stability than Alternative 2 and it would be a little bit more conservative than Alternative 2, but other than that, it's very much the same and it has the other factors in here, with OY as equal to either 75 percent of the maximum fishing mortality threshold or 75 percent of the OFL. For stocks in a rebuilding plan, OY is the yield corresponding to the rebuilding plan and in all cases, ACL may not exceed the OY or the ABC.

Then Alternative 4 is the simplest solution to reconciling having differences between OY and ACL. It simply says OY will be set equal to the stock ACL. That way, the two numbers are the same and we no longer have a conflict between the two numbers.

The drawback here is that that does not recognize the reasons why we have an OY versus the reasons why we have an ACL and so those are the actions that we have in here right now. It's still a very technical document and I think we still need to go through and try to make it more readable. I have tried to simplify it, but this is where we stand right now.

CHAIRMAN GREENE: Okay. Any questions?

MR. PEARCE: Dr. Atran, are you asking us to -- Are you trying to develop this into a public hearing document? Is that what you're trying to do?

MR. ATRAN: Yes, eventually. I don't think this options paper is quite ready to go to that step yet and I think probably we'll need to come back with either a pre-public hearing document or a revised options paper, but we would like to get some feedback from the council.

MR. PEARCE: So you're still going to come back to us with another document that we're going to try to develop into a public hearing document? I am trying to get past where we are, because I think a lot of us are in the weeds around this table right now and if you want to go to a public hearing document, I

will make a motion that you develop this into a public hearing document right now, but other than that, I'm not sure what direction we're going to go today, unless somebody else can help me.

MR. PERRET: Steve, you're right that it's a very technical document. On Action 1 and Action 2, Action 1 of MSY and Action 2 of maximum fishing mortality threshold, why do we have -- Why are we developing MSYs for a species that's been closed since I think 1988, goliath grouper, and red drum? Hopefully we'll get red drum opened for something, but I see red drum mentioned in Action 1, but not in Action 2, but I see goliath grouper in both 1 and 2 and why are we dealing with goliath grouper?

MR. ATRAN: Right now, there is a joint committee composed of South Atlantic and Gulf Council members and they are going to be meeting later this summer to try to work out issues with goliath grouper, to see if there is some way we could open them up. We will need some thresholds to define overfishing and overfished.

MR. PERRET: Okay and so we're just trying to get ahead of the curve if indeed that happens with goliath and red drum?

MR. ATRAN: Correct.

DR. CRABTREE: I think this still has a long, long way to go. I guess one thing that strikes me is in Action 1. I mean we have OFLs that were defined based on average catch series and I don't see anything in here that addresses that and it seems to me though we used average catch as the basis for some of our ACLs in the ACL Amendment and OFLs. I don't see that the SPR proxies here work outside of assessed stocks.

MR. ATRAN: To that point, yes, our data-poor species OFL was set based upon recent history of catches and we do have -- The reason why they're not in here is because we do have OFLs established for everything except that other shallow-water grouper complex and so it's not really necessary to revisit them here.

DR. CRABTREE: Okay, but the OFL is directly related to MSY and then as the basis for the ACLs and everything else and not an SPR proxy. I think you overstate that NMFS has subsequently accepted the use of yield at SPR reference points as an acceptable biomass proxy. I don't believe that's accurate.

SPR can be a useful guide when you have stock assessments that combine it then with recruitment estimates and can give you

those yields, but for unassessed stocks, I don't think it's informative and doesn't get you at MSY at all. I think that's going to have to be more based on the ORCS method or average catches and so I don't think you can treat assessed stocks and unassessed stocks in the same fashion here.

It seems, to me, there's a significant amount of restructuring of all this and the whole OY discussion that's going to have to be done to better address that and then it seems, to me, on the Actions 2 and 3 that you're going to definitely need, if we're going to go down this path, a much wider range of alternatives there. I don't think it's going to be okay to just say MFMT equals FMSY. Why isn't it 90 percent of FMSY or some level below that and the same with MSST.

There is a host of different levels we might set it at other than one minus M times BMSY and 50 percent and so I think there's a lot more that's going to go into this and it seems, to me, this needs to be looked at with some technical subcommittees and maybe with some input from the SSC, but I think it's got a long way to go to get us to where we need to be.

MR. ATRAN: To a couple of your points, yes, I realized I was kind of limiting which proxies for MSY or FMSY would be used to the most commonly used ones. There are others that we could put in there and I was kind of relying on our NEPA expert on our IPT to tell me when we've got a sufficient number and so we'll go back and I will use his guidance to indicate what we need to put in and how much we need to put in.

As far as the SSC, we are already planning to bring this or if it's a subsequent document to the SSC at its next meeting for review.

When we started working on this a couple of years ago, at that time I didn't have a document, but I went to the SSC and I explained that we were trying to come up with default status determination criteria for all the stocks that didn't currently have them and asked if they had some guidance, but their response was let's wait and see what you come up with and then come back to us and then we'll comment on it. It is imperfect at this point, but I think we have something that the SSC can comment on.

CHAIRMAN GREENE: Any further discussion on this?

EXECUTIVE DIRECTOR GREGORY: I would just say that we don't want to overly complicate this. I think it's already complicated,

just in jargon, and, to me, with the MSST discussion, the important thing is to get out of the literature why the more sophisticated stock assessment councils are using one-half of BMSY and why are the southern councils using one minus M and what are the ramifications of both?

I don't favor either one as the ideal solution and so we might want to look for something in between, but that's the kind of analysis I think we ought to bring to the council, is a better understanding of why different councils are using different definitions, but you can go anywhere from 50 percent to 90 percent on MSST as far as a fraction of MSY, but it doesn't really -- It's all arbitrary. I want to try to keep it simple and straightforward and related to what's kind of existing in the literature.

DR. CRABTREE: I agree with you on that. We need to revisit MSST. The one minus M formula is a real problem and doesn't work, because the natural mortality rates that we're using now are so low, in many cases, that we're setting the MSST, I think, awfully close to BMSY and that's a real problem. I agree with you that that's something we need to look at.

I think the most -- The part of this that creates the most heartburn, for me, is in the MSY and OY and I think it's overly reliant on SPR, which I think we're going to have to use more catch-based proxies in a lot of cases, because that's the basis for more of these ACLs.

CHAIRMAN GREENE: Any more comments? I am not seeing any and we'll move on into the next agenda item, which is Number VI, the Permits for Veterans Proposal.

PERMITS FOR VETERANS PROPOSAL

MR. ATRAN: This is based upon a series of emails that were addressed to Kevin Anson and Kevin indicated that he could lead on this.

MR. ANSON: I was forwarded an email from Charlene regarding a request to look at the possibility of veterans receiving permits or having access to permits and it's more along the lines of for-hire permits and reef fish permits, but also for potentially commercial permits too and so we threw that in there, but it was originally more along the lines of the for-hire permits.

Mr. Barton, who inquired about the possibility of the council to allow some permits to be issued, he just came up with a few

points here, just for discussion purposes, to get the ball rolling to see if there's any interest on the council to do that or set up that program, but must have been honorably discharged in order to be eligible and permits are non-transferable, except to immediate family members.

They are not able to be transferred and then a timeline for transfer and some maximum two permits allowed per category to be held by the individual and so just I told him I would at least bring it to the council and start the discussion and see if there was any interest among the council to go ahead and do something like this.

I was thinking potentially we're trying to look at growth in the industry and we have some folks that might be interested in getting in and certainly our veterans should receive some additional recognition, in my mind, if there's an opportunity to issue or reissue permits, if you will, but maybe something along the lines of every year bring back some permits that don't get renewed and we have a certain percentage of those that are available for a pool and if you meet the eligibility requirements as they're listed here, if we develop, and then they're randomly selected.

I don't know if legally the agency can do that, but potentially have some permits available that way and so, again, I just brought it to the committee and the Ecosystem/Sustainable Fisheries Committee is where it landed and so I would leave it up to you, Mr. Chair.

MR. PERRET: I am not on your committee and it's certainly an admirable goal, but the first question is legal. Mara, can we legally do something like this, permits for veterans?

MS. LEVY: I guess I feel like it would depend on exactly what it is you're trying to do. Obviously we would have to comply with the Magnuson requirements and I would have to think about that.

I mean there's not going to be any implication about discrimination between residents of different states and I think you could probably set up some sort of program. I think, just from an implementation standpoint, that that may create a lot of issues and I'm not sure how you would address some of those, but I think we would have to talk further about what it is exactly that you would want to do and then look at the different requirements.

MR. PERRET: Again, I think it's a very admirable thing, but we've got a lot of veterans and we have no idea the number of people we're talking about and non-transferable except to immediate family members, I've got a problem with that right away.

If we want to do it for the veterans, that's one thing, but I don't think they should be transferable to anyone and are we going to -- If we get into this, are we going to do it forever and any time a veteran is honorably discharged they can get a permit? I think it's going to take a whole lot of thought if we want to go down this line and I think we all want to help our veterans, but we need to give this a lot of thought.

MR. CAMPO MATENS: I agree with Corky, to a large extent. I am a veteran, although I am probably too old, but I was honorably discharged, contrary to what you might think. It's a nice idea and we are going to find ourselves in a position of trying to pick and choose between veterans and if we get 10,000 applicants, what are we going to do? Veterans from where, of what arena? I am certainly in favor of veterans, but this, I think, is something that's just too complicated to fool with. Thank you.

MR. ANSON: I am not on your committee, but to address Corky's comments, certainly these are just some ideas that Mr. Barton had proposed and we can set the criteria as we wish, based on the legal parameters that we have to work with within the Act or other legal requirements.

Again, just I look at it as a potential, or at least my proposal or thoughts on it, were that for those permits that don't get renewed and so they've been issued and they were issued at one time and they were potentially part of the fishery, but then they go away.

Taking those permits and, again, there are few in number relative potentially to the demand, but somehow or another having some of those permits go back into the fishery to help maintain the fishery might be a possibility and certainly it would be challenging.

It's something that I don't think the agency has ever done or a council has ever done before, but you know like other things that we do, think outside the box and try to do some programs that address certain needs and I just think that it would be at least worthwhile to maybe investigate it, but I am not on your committee and so, again, thank you for allowing me to speak.

MS. BOSARGE: When I look at this, I try not to look at it from a veteran perspective as much as from a holistic perspective of allowing people, whoever -- Whether they are Indians or women or veterans or whoever they are, to come back and get these permits that we have these moratoriums on.

I have an issue with that simply because we put these moratoriums into place for a reason and every industry, whether it's charterboat or whether it's the IFQ or whether it's shrimp moratorium permits, they may have a different reason in every circumstance, but there was a reason and they serve a purpose for being there.

I worry about opening this up, where we're starting to let people in and we have an exception for this group or for you or for whoever and if we were to issue more permits, in the situations where it's a permit with a moratorium, in my personal opinion, that should first and foremost go to the men and women that chose to spend their life in the fishing industry and that want to further their life in the fishing industry.

Everybody makes a choice at some point early on, usually, in their life as to what they're going to do and what path they're going to go down and I would like to see the people that chose fishing for their livelihood for the long term to be the first that would have access to something like this that have put their years in and their time in.

That's not to say that -- I mean veterans, they made a very important career path choice and I mean they take care of all of us, but when we're talking about fishing, I try to block out who it is that's asking, what group, and focus on what we're dealing with and that, to me, is an important thing to think about.

MS. LEVY: I just wanted to mention that this is -- Doing something like this is arguably an allocation, right, because you're going to allocate fishing privileges to a specific, identifiable group of people.

If you were thinking about doing this, it has to be fair and equitable and it has to be in line with the objectives of the FMP and so it can't just be we like these people and we're going to allocate them. What does it do in terms of the objectives of the FMP and I think that was a really good point that Leann made about what's the purpose of the moratorium and how does that fit into the objective of the FMP and how does allowing other people to come in meet with that objective? I think there are a lot of

things that you're going to have to consider before you can go down this road.

CHAIRMAN GREENE: Thank you. I didn't have anything else listed under Other Business and is there anything else? Okay, Mr. Chairman, I will hand it back over to you.

(Whereupon, the meeting adjourned at 4:15 p.m., June 25, 2014.)

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Tab E, No. 3

Sustainable Fisheries/Ecosystem Committee: Action Schedule for Tab E

Agenda Item IV: NOAA Climate Change Strategy

Timeline Status: Information, comments sought

Council Input and Next Steps: Roger Griffis, NMFS Climate Change Coordinator, gave a presentation on the draft climate change strategy to the Council at its January meeting. He also gave a presentation to the SSC via webinar in March. The SSC representative will review the comments that the SSC provided on the policy. The Committee may decide whether to provide any additional comments.

Agenda Item V: National Standard 1, 3, and 7 Proposed Revisions.

Timeline Status: Information, comments sought

Council Input and Next Steps: NMFS will present proposed revisions to the National Standard 1, 3, and 7 guidelines. SSC comments on the proposed revisions will also be presented. The Committee is asked to provide input that Council staff will include in a letter to NMFS providing the Council's comments.

Agenda Item VI: Final Action – Categorical Exclusion – Charter/Headboat Decals

Timeline Status: Final action

Council Input and Next Steps: Staff will present a draft regulatory action document to propose elimination of the decal requirement for charter vessels and headboats under a categorical exclusion. This is an action requested by the Council in October 2014. The Committee should recommend whether to proceed with this proposed action as a categorical exclusion, as a framework action, or not proceed.

Agenda Item VII: Ecosystem SSC Report

Timeline Status: Information

Council Input and Next Steps: A representative of the Ecosystem SSC, Wei Wu, will present the recommendation made by the Ecosystem SSC regarding marine reserves at its February 25, 2015 meeting. The Committee should decide whether to recommend that the Council take action on the recommendations of the SSC.

Agenda Item VIII: Other Business

Timeline Status: Information

Council Input and Next Steps: Any other business to come before the Committee can be discussed here.

NOAA FISHERIES

Proposed Changes to the National Standard Guidelines

On January 20, 2015, NOAA Fisheries published a proposed rule to revise the general section of the National Standard guidelines, and the guidelines for National Standard 1, 3, and 7 (80 FR 2786). This document was prepared to show the proposed changes in a track-change format so that the public can more easily see the proposed changes to the guidelines. Any discrepancies between this document and the proposed rule will be resolved in favor of the *Federal Register*.

Key
Black text = current language
Red text = proposed new language
~~Red text~~ = current language that NOAA Fisheries is proposing to remove from the guidelines.
~~Green text~~ and Green text = current language that NOAA Fisheries is proposing to move from one paragraph to another paragraph in the guidelines.

§ 600.305 General.

(a) *Purpose*.

(1) This subpart establishes guidelines, based on the national standards, to assist in the development and review of FMPs, amendments, and regulations prepared by the Councils and the Secretary.

(2) In developing FMPs, the Councils have the initial authority to ascertain factual circumstances, to establish management objectives, and to propose management measures that will achieve the objectives. The Secretary will determine whether the proposed management objectives and measures are consistent with the national standards, other provisions of the Magnuson-Stevens Act, and other applicable law. The Secretary has an obligation under section 301(b) of the Magnuson-Stevens Act to inform the Councils of the Secretary's interpretation of the national standards so that they will have an understanding of the basis on which FMPs will be reviewed.

(3) The national standards are statutory principles that must be followed in any FMP. The guidelines summarize Secretarial interpretations that have been, and will be, applied under these principles. The guidelines are intended as aids to decision-making; FMPs formulated according to the guidelines will have a better chance for expeditious Secretarial review, approval, and implementation. FMPs that are in substantial compliance with the guidelines, the Magnuson-Stevens Act, and other applicable law must be approved.

(b) *Fishery management objectives*.

(1) Each FMP, whether prepared by a Council or by the Secretary, should identify what the FMP is designed to accomplish (i.e., the management objectives to be attained in regulating the fishery under consideration). In establishing objectives, Councils balance biological constraints with human needs, reconcile present and future costs and benefits, and integrate the diversity of public and private interests. If objectives are in conflict, priorities should be established among them.

(2) To reflect the changing needs of the fishery over time, Councils should reassess the objectives of the fishery on a regular basis.

(3) How objectives are defined is important to the management process. Objectives should address the problems of a particular fishery. The objectives should be clearly stated, practicably attainable, framed in terms of definable events and measurable benefits, and based upon a comprehensive rather than a fragmentary approach to the problems addressed. An FMP should make a clear distinction between objectives and the management measures chosen to achieve them. The objectives of each FMP provide the

context within which the Secretary will judge the consistency of an FMP's conservation and management measures with the national standards.

(c) Stocks that require conservation and management.

(1) Magnuson-Stevens Act section 302(h)(1) requires a Council to prepare an FMP for each fishery under its authority that requires (or in other words, is in need of) conservation and management. Not every fishery requires Federal management. Any stocks that are predominately caught in Federal waters and are overfished or subject to overfishing, or likely to become overfished or subject to overfishing, are considered to require conservation and management. In addition, the following non-exhaustive list of factors should be used by a Council when deciding whether stocks require conservation and management:

(i) The stock is an important component of the marine environment.

(ii) The stock is caught by the fishery.

(iii) Whether an FMP can improve or maintain the condition of the stocks.

(iv) The stock is a target of a fishery.

(v) The stock is important to commercial, recreational, or subsistence users.

(vi) The fishery is important to the Nation and to the regional economy.

(vii) The need to resolve competing interests and conflicts among user groups and whether an FMP can further that resolution.

(viii) The economic condition of a fishery and whether an FMP can produce more efficient utilization.

(ix) The needs of a developing fishery, and whether an FMP can foster orderly growth.

(x) The extent to which the fishery could be or is already adequately managed by states, by state/Federal programs, by Federal regulations pursuant to other FMPs or international commissions, or by industry self-regulation, consistent with the policies and standards of the Magnuson-Stevens Act.

(2) When considering adding a new stock to an FMP or keeping an existing stock within an FMP, Councils should prepare a thorough analysis of the factors, and any additional considerations that may be relevant to the particular stock. No single factor is dispositive, but Councils should consider weighting the factors as follows. Factors (c)(1)(i)-(iii) of this section should be considered first, as they address maintaining a fishery resource and the marine environment. *See* § 1802(5)(A). These factors weigh in favor of including a stock in an FMP. Councils should next consider factors (c)(1)(iv)-(ix) of this section, which set forth key economic, social, and other reasons contained within the MSA for an FMP action. *See* 16 U.S.C. §1802(5)(B). Regardless of whether any of the first nine factors indicates a conservation and management need, a Council should consider factor (c)(1)(x) of this section before deciding to include or maintain a stock in an FMP. In many circumstances, adequate management of a fishery by states, state/Federal programs, or another Federal FMP would weigh heavily against a Federal FMP action. *See*, *e.g.*, 16 U.S.C. § 1851(a)(7); 1856(a)(3). In evaluating the above criteria, a Council should consider the specific circumstances of a fishery, based on the best scientific information available; to determine whether there are biological, economic, social and/or operational concerns that can be addressed by Federal management.

(3) Councils may choose to identify stocks within their FMPs as ecosystem component (EC) species (see 50 CFR 600.310(d)(1)) if they do not require conservation and management. EC species may be identified at the species or stock level, and may be grouped into complexes. Consistent with National Standard 9, MSA section 303(b)(12), and other applicable MSA sections, management measures can be adopted in order to, for example, collect data on the EC species, minimize bycatch or bycatch mortality of EC species, protect the associated role of EC species in the ecosystem, or for other reasons.

(4) A stock or stock complex may be identified in more than one FMP. In this situation, the relevant Councils should choose which FMP will be the primary FMP in which reference points for the stock or stock complex are established. In other FMPs, the stock or stock complex may be identified as "other managed stocks" and management measures that are consistent with the objectives of the primary FMP can be established.

(5) Councils should periodically review their FMPs and the best scientific information available and determine if the stocks are appropriately identified. As appropriate, stocks should be reclassified within a FMP, added to or removed from an existing FMP, or added to a new FMP, through a FMP amendment that documents the rationale for the decision.

(d~~e~~) Word usage~~.~~ within the National Standard Guidelines. The word usage refers to all regulations in this subpart.

(1) *Must* is used, instead of "shall", to denote an obligation to act; it is used primarily when referring to requirements of the Magnuson-Stevens Act, the logical extension thereof, or of other applicable law.

(2) *Shall* is used only when quoting statutory language directly, to avoid confusion with the future tense.
(3) *Should* is used to indicate that an action or consideration is strongly recommended to fulfill the Secretary's interpretation of the Magnuson-Stevens Act, and is a factor reviewers will look for in evaluating a SOPP or FMP.
(4) *May* is used in a permissive sense.
~~(5) *May not* is proscriptive; it has the same force as "must not."~~
~~(6~~(5) *Will* is used descriptively, as distinguished from denoting an obligation to act or the future tense.
(~~7~~6) *Could* is used when giving examples, in a hypothetical, permissive sense.
(~~8~~7) *Can* is used to mean "is able to," as distinguished from "may."
(~~9~~8) *Examples* are given by way of illustration and further explanation. They are not inclusive lists; they do not limit options.
(~~10~~9) *Analysis,* as a paragraph heading, signals more detailed guidance as to the type of discussion and examination an FMP should contain to demonstrate compliance with the standard in question.
(~~11~~10) *Council* includes the Secretary, as applicable, when preparing FMPs or amendments under section 304(c) and (g) of the Magnuson-Stevens Act.
~~(12) *Stock or stock complex* is used as a synonym for "fishery" in the sense of the Magnuson-Stevens Act's first definition of the term; that is, as "one or more stocks of fish that can be treated as a unit for purposes of conservation and management and that are identified on the basis of geographic, scientific, technical, recreational, or economic characteristics," as distinguished from the Magnuson-Stevens Act's second definition of fishery as "any fishing for such stocks."~~
(11) *Target stocks* are stocks or stock complexes that fishers seek to catch for sale or personal use, including "economic discards" as defined under Magnuson-Stevens Act section 3(9).

§ 600.310 National Standard 1—Optimum Yield.

(a) *Standard 1*. Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield (OY) from each fishery for the U.S. fishing industry.

(b) *General*.

(1) The guidelines set forth in this section describe fishery management approaches to meet the objectives of National Standard 1 (NS1), and include guidance on:

(i) Specifying maximum sustainable yield (MSY) and OY;

(ii) Specifying status determination criteria (SDC) so that overfishing and overfished determinations can be made for stocks and stock complexes that ~~are part of a fishery~~require, or are in need of, conservation and management;

(iii) Preventing overfishing and achieving OY, incorporation of scientific and management uncertainty in control rules, and adaptive management using annual catch limits (ACL) and measures to ensure accountability (~~AM);~~i.e., accountability measures (AMs)); and

(iv) Rebuilding stocks and stock complexes.

(2) *Overview of Magnuson-Stevens Act concepts and provisions related to NS1—*

(i) *MSY*. The Magnuson-Stevens Act establishes MSY as the basis for fishery management and requires that: The fishing mortality rate ~~does~~must not jeopardize the capacity of a stock or stock complex to produce MSY; the abundance of an overfished stock or stock complex must be rebuilt to a level that is capable of producing MSY; and OY must not exceed MSY.

(ii) *OY*. The determination of OY is a decisional mechanism for resolving the Magnuson-Stevens Act's conservation and management objectives, achieving a fishery management plan's (FMP) objectives, and balancing the various interests that comprise the greatest overall benefits to the Nation. OY is based on MSY as reduced under paragraphs (e)(3)(iii)(A) and (~~iv~~B) of this section. The most important limitation on the specification of OY is that the choice of OY and the conservation and management measures proposed to achieve it must prevent overfishing.

(iii) *ACLs and AMs*. Any FMP ~~which is prepared by any Council~~ shall establish a mechanism for specifying ACLs in the FMP (including a multiyear plan), implementing regulations, or annual specifications, at a level such that overfishing does not occur in the fishery, including measures to ensure accountability (Magnuson-Stevens Act section 303(a)(15)). ~~Subject to certain exceptions and circumstances described in paragraph (h) of this section, this requirement takes effect in fishing year 2010, for fisheries determined subject to overfishing, and in fishing year 2011, for all other fisheries (Magnuson-Stevens Act section 303 note). "Council" includes the Regional Fishery Management Councils and the Secretary of Commerce, as appropriate (*see* § 600.305(c)(11)).~~

(iv) *Reference points*. SDC, MSY, OY, acceptable biological catch (ABC), and ACL, which are described further in paragraphs (e) and (f) of this section, are collectively referred to as "reference points."

(v) *Scientific advice*. The Magnuson-Stevens Act has requirements regarding scientific and statistical committees (SSC) of the Regional Fishery Management Councils, including but not limited to, the following provisions~~:~~ (paragraphs (b)(2)(v)(A)-(D) of this section). See the National Standard 2 guidelines for further guidance on SSCs and the peer review process (§ 600.315).

(A) Each Regional Fishery Management Council shall establish an SSC as described in section 302(g)(1)(A) of the Magnuson-Stevens Act.

(B) Each SSC shall provide its Regional Fishery Management Council recommendations for ABC as well as other scientific advice, as described in Magnuson-Stevens Act section 302(g)(1)(B).

(C) The Secretary and each Regional Fishery Management Council may establish a peer review process for that Council for scientific information used to advise the Council about the conservation and management of a fishery (see Magnuson-Stevens Act section 302(g)(1)(E)). If a peer review process is established, it should investigate the technical merits of stock assessments and other scientific information to be used by the SSC or agency or international scientists, as appropriate. For Regional Fishery Management Councils, the peer review process is not a substitute for the SSC and should work in conjunction with the SSC. For the Secretary, which does not have an SSC, the peer review process should provide the scientific information necessary.

(D) Each Council shall develop ACLs for each of its managed fisheries that may not exceed the "fishing level recommendations" of its SSC or peer review process (Magnuson-Stevens Act section 302(h)(6)). The SSC recommendation that is the most relevant to ACLs is ABC, as both ACL and ABC are levels of annual catch.

(3) *Approach for setting limits and accountability measures, including targets, for consistency with NS1*. ~~In general, when~~ When specifying limits and accountability measures~~ intended to avoid overfishing and achieve sustainable fisheries~~, Councils must take an approach that considers uncertainty in scientific information and management control of the fishery. These guidelines describe how ~~to~~the Councils could address uncertainty such that there is a low risk that limits are exceeded as described in paragraphs (f)(4~~2~~) and (~~f~~)(6g)(4) of this section.

(4~~10~~) *Vulnerability*. A stock's vulnerability to fishing pressure is a combination of its productivity, which depends upon its life history characteristics, and its susceptibility to the fishery. Productivity refers to the capacity of the stock to produce MSY and to recover if the population is depleted or overfished, and susceptibility is the potential for the stock to be impacted by the fishery, which includes direct captures, as well as indirect impacts to the fishery (e.g., loss of habitat quality).

(c) *Summary of items to include in FMPs related to NS1*. This section provides a summary of items that Councils must include in their FMPs and FMP amendments in order to address ACL, AM, and other aspects of the NS1 guidelines. ~~As described in further detail in paragraph (d) of this section, Councils may review their FMPs to decide if all stocks are "in the fishery" or whether some fit the category of "ecosystem component species."~~ Councils must ~~also~~ describe fisheries data for the stocks~~,~~ and stock complexes~~, and ecosystem component species~~ in their FMPs, or associated public documents such as Stock Assessment and Fishery Evaluation (SAFE) Reports. For all stocks and stock complexes that ~~are "in the fishery" (see paragraph (d)(2) of this section),~~require conservation and management (see § 600.305(c)), the Councils must evaluate and describe the following items in their FMPs and amend the FMPs, if necessary, to align their management objectives to end or prevent overfishing and to achieve OY:

(1) MSY and SDC (see paragraphs (e)(1) and (2) of this section).

(2) OY at the stock, stock complex, or fishery level and provide the OY specification analysis (see paragraph (e)(3) of this section).

(3) ABC control rule (see paragraph (f)(4~~2~~) of this section).

(4) Mechanisms for specifying ACLs ~~and possible sector-specific ACLs in relationship to the ABC~~ (see paragraph~~s~~ (f)(~~5) and (h~~4) of this section).

(5) AMs (see paragraph~~s~~ (g) ~~and (h)(1)~~ of this section).

(6) Stocks and stock complexes that have statutory exceptions from ACLs and AMs (see paragraph (h)(~~2~~1) of this section) or which fall under limited circumstances which require different approaches to meet the ~~ACL~~Magnuson-Stevens Act requirements (see paragraph (h)(~~3~~2) of this section).

(d) ~~*Classifying stocks in an FMP*~~ *Stocks and stock complexes—*

(1) *Introduction*. As described in § 600.305(c), Councils should identify in their FMPs the stocks that require conservation and management. Such stocks must have ACLs, other reference points, and accountability measures. Other stocks that are identified in an FMP (i.e., ecosystem component species or stocks that the fishery interacts with but are managed primarily under another FMP, see § 600.305(c)(3)-(4)) do not require ACLs, other reference points, and accountability measures.

~~(1) *Introduction*. Magnuson-Stevens Act section 303(a)(2) requires that an FMP contain, among other things, a description of the species of fish involved in the fishery. The relevant Council determines which specific target stocks and/or non-target stocks to include in a fishery. This section provides that a Council may, but is not required to, use an "ecosystem component (EC)" species classification. As a default, all stocks in an FMP are considered to be "in the fishery," unless they are identified as EC species (see § 600.310(d)(5)) through an FMP amendment process.~~

~~(2) *Stocks in a fishery*. Stocks in a fishery may be grouped into stock complexes, as appropriate. Requirements for reference points and management measures for these stocks are described throughout these guidelines.~~

~~(3) "Target stocks" are stocks that fishers seek to catch for sale or personal use, including "economic discards" as defined under Magnuson-Stevens Act section 3(9).~~

~~(4) "Non-target species" and "non-target stocks" are fish caught incidentally during the pursuit of target stocks in a fishery, including "regulatory discards" as defined under Magnuson-Stevens Act section 3(38). They may or may not be retained for sale or personal use. Non-target species may be included in a fishery and, if so, they should be identified at the stock level. Some non-target species may be identified in an FMP as ecosystem component (EC) species or stocks.~~

(5) *Ecosystem component (EC) species.*

(i) To be considered for possible classification as an EC species, the species should:

(A) Be a non-target species or non-target stock;

(B) Not be determined to be subject to overfishing, approaching overfished, or overfished;

(C) Not be likely to become subject to overfishing or overfished, according to the best available information, in the absence of conservation and management measures; and

(D) Not generally be retained for sale or personal use.

(ii) Occasional retention of the species would not, in and of itself, preclude consideration of the species under the EC classification. In addition to the general factors noted in paragraphs (d)(5)(i)(A)-(D) of this section, it is important to consider whether use of the EC species classification in a given instance is consistent with MSA conservation and management requirements.

(iii) EC species may be identified at the species or stock level, and may be grouped into complexes. EC species may, but are not required to, be included in an FMP or FMP amendment for any of the following reasons: For data collection purposes; for ecosystem considerations related to specification of OY for the associated fishery; as considerations in the development of conservation and management measures for the associated fishery; and/or to address other ecosystem issues. While EC species are not considered to be "in the fishery," a Council should consider measures for the fishery to minimize bycatch and bycatch mortality of EC species consistent with National Standard 9, and to protect their associated role in the ecosystem. EC species do not require specification of reference points but should be monitored to the extent that any new pertinent scientific information becomes available (e.g., catch trends, vulnerability, etc.) to determine changes in their status or their vulnerability to the fishery. If necessary, they should be reclassified as "in the fishery."

(6) *Reclassification.* A Council should monitor the catch resulting from a fishery on a regular basis to determine if the stocks and species are appropriately classified in the FMP. If the criteria previously used to classify a stock or species is no longer valid, the Council should reclassify it through an FMP amendment, which documents rationale for the decision.

(7) *Stocks or species identified in more than one FMP.* If a stock is identified in more than one fishery, Councils should choose which FMP will be the primary FMP in which management objectives, SDC, the stock's overall ACL and other reference points for the stock are established. Conservation and management measures in other FMPs in which the stock is identified as part of a fishery should be consistent with the primary FMP's management objectives for the stock.

(8) *Stock complex.* "Stock complex" means a group of stocks that are sufficiently similar in geographic distribution, life history, and vulnerabilities to the fishery such that the impact of management actions on the stocks is similar.

(2) *Stock complex.* Stocks that require conservation and management can be grouped into stock complexes. A "stock complex" is a tool to manage a group of stocks within a FMP.

(i) At the time a stock complex is established, the FMP should provide, to the extent practicable, a full and explicit description of the proportional composition of each stock in the stock complex, to the extent possible.. Stocks may be grouped into complexes for various reasons, including where stocks in a multispecies fishery cannot be targeted independent of one another and MSY cannot be defined on a stock-by-stock basis (*see* paragraph (e)(1)(iii) of this section);; where there is insufficient data to measure theira stock's status relative to SDC; or when it is not feasible for fishermen to distinguish individual stocks among their catch. Where practicable, the group of stocks should have a similar geographic distribution, life history characteristics, and vulnerabilities to fishing pressure such that the impact of management actions on the stocks is similar. The vulnerability of individual stocks to the fishery should be evaluatedconsidered when determining if a particular stock complex should be established or reorganized, or if a particular stock should be included in a complex. Stock complexes may be comprised of: one or more indicator stocks, each of which has SDC and ACLs, and several other stocks; several stocks without an indicator stock, with SDC and an ACL for the complex as a whole; or one of more indicator stocks, each of which has SDC and management objectives, with an ACL for the complex as a whole (this situation might be applicable to some salmon species).

(9) ii) *Indicator stocks.*

(A) An indicator stock is a stock with measurable and objective SDC that can be used to help manage and evaluate more poorly known stocks that are in a stock complex.

(B) Where practicable, stock complexes should include one or more indicator stocks (each of which has SDC and ACLs). Otherwise, stock complexes may be comprised of: several stocks without an indicator stock (with SDC and an ACL for the complex as a whole), or one or more indicator stocks (each of which has SDC and management objectives) with an ACL for the complex as a whole (this situation might be applicable to some salmon species). Councils should review the available quantitative or qualitative information (e.g., catch trends, changes in vulnerability, fish health indices, etc.) of stocks within a complex on a regular basis to determine if they are being sustainably managed.

(C) If an indicator stock is used to evaluate the status of a complex, it should be representative of the typical ~~status~~vulnerability of ~~each stock~~stocks within the complex~~, due to similarity in vulnerability.~~. If the stocks within a stock complex have a wide range of vulnerability, they should be reorganized into different stock complexes that have similar vulnerabilities; otherwise the indicator stock should be chosen to represent the more vulnerable stocks within the complex. In instances where an indicator stock is less vulnerable than other members of the complex, management measures ~~need to~~should be more conservative so that the more vulnerable members of the complex are not at risk from the fishery.

(D) More than one indicator stock can be selected to provide more information about the status of the complex. ~~When indicator stock(s) are used, periodic re-evaluation of available quantitative or qualitative information (e.g., catch trends, changes in vulnerability, fish health indices, etc.) is needed to determine whether a stock is subject to overfishing, or is approaching (or in) an overfished condition.~~

(E) When indicator stocks are used, the stock complex's MSY could be listed as "unknown," while noting that the complex is managed on the basis of one or more indicator stocks that do have known stock-specific MSYs, or suitable proxies, as described in paragraph (e)(1)(iv) of this section.

~~(10) *Vulnerability.* A stock's vulnerability is a combination of its productivity, which depends upon its life history characteristics, and its susceptibility to the fishery. Productivity refers to the capacity of the stock to produce MSY and to recover if the population is depleted, and susceptibility is the potential for the stock to be impacted by the fishery, which includes direct captures, as well as indirect impacts to the fishery (e.g., loss of habitat quality). Councils in consultation with their SSCs, should analyze the vulnerability of stocks in stock complexes where possible.~~

(e) *Features of MSY, SDC, and OY—*

(1) *MSY.* Each FMP must include an estimate of MSY for the stocks and stock complexes ~~in~~that require conservation and management. MSY may also be specified for the fishery~~,~~ as ~~described in paragraph (d)(2) of this section),~~a whole.

(i) *Definitions.*

(A) *MSY* is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological, environmental conditions and fishery technological characteristics (e.g., gear selectivity), and the distribution of catch among fleets.

(B) *MSY fishing mortality rate* (F_{msy}) is the fishing mortality rate that, if applied over the long term, would result in MSY.

(C) *MSY stock size* (B_{msy}) means the long-term average size of the stock or stock complex, measured in terms of spawning biomass or other appropriate measure of the stock's reproductive potential that would be achieved by fishing at Fmsy.

(ii) *MSY for stocks.* MSY should be estimated for each stock based on the best scientific information available (see § 600.315).

(iii) *MSY for stock complexes.* When stock complexes are used, MSY should be estimated ~~on a stock-by-stock basis whenever possible. However, where MSY cannot be estimated for each stock in a stock complex, then MSY may be estimated~~ for one or more indicator stocks ~~for the complex~~ or for the complex as a whole (see paragraph (d)(2)(ii)). ~~When indicator stocks are used, the stock complex's MSY could be listed as "unknown," while noting that the complex is managed on~~

~~the basis of one or more indicator stocks that do have known stock-specific MSYs, or suitable proxies, as described in paragraph (e)(1)(iv) of this section.~~ ~~When indicator stocks are not used, MSY, or a suitable proxy, should be calculated for the stock complex as a whole.~~

(iv) *Methods of estimating MSY for an aggregate group of stocks.* Estimating MSY for an aggregate group of stocks (including stock complexes and the fishery as a whole) can be done using models that account for multi-species interactions, composite properties for a group of similar species, common biomass (energy) flow and production patterns, or other relevant factors (see paragraph (e)(3)(iv)(C) of this section).

(~~iv)~~ v) *Specifying MSY.*

(A) Because MSY is a long-term average, it need not be estimated annually, ~~but it must be based on the best scientific information available (see § 600.315),~~ and should be re-estimated as required by changes in long-term environmental or ecological conditions, fishery technological characteristics, or new scientific information.

(B) When data are insufficient to estimate MSY directly, Councils should adopt other measures of reproductive potential~~, based on the best scientific information available,~~ that can serve as reasonable proxies for MSY, F_{msy}, and B_{msy}~~, to the extent possible.~~.

(C) The MSY for a stock or stock complex is influenced by its interactions with other stocks in its ecosystem and these interactions may shift as multiple stocks in an ecosystem are fished. ~~These ecological conditions~~Ecological and environmental information should be taken into account, to the extent ~~possible~~practicable, when assessing stocks and specifying MSY. Ecological ~~conditions~~and environmental information that is not directly accounted for in the specification of MSY can be among the ecological factors considered when setting OY below MSY.

(D) As MSY values are estimates or are based on proxies, they will have some level of uncertainty associated with them. The degree of uncertainty in the estimates should be identified, when ~~possible~~practicable, through the stock assessment process and peer review (see §~~600.335),~~ 600.335), and should be taken into account when specifying the ABC Control rule (see paragraph (f)(2) of this section). ~~Where uncertainty cannot be directly calculated, such as when proxies are used, then a proxy for the uncertainty itself should be established based on the best scientific information, including comparison to other stocks.~~

(2) *Status determination criteria—*

(i) *Definitions.*

(A) *Status determination criteria* (*SDC*) mean the ~~quantifiable~~measurable and objective factors, MFMT, OFL, and MSST, or their proxies, that are used to determine if overfishing has occurred, or if the stock or stock complex is overfished. Magnuson-Stevens Act (section 3(34)) defines both "overfishing" and "overfished" to mean a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the MSY on a continuing basis. To avoid confusion, this section clarifies that "overfished" relates to biomass of a stock or stock complex, and "overfishing" pertains to a rate or level of removal of fish from a stock or stock complex.

(B) *Overfishing* ~~(to overfish)~~ occurs whenever a stock or stock complex is subjected to a level of fishing mortality or ~~annual~~ total catch that jeopardizes the capacity of a stock or stock complex to produce MSY on a continuing basis.

(C) *Maximum fishing mortality threshold* (*MFMT*) means the level of fishing mortality (F)~~, on an annual basis,~~ above which overfishing is occurring. The MFMT or reasonable proxy may be expressed either as a single number (a fishing mortality rate or F value), or as a function of spawning biomass or other measure of reproductive potential.

(D) *Overfishing limit* (*OFL*) means the annual amount of catch that corresponds to the estimate of MFMT applied to a stock or stock complex's abundance and is expressed in terms of numbers or weight of fish. ~~The OFL is an estimate of the catch level above which overfishing is occurring.~~

(E) *Overfished.* A stock or stock complex is considered "overfished" when its biomass has declined below MSST.~~a level that jeopardizes the capacity of the stock or stock complex to produce MSY on a continuing basis.~~

(F) *Depleted*. An overfished stock or stock complex is considered depleted when it has not experienced overfishing at any point over a period of two generation times of the stock and its biomass has declined below MSST, or when a rebuilding stock or stock complex has reached its targeted time to rebuild and the stock's biomass has shown no significant signs of growth despite being fished at or below catch levels that are consistent with the rebuilding plan throughout that period (see paragraphs (j)(3)(i)(B)(2)(i) and (j)(6) of this section).

(~~F~~G) *Minimum stock size threshold* (*MSST*) means the level of biomass below which the capacity of the stock or stock complex ~~is considered~~ to ~~be overfished~~produce MSY on a continuing basis has been jeopardized.

(~~G)~~ H) *Approaching an overfished condition.* A stock or stock complex is approaching an overfished condition when it is projected that there is more than a 50 percent chance that the biomass of the stock or stock complex will decline below the MSST within two years.

(ii) *Specification of SDC and overfishing and overfished determinations.* Each FMP must describe how objective and measurable SDCs will be specified, as described in paragraphs (e)(2)(ii)(A) and (B) of this section. To be measurable and objective, SDC must be expressed in a way that enables the Council to monitor the status of each stock or stock complex in the FMP~~, and determine annually, if possible, whether~~. Applying the SDC set forth in the FMP, the Secretary determines if overfishing is occurring and whether the stock or stock complex is overfished~~.~~ (Magnuson-Stevens Act section 304(e)). SDCs are often based on fishing rates or biomass levels associated with MSY or MSY based proxies. When data are not available to specify SDCs based on MSY or MSY proxies, alternative types of SDCs that promote sustainability of the stock or stock complex can be used. For example, SDC could be based on recent average catch, fish densities derived from visual census surveys, length/weight frequencies or other methods. In specifying SDC, a Council must provide an analysis of how the SDC were chosen and how they relate to reproductive potential~~. Each FMP must specify, to the extent possible, objective and measurable SDC as follows (*see* paragraphs (e)(2)(ii)(A) and (B) of this section):~~ of stocks of fish within the fishery. If alternative types of SDCs are used, the Council should explain how the approach will promote sustainability of the stock or stock complex on a long term basis. A Council should consider a process that allows SDCs to be quickly updated to reflect the best scientific information available. In the case of internationally-managed stocks, the Council may decide to use the SDCs defined by the relevant international body. In this instance, the SDCs should allow the Council to monitor the status of a stock or stock complex, recognizing that the SDCs may not be defined in such a way that a Council could monitor the MFMT, OFL, or MSST as would be done with a domestically managed stock or stock complex.

(A) *SDC to D~~d~~etermine O~~o~~verfishing S~~s~~tatus.* ~~Each FMP must describe which of the following two methods will be used for each stock or stock complex to determine an overfishing status.~~ Each FMP must describe the method used to determine the overfishing status for each stock or stock complex. For domestically-managed stocks or stocks complexes, one of the following methods should be used:

(1) Fishing M~~m~~ortality R~~r~~ate E~~e~~xceeds MFMT. Exceeding the MFMT for a period of 1 year or ~~more~~exceeding a multi-year mortality reference point constitutes overfishing. ~~The MFMT or reasonable proxy may be expressed either as a single number (a fishing mortality rate or F value), or as a function of spawning biomass or other measure of reproductive potential.~~

(2) Catch E~~e~~xceeds the OFL. ~~Should the annual catch exceed~~Exceeding the annual OFL for 1 year or ~~more, the stock or stock complex is considered subject to~~exceeding a multi-year catch reference point constitutes overfishing.

(3) Use of Multi-Year Periods to Determine Overfishing Status. A multi-year period may not exceed three years. A Council may develop overfishing SDCs that use a multi-year approach, so long as it provides a comprehensive analysis based on the best scientific information available that supports that the approach will not jeopardize the capacity of the fishery to produce MSY on a continuing basis. A Council should identify in its FMP or FMP amendment circumstances

in which the multi-year approach should not be used (e.g., because the capacity of the stock to produce MSY over the longer term could be jeopardized).

(B) *SDC to determine overfished status.* The MSST or reasonable proxy must be expressed in terms of spawning biomass or other measure of reproductive potential. ~~To the extent possible, the MSST should equal whichever of the following is greater: One-half the MSY stock size, or the minimum stock size at which rebuilding to the MSY level would be expected to occur within 10 years, if the stock or stock complex were exploited at the MFMT specified under paragraph (e)(2)(ii)(A)(1) of this section. Should the estimated size of the stock or stock complex in a given year fall below this threshold, the stock or stock complex is considered overfished.~~ MSST should be between ½ B_{msy} and B_{msy}, and could be informed by the life history of the stock, the natural fluctuations in biomass associated with fishing at MFMT over the long-term, the time needed to rebuild to B_{msy} and associated social and/or economic impacts on the fishery, the requirements of internationally-managed stocks, or other considerations.

(C) Where practicable, all sources of mortality including that resulting from bycatch, scientific research catch, and all fishing activities should be accounted for in the evaluation of stock status with respect to reference points.

(iii) *Relationship of SDC to environmental and habitat change*. Some short-term environmental changes can alter the size of a stock or stock complex without affecting its long-term reproductive potential. Long-term environmental changes affect both the short-term size of the stock or stock complex and the long-term reproductive potential of the stock or stock complex.

(A) If environmental changes cause a stock or stock complex to fall below its MSST without affecting its long-term reproductive potential, fishing mortality must be constrained sufficiently to allow rebuilding within an acceptable time frame (see also ~~see~~ paragraph (j)(3)(~~ii~~ii) of this section). SDC should not be respecified.

(B) If environmental, ecosystem, or habitat changes affect the long-term reproductive potential of the stock or stock complex, one or more components of the SDC must be respecified. Once SDC have been respecified, fishing mortality may or may not have to be reduced, depending on the status of the stock or stock complex with respect to the new criteria.

(C) If manmade environmental changes are partially responsible for a stock or stock complex's biomass being ~~in an overfished condition~~below MSST, in addition to controlling fishing mortality, Councils should recommend restoration of habitat and other ameliorative programs, to the extent possible (see also the guidelines issued pursuant to section 305(b) of the Magnuson-Stevens Act for Council actions concerning essential fish habitat).

(iv) *Secretarial approval of SDC*. Secretarial approval or disapproval of proposed SDC will be based on consideration of whether the proposal:

(A) ~~Has sufficient~~ Is based on the best scientific ~~merit~~information available;

(B) Contains the elements described in paragraph (e)(2)(ii) of this section;

(C) Provides a basis for objective measurement of the status of the stock or stock complex against the criteria; and

(D) ~~is~~Is operationally feasible.

(3) *Optimum yield*—For stocks that require conservation and management, OY may be established at the stock, ~~or~~ stock complex, ~~level, or~~ at the ~~at the~~ fishery level.

(i) *Definitions*—

(A) *Optimum yield (OY).* Magnuson-Stevens Act section (3)(33) defines "optimum," with respect to the yield from a fishery, as the amount of fish that will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities and taking into account the protection of marine ecosystems; that is prescribed on the basis of the MSY from the fishery, as reduced by any relevant economic, social, or ecological factor; and, in the case of an overfished fishery, that provides for rebuilding to a level consistent with producing the MSY in such fishery. ~~OY may be established at the stock or stock complex level, or at the fishery level.~~

(B) In NS1, use of the phrase "achieving, on a continuing basis, the optimum yield from each fishery" means: producing, from each stock, stock complex, or fishery~~: a long-term~~

series, an amount of catches suchcatch that theis, on average catch is, equal to the Council's specified OY,; prevents overfishing is prevented,; maintains the long term average biomass is near or above Bmsy,; and rebuilds overfished stocks and stock complexes are rebuilt consistent with timing and other requirements of section 304(e)(4) of the Magnuson-Stevens Act and paragraph (j) of this section.

(ii) *General*. OY is a long-term average amount of desired yield from a stock, stock complex, or fishery. An FMP must contain conservation and management measures, including ACLs and AMs, to achieve OY on a continuing basis, and provisions for information collection that are designed to determine the degree to which OY is achieved. These measures should allow for practical and effective implementation and enforcement of the management regime. The Secretary has an obligation to implement and enforce the FMP. If management measures prove unenforceable—or too restrictive, or not rigorous enough to prevent overfishing while achieving on a continuing basis OY—they should be modified; an alternative is to reexamine the adequacy of the OY specification to ensure that the dual requirements of NS1 are met (preventing overfishing while achieving, on a continuing basis, OY). Exceeding OY does not necessarily constitute overfishing. However, even if no overfishing resulted from exceeding OY, continual harvest at a level above OY would violate NS1, because OY was not achieved on a continuing basis.

(iii) *Assessing OY.* An FMP must contain an assessment and specification of OY, includingwhich documents how the OY will produce the greatest benefits to the nation and prevent overfishing. The assessment should include a summary of information utilized in making such specification, consistent with requirements of section 303(a)(3) of the Magnuson-Stevens Act. A Council must identify those and consideration of the economic, social, and ecological factors relevant to management of a particular stock, stock complex, or fishery, and then evaluate them to determine the. Consistent with Magnuson-Stevens Act section 302(h)(5), the assessment and specification of OY. The choice of a particular OY must should be carefully documented to showreviewed on a continuing basis, so that the OY selected will produceit is responsive to changing circumstances in the greatest benefit to the Nation and prevent overfishingfishery.

(iii) A) *Determining the greatest benefit to the Nation.* In determining the greatest benefit to the Nation, the values that should be weighed and receive serious attention when considering the economic, social, or ecological factors used in reducing MSY, or its proxy, to obtain OY are:

(A) *1)* The benefits of food production are derived from providing seafood to consumers; maintaining an economically viable fishery together with its attendant contributions to the national, regional, and local economies; and utilizing the capacity of the Nation's fishery resources to meet nutritional needs.

(B) 2) The benefits of recreational opportunities reflect the quality of both the recreational fishing experience and non-consumptive fishery uses such as ecotourism, fish watching, and recreational diving. Benefits also include the contribution of recreational fishing to the national, regional, and local economies and food supplies.

(C) 3) The benefits of protection afforded to marine ecosystems are those resulting from maintaining viable populations (including those of unexploited species), maintaining adequate forage for all components of the ecosystem, maintaining evolutionary and ecological processes (e.g., disturbance regimes, hydrological processes, nutrient cycles), maintaining productive habitat, maintaining the evolutionary potential of species and ecosystems, and accommodating human use.

(iv) B) *Economic, Ecological, and Social Factors.* Factors to consider in OY specification. Councils should consider the management objectives of their FMPs and their management framework to determine the relevant social, economic, and ecological factors used to determine OY. There will be inherent trade-offs when determining the objectives of the fishery.

Because fisheries have limited capacities, any attempt to maximize the measures of benefits described in paragraph (e)(3)(iii) of this section will inevitably encounter practical constraints. OY cannot exceed MSY in any circumstance, and must take into

~~account the need to prevent overfishing and rebuild overfished stocks and stock complexes. OY is prescribed on the basis of MSY as reduced by social, economic, and ecological factors. To the extent possible, the relevant social, economic, and ecological factors used to establish OY for a stock, stock complex, or fishery should be quantified and reviewed in historical, short-term, and long-term contexts. Even where quantification of social, economic, and ecological factors is not possible, the FMP still must address them in its OY specification.~~ The following is a non-exhaustive list of potential considerations for ~~each factor. An FMP must address each factor but not necessarily each example.~~social, economic, and ecological factors.

(~~A)~~ *1) Social factors.* Examples are enjoyment gained from recreational fishing, avoidance of gear conflicts and resulting disputes, preservation of a way of life for fishermen and their families, and dependence of local communities on a fishery (e.g., involvement in fisheries and ability to adapt to change). Consideration may be given to fishery-related indicators (e.g., number of fishery permits, number of commercial fishing vessels, number of party and charter trips, landings, ex-vessel revenues etc.) and non-fishery related indicators (e.g., unemployment rates, percent of population below the poverty level, population density, etc.)~~.~~, and preference for a particular type of fishery (e.g., size of the fishing fleet, type of vessels in the fleet, permissible gear types). Other factors that may be considered include the effects that past harvest levels have had on fishing communities, the cultural place of subsistence fishing, obligations under Indian treaties, proportions of affected minority and low-income groups, and worldwide nutritional needs.

(~~B)~~ 2) Economic factors. Examples are prudent consideration of the risk of overharvesting when a stock's size or reproductive potential is uncertain (see § 600.335(c)(2)(i)), satisfaction of consumer and recreational needs, and encouragement of domestic and export markets for U.S. harvested fish. Other factors that may be considered include: the value of fisheries, the level of capitalization, the decrease in cost per unit of catch afforded by an increase in stock size, the attendant increase in catch per unit of effort, alternate employment opportunities, and economic contribution to fishing communities, coastal areas, affected states, and the nation.

(~~C)~~ 3) Ecological factors. Examples include impacts on ecosystem component species, forage fish stocks, other fisheries, predator-prey or competitive interactions, marine mammals, threatened or endangered species, and birds. Species interactions that have not been explicitly taken into account when calculating MSY should be considered as relevant factors for setting OY below MSY. In addition, consideration should be given to managing forage stocks for higher biomass than Bmsy to enhance and protect the marine ecosystem. Also important are ecological or environmental conditions that stress marine organisms or their habitat, such as natural and manmade changes in wetlands or nursery grounds, and effects of pollutants on habitat and stocks.

~~(v) *Specification of OY.*~~ (iv) *Specifying OY.* ~~The specification of OY must be consistent with paragraphs (e)(3)(i) (iv) of this section.~~ If the estimates of MFMT and current biomass are known with a high level of certainty and management controls can accurately limit catch, then OY could be set very close to MSY, assuming no other reductions are necessary for social, economic, or ecological factors. To the degree that such MSY estimates and management controls are lacking or unavailable, OY should be set farther from MSY. ~~If management measures cannot adequately control fishing mortality so that the specified OY can be achieved without overfishing, the Council should reevaluate the management measures and specification of OY so that the dual requirements of NS1 (preventing overfishing while achieving, on a continuing basis, OY) are met.~~

(A) The ~~amount of fish that constitutes the~~ OY ~~should~~can be expressed in terms of numbers or weight of fish~~.~~

~~(B) Either a range or~~, and either as a single value or a range. When it is not possible to specify OY quantitatively, OY may be ~~specified for OY.~~described qualitatively.

~~(C) All catch must be counted against OY, including that resulting from bycatch, scientific research, and all fishing activities.~~

~~(D) The OY specification should be translatable into an annual numerical estimate for the purposes of establishing any total allowable level of foreign fishing (TALFF) and analyzing impacts of the management regime.~~

~~(E)~~ (B) The determination of OY is based on MSY, directly or through proxy. However, even where sufficient scientific data as to the biological characteristics of the stock do not exist, or where the period of exploitation or investigation has not been long enough for adequate understanding of stock dynamics, or where frequent large-scale fluctuations in stock size diminish the meaningfulness of the MSY concept, OY must still be established based on the best scientific information available.

(~~F)~~ C) An OY established at a fishery level may not exceed the sum of the MSY values for each of the stocks or stock complexes within the fishery. Aggregate level MSY estimates could be used as a basis for specifying OY for the fishery (see paragraph (e)(1)(iv) of this section). When aggregate level MSY is estimated, single stock MSY estimates can also be used to inform single stock management. For example, OY could be specified for a fishery, while other reference points are specified for individual stocks in order to prevent overfishing on each stock within the fishery.

~~(G) There should be a mechanism in the FMP for periodic reassessment of the OY specification, so that it is responsive to changing circumstances in the fishery.~~

~~(H) Part of the OY may be held as a reserve to allow for factors such as uncertainties in estimates of stock size and domestic annual harvest (DAH). If an OY reserve is established, an adequate mechanism should be included in the FMP to permit timely release of the reserve to domestic or foreign fishermen, if necessary.~~

(D) For internationally-managed stocks, fishing levels that are agreed upon by the U.S. at the international level are consistent with achieving OY.

(v~~i~~) *OY and foreign fishing*. Section 201(d) of the Magnuson-Stevens Act provides that fishing by foreign nations is limited to that portion of the OY that will not be harvested by vessels of the United States. The FMP must include an assessment to address the following, as required by section 303(a)(4) of the Magnuson-Stevens Act:

(A) The OY specification is the basis for establishing any total allowable level of foreign fishing (TALFF).

(B) Part of the OY may be held as a reserve to allow for ~~factors such as uncertainties in estimates of stock size and~~ domestic annual harvest (DAH). If an OY reserve is established, an adequate mechanism should be included in the FMP to permit timely release of the reserve to domestic or foreign fishermen, if necessary.

(~~A~~C) *DAH*. Councils and/or the Secretary must consider the capacity of, and the extent to which, U.S. vessels will harvest the OY on an annual basis. Estimating the amount that U.S. fishing vessels will actually harvest is required to determine the surplus.

(~~B)~~ D) *Domestic annual processing (DAP)*. Each FMP must assess the capacity of U.S. processors. It must also assess the amount of DAP, which is the sum of two estimates: The estimated amount of U.S. harvest that domestic processors will process, which may be based on historical performance or on surveys of the expressed intention of manufacturers to process, supported by evidence of contracts, plant expansion, or other relevant information; and the estimated amount of fish that will be harvested by domestic vessels, but not processed (e.g., marketed as fresh whole fish, used for private consumption, or used for bait).

(~~C)~~ E) *Joint venture processing (JVP)*. When DAH exceeds DAP, the surplus is available for JVP.

(f) *Acceptable biological catch~~,~~ and annual catch limits~~, and annual catch targets~~*. ~~The following features (see paragraphs (f)(1) through (f)(5) of this section) of acceptable biological catch and annual catch limits apply to stocks and stock complexes in the fishery (see paragraph (d)(2) of this section).~~

~~(1) *Introduction*. A control rule is a policy for establishing a limit or target fishing level that is based on the best available scientific information and is established by fishery managers in consultation with fisheries scientists. Control rules should be designed so that management actions become more conservative as biomass estimates, or other proxies, for a stock or stock complex decline and as science and management~~

~~uncertainty increases. Examples of scientific uncertainty include uncertainty in the estimates of MFMT and biomass. Management uncertainty may include late catch reporting, misreporting, and underreporting of catches and is affected by a fishery's ability to control actual catch. For example, a fishery that has inseason catch data available and inseason closure authority has better management control and precision than a fishery that does not have these features.~~

(1)~~(2)~~*Definitions.*

(i) *Catch* is the total quantity of fish, measured in weight or numbers of fish, taken in commercial, recreational, subsistence, tribal, and other fisheries. Catch includes fish that are retained for any purpose, as well as mortality of fish that are discarded.

(ii) *Acceptable biological catch (ABC)* is a level of a stock or stock complex's annual catch, which is based on an ABC control rule that accounts for the scientific uncertainty in the estimate of OFL ~~and~~, any other scientific uncertainty ~~(see paragraph (f)(3) of this section), and should be specified based on the ABC control rule~~, and the Council's risk policy.

~~(iii) *ABC control rule* means a specified approach to setting the ABC for a stock or stock complex as a function of the scientific uncertainty in the estimate of OFL and any other scientific uncertainty (*see* paragraph (f)(4) of this section).~~

(i~~i~~ii~~v~~) *Annual catch limit (ACL)* is a limit on the ~~level of~~total annual catch of a stock or stock complex, which cannot exceed the ABC, that serves as the basis for invoking AMs. ~~ACL cannot exceed the ABC, but~~ An ACL may be divided into sector-ACLs (see paragraph (f)(~~5~~4) of this section).

~~(v) *Annual catch target (ACT)* is an amount of annual catch of a stock or stock complex that is the management target of a fishery, and accounts for management uncertainty in controlling the actual catch at or below the ACL. ACTs are recommended in the system of accountability measures so that ACL is not exceeded.~~

~~(vi) *ACT control rule* means a specified approach to setting the ACT for a stock or stock complex such that the risk of exceeding the ACL due to management uncertainty is at an acceptably low level.~~

(iv) *Control rule* is a policy for establishing a limit or target catch level that is based on the best scientific information available and is established by the Council in consultation with its SSC.

(v) *Management uncertainty* refers to uncertainty in the ability of managers to constrain catch so that the ACL is not exceeded, and the uncertainty in quantifying the true catch amounts (i.e., estimation errors). The sources of management uncertainty could include: late catch reporting; misreporting; underreporting of catches; lack of sufficient inseason management, including inseason closure authority; or other factors.

(vi) *Scientific uncertainty* refers to uncertainty in the information about a stock and its reference points. Sources of scientific uncertainty could include: uncertainty in stock assessment results; uncertainty in the estimates of MFMT, MSST, the biomass of the stock, and OFL; time lags in updating assessments; the degree of retrospective revision of assessment results; uncertainty in projections; uncertainties due to the choice of assessment model; longer-term uncertainties due to potential ecosystem and environmental effects; or other factors.

(2) *ABC control rule.—*

(i) For stocks and stock complexes required to have an ABC, each Council must establish an ABC control rule that accounts for scientific uncertainty in the OFL and the Council's risk policy. The Council's risk policy could be based, on an acceptable probability (at least 50 percent) that catch equal to the stock's ABC will not result in overfishing, but other appropriate methods can be used. When determining the risk policy, Councils could consider the economic, social, and ecological trade-offs between being more or less risk averse. The Council's choice of a risk policy cannot result in an ABC that exceeds the OFL. The process of establishing an ABC control rule may~~could also~~ involve science advisors or the peer review process established under Magnuson-Stevens Act section 302(g)(1)(E).

(ii) The ABC control rule must articulate how ABC will be set compared to the OFL based on the scientific knowledge about the stock or stock complex and taking into account scientific uncertainty (see paragraph (f)(1)(vi) of this section).

The ABC control rule should consider reducing fishing mortality as stock size declines below B_{msy} and as scientific uncertainty increases, and may establish a stock abundance level below which directed fishing would not be allowed. When~~re~~ scientific uncertainty cannot be directly

calculated, such as when proxies are used, then a proxy for the uncertainty itself should be established based on the best scientific information, including comparison to other stocks. The control rule may be used in a tiered approach to address different levels of scientific uncertainty. Councils can develop ABC control rules that allow for changes in catch limits to be phased-in over time or to account for the carry-over of some of the unused portion of the ACL from one year to the next; in which case, the Council must provide a comprehensive analysis and articulate within their FMP when the control rule can and cannot be used and how the control rule prevents overfishing.

(A) *Phase-in ABC control rules*. Large changes in catch limits due to new scientific information about the status of the stock can have negative short-term effects on a fishing industry. To help stabilize catch levels as stock assessments are updated, a Council may choose to develop a control rule that phases in changes to ABC over a period of time, not to exceed 3 years, as long as overfishing is prevented.

(B) *Carry-over ABC control rules*. An ABC control rule may include provisions for carry-over of some of the unused portion of the ACL from one year to increase the ABC for the next year, based on the increased stock abundance resulting from the fishery harvesting less than the full ACL. The resulting ABC recommended by the SSC must prevent overfishing and consider scientific uncertainty consistent with the Council's risk policy. In cases where an ACL has been reduced from the ABC, carry-over provisions may not require the ABC to be re-specified if the ACL can be adjusted upwards so that it is equal to or below the existing ABC.

(3) *Specification of ABC*. ABC may not exceed OFL (see paragraph (e)(2)(i)(D) of this section). Councils and their SSC should develop a process ~~for receiving~~by which the SSC can access the best scientific information ~~and advice used to establish ABC. This process should: Identify the body that will apply~~available regarding implementation of the ABC control rule ~~(*i.e.*, calculates the ABC), and identify the review process that will evaluate the resulting ABC. The SSC must recommend the ABC to the Council.~~. An SSC may recommend an ABC that differs from the result of the ABC control rule calculation, based on factors such as data uncertainty, recruitment variability, declining trends in population variables, and other factors, but must ~~explain why.~~provide an explanation for the deviation. For Secretarial FMPs or ~~FMP~~ amendments, agency scientists or a peer review process would provide the scientific advice to establish ABC. For internationally-assessed stocks, an ABC as defined in these guidelines is not required if ~~they meet~~stocks fall under the international exception (see paragraph (h)(~~2~~1)(ii)~~).~~ of this section). While the ABC is allowed to equal OFL, NMFS expects that in most cases ABC will be reduced from OFL to reduce the probability that overfishing might occur in a year. ~~Also, *see* paragraph (f)(5) of this section for cases where a Council recommends that ACL is equal to ABC, and ABC is equal to OFL.~~

(i) *Expression of ABC*. ABC should be expressed in terms of catch, but may be expressed in terms of landings as long as estimates of bycatch and any other fishing mortality not accounted for in the landings are incorporated into the determination of ABC.

(ii) *ABC for overfished stocks*. For overfished stocks and stock complexes, a rebuilding ABC must be set to reflect the annual catch that is consistent with the schedule of fishing mortality rates (i.e., $F_{rebuild}$) in the rebuilding plan.

~~(4) *ABC control rule*. For stocks and stock complexes required to have an ABC, each Council must establish an ABC control rule based on scientific advice from its SSC. The determination of ABC should be based, when possible, on the probability that an actual catch equal to the stock's ABC would result in overfishing. This probability that overfishing will occur cannot exceed 50 percent and should be a lower value. The ABC control rule should consider reducing fishing mortality as stock size declines and may establish a stock abundance level below which fishing would not be allowed. The process of establishing an ABC control rule could also involve science advisors or the peer review process established under Magnuson-Stevens Act section 302(g)(1)(E). The ABC control rule must articulate how ABC will be set compared to the OFL based on the scientific knowledge about the stock or stock complex and the scientific uncertainty in the estimate of OFL and any other scientific uncertainty. The ABC control rule should consider uncertainty in factors such as stock assessment results, time lags in updating assessments, the degree of retrospective revision of assessment results, and projections. The control rule may be used in a tiered approach to address different levels of scientific uncertainty.~~

(~~4~~5) Setting the annual catch limit—

(i) *General*. ACL cannot exceed the ABC and may be set annually or on a multiyear plan basis. ACLs in coordination with AMs must prevent overfishing (see MSA section 303(a)(15)). If an annual catch target (ACT) is not used, management uncertainty should be accounted for in the ACL. If a Council recommends an ACL which equals ABC, and the ABC is equal to OFL, the Secretary may presume that the proposal would not prevent overfishing, in the absence of sufficient analysis and justification for the approach. A "multiyear plan" as referenced in section 303(a)(15) of the Magnuson-Stevens Act is a plan that establishes harvest specifications or harvest guidelines for each year of a time period greater than 1 year. A multiyear plan must include a mechanism for specifying ACLs for each year with appropriate AMs to prevent overfishing and maintain an appropriate rate of rebuilding if the stock or stock complex is in a rebuilding plan. A multiyear plan must provide that, if an ACL is exceeded for a year, then AMs are ~~triggered~~implemented for the next year consistent with paragraph (g)(3) of this section.

(ii) *Sector-ACLs*. A Council may, but is not required to, divide an ACL into sector-ACLs. If sector-ACLs are used, sector-AMs should also be specified. "Sector," for purposes of this section, means a distinct user group to which separate management strategies and separate catch quotas apply. Examples of sectors include the commercial sector, recreational sector, or various gear groups within a fishery. If the management measures for different sectors differ in the degree of management uncertainty, then sector-ACLs may be necessary so that appropriate AMs can be developed for each sector. If a Council chooses to use sector-ACLs, the sum of sector-ACLs must not exceed the stock or stock complex level ACL. The system of ACLs and AMs designed must be effective in protecting the stock or stock complex as a whole. Even if sector-ACLs and AMs are established, additional AMs at the stock or stock complex level may be necessary.

(iii) *ACLs for State-Federal Fisheries*. For stocks or stock complexes that have harvest in state or territorial waters, FMPs and FMP amendments should include an ACL for the overall stock that may be further divided. For example, the overall ACL could be divided into a Federal-ACL and state-ACL. However, NMFS recognizes that Federal management is limited to the portion of the fishery under Federal authority ~~(*see* paragraph (g)(5) of this section)~~. See 16 U.S.C. 1856. When stocks are co-managed by Federal, state, tribal, and/or territorial fishery managers, the goal should be to develop collaborative conservation and management strategies, and scientific capacity to support such strategies (including AMs for state or territorial and Federal waters), to prevent overfishing of shared stocks and ensure their sustainability.

(iv) *Relationship between OY and the ACL framework*. The dual goals of NS1 are to prevent overfishing and achieve on a continuing basis OY. The ABC is an upper limit on catch and is designed to prevent overfishing. As described in paragraph (e)(3) of this section, ecological, economic, and social factors, as well as values associated with determining the greatest benefit to the Nation, are important considerations in specifying OY. These OY considerations can also be considered in the ACL framework. For example, an ACL (or ACT) could be set lower than the ABC to account for OY considerations (e.g., needs of forage fish, promoting stability, addressing market conditions, etc.). Additionally, economic, social, or ecological trade-offs could be evaluated when determining the risk policy for an ABC control rule (see paragraph (f)(2) of this section). While OY is a long-term average amount of desired yield, there is, for each year, an amount of fish that is consistent with achieving the long-term OY. A Council can choose to express OY on an annual basis, in which case the FMP or FMP amendment should indicate that the OY is an "annual OY." An annual OY cannot exceed the ACL.

~~(6) *ACT control rule*. If ACT is specified as part of the AMs for a fishery, an ACT control rule is utilized for setting the ACT. The ACT control rule should clearly articulate how management uncertainty in the amount of catch in the fishery is accounted for in setting ACT. The objective for establishing the ACT and related AMs is that the ACL not be exceeded.~~

~~(i) *Determining management uncertainty*. Two sources of management uncertainty should be accounted for in establishing the AMs for a fishery, including the ACT control rule if utilized: Uncertainty in the ability of managers to constrain catch so the ACL is not exceeded, and uncertainty in quantifying the true catch amounts (*i.e.*, estimation errors). To determine the level of management uncertainty in controlling catch, analyses need to consider past management performance in the fishery and factors such as time lags in reported catch. Such analyses must be based on the best available scientific information from an SSC, agency scientists, or peer review process as appropriate.~~

~~(ii) *Establishing tiers and corresponding ACT control rules.* Tiers can be established based on levels of management uncertainty associated with the fishery, frequency and accuracy of catch monitoring data available, and risks of exceeding the limit. An ACT control rule could be established for each tier and have, as appropriate, different formulas and standards used to establish the ACT.~~

~~(7) A Council may choose to use a single control rule that combines both scientific and management uncertainty and supports the ABC recommendation and establishment of ACL and if used ACT.~~

(g) *Accountability measures* *(AMs)*. ~~The following features (see paragraphs (g)(1) through (5) of this section) of accountability measures apply to those stocks and stock complexes in the fishery.~~

(1) *Introduction*. AMs are management controls to prevent ACLs, including sector-ACLs, from being exceeded, and to correct or mitigate overages of the ACL if they occur. AMs should address and minimize both the frequency and magnitude of overages and correct the problems that caused the overage in as short a time as possible. NMFS identifies two categories of AMs, inseason AMs and AMs for when the ACL is exceeded. The FMP should identify what sources of data will be used to implement AMs (e.g., inseason data, annual catch compared to the ACL, or multi-year averaging approach).

(2) *Inseason AMs*. Whenever possible, FMPs should include inseason monitoring and management measures to prevent catch from exceeding ACLs. Inseason AMs could include, but are not limited to: ~~ACT;~~an annual catch target (see paragraph (g)(4) of this section); closure of a fishery; closure of specific areas; changes in gear; changes in trip size or bag limits; reductions in effort; or other appropriate management controls for the fishery. If final data or data components of catch are delayed, Councils should make appropriate use of preliminary data, such as landed catch, in implementing inseason AMs. FMPs should contain inseason closure authority giving NMFS the ability to close fisheries if it determines, based on data that it deems sufficiently reliable, that an ACL has been exceeded or is projected to be reached, and that closure of the fishery is necessary to prevent overfishing. For fisheries without inseason management control to prevent the ACL from being exceeded, AMs should utilize ACTs that are set below ACLs so that catches do not exceed the ACL.

(3) *AMs for when the ACL is exceeded*. On an annual basis, the Council must determine as soon as possible after the fishing year if an ACL was exceeded. If an ACL was exceeded, AMs must be ~~triggered and~~ implemented as soon as possible to correct the operational issue that caused the ACL overage, as well as any biological consequences to the stock or stock complex resulting from the overage when it is known. These AMs could include, among other things, modifications of inseason AMs, the use or modification of ACTs, or overage adjustments. The type of AM chosen by a Council will likely vary depending on the sector of the fishery, status of the stock, the degree of the overage, recruitment patterns of the stock, or other pertinent information. If an ACL is set equal to zero and the AM for the fishery is a closure that prohibits fishing for a stock, additional AMs are not required if only small amounts of catch or bycatch occur, and the catch or bycatch is unlikely to result in overfishing. For stocks and stock complexes in rebuilding plans, the AMs should include overage adjustments that reduce the ACLs in the next fishing year by the full amount of the overage~~s~~, unless the best scientific information available shows that a reduced overage adjustment, or no adjustment, is needed to mitigate the effects of the overage~~s~~. ~~If catch exceeds the ACL for a given stock or stock complex more than once in the last four years, the system of ACLs and AMs should be re-evaluated, and modified if necessary, to improve its performance and effectiveness. A Council could choose a higher performance standard (e.g., a stock's catch should not exceed its ACL more often than once every five or six years) for a stock that is particularly vulnerable to the effects of overfishing, if the vulnerability of the stock has not already been accounted for in the ABC control rule.~~

(4) *Annual Catch Target (ACT) and ACT control rule*. ACTs are recommended in the system of AMs~~accountability measures~~ so that ACL is not exceeded. An ACT is an amount of annual catch of a stock or stock complex that is the management target of a fishery, and accounts for management uncertainty in controlling the ~~actual~~ catch at or below the ACL. ACT control rules can be used to articulate how management uncertainty is accounted for in setting the ACT. ACT control rules can be developed by the Council, in coordination with the SSC, to help the Council account for management uncertainty.

(5~~4~~) *AMs based on multi-year average data*. Some fisheries have highly variable annual catches and lack reliable inseason or annual data on which to base AMs. If there are insufficient data upon which to compare catch to ACL, ~~either inseason or on an annual basis,~~ AMs could be based on comparisons of average catch to average ACL over a three-year moving average period or, if supported by analysis, some other appropriate multi-year period. Councils should explain why basing AMs on a multi-year period is

appropriate. Evaluation of the moving average catch to the average ACL must be conducted annually, and ~~AMs should be implemented~~ if the average catch exceeds the average ACL, appropriate AMs should be implemented consistent with paragraph (g)(3) of this section. ~~As a performance standard, if the average catch exceeds the average ACL for a stock or stock complex more than once in the last four years, then the system of ACLs and AMs should be re-evaluated and modified if necessary to improve its performance and effectiveness. The initial ACL and management measures may incorporate information from previous years so that AMs based on average ACLs can be applied from the first year. Alternatively, a Council could use a stepped approach where in year 1, catch is compared to the ACL for year 1; in year 2 the average catch for the past 2 years is compared to the average ACL; then in year 3 and beyond, the most recent 3 years of catch are compared to the corresponding ACLs for those years.~~

(~~6~~5) *AMs for State-Federal Fisheries*. For stocks or stock complexes that have harvest in state or territorial waters, FMPs and FMP amendments must, at a minimum, have AMs for the portion of the fishery under Federal authority. Such AMs could include closing the EEZ when the Federal portion of the ACL is reached, or the overall stock's ACL is reached, or other measures.

(7) *Performance Standard*. If catch exceeds the ACL for a given stock or stock complex more than once in the last four years, the system of ACLs and AMs should be re-evaluated, and modified if necessary, to improve its performance and effectiveness. If AMs are based on multi-year average data, the performance standard is based on a comparison of the average catch to the average ACL. A Council could choose a higher performance standard (e.g., a stock's catch should not exceed its ACL more often than once every five or six years) for a stock that is particularly vulnerable to the effects of overfishing, if the vulnerability of the stock has not already been accounted for in the ABC control rule.

(h) *Establishing ACL mechanisms and AMs in FMPs*. FMPs or FMP amendments must establish ACL mechanisms and AMs for all stocks and stock complexes ~~in the fishery,~~that require conservation and management (see § 600.305(c)), unless paragraph (h)(~~2~~1) of this section is applicable. These mechanisms should describe the annual or multiyear process by which ~~specific~~ ACLs, AMs, and other reference points such as OFL, and ABC will be established. ~~If a complex has multiple indicator stocks, each indicator stock must have its own ACL; an additional ACL for the stock complex as a whole is optional. In cases where fisheries (e.g., Pacific salmon) harvest multiple indicator stocks of a single species that cannot be distinguished at the time of capture, separate ACLs for the indicator stocks are not required and the ACL can be established for the complex as a whole.~~

~~(1) In establishing ACL mechanisms and AMs, FMPs should describe:~~

~~(i) Timeframes for setting ACLs (e.g., annually or multi-year periods);~~

~~(ii) Sector ACLs, if any (including set-asides for research or bycatch);~~

~~(iii) AMs and how AMs are triggered and what sources of data will be used (e.g., inseason data, annual catch compared to the ACL, or multi-year averaging approach); and~~

~~(iv) Sector AMs, if there are sector ACLs.~~

(~~1~~2) Exceptions from ACL and AM requirements—

(i) *Life cycle*. Section 303(a)(15) of the Magnuson-Stevens Act "shall not apply to a fishery for species that has a life cycle of approximately 1 year unless the Secretary has determined the fishery is subject to overfishing of that species" (as described in Magnuson-Stevens Act section 303 note). This exception applies to a stock for which the average ~~length~~age of ~~time it takes for an individual to produce a reproductively active offspring~~spawners in the population is approximately 1 year ~~and that the individual has only one breeding season in its lifetime.~~or less. While exempt from the ACL and AM requirements, FMPs or FMP amendments for these stocks must have SDC, MSY, OY, ABC, and an ABC control rule.

(ii) *International fishery agreements*. Section 303(a)(15) of the Magnuson-Stevens Act applies "unless otherwise provided for under an international agreement in which the United States participates" (Magnuson-Stevens Act section 303 note). This exception applies to stocks or stock complexes subject to management under an international agreement, which is defined as "any bilateral or multilateral treaty, convention, or agreement which relates to fishing and to which the United States is a party" (see Magnuson-Stevens Act section 3(24)). These stocks would still need to have SDC, MSY, and ~~MSY~~OY.

(~~2~~3) *Flexibility in application of NS1 guidelines*. There are limited circumstances that may not fit the standard approaches to specification of reference points and management measures set forth in these guidelines. These include, among other things, conservation and management of Endangered Species Act listed species, harvests from aquaculture operations, ~~and~~ stocks with unusual life history characteristics (e.g., Pacific salmon, where the spawning potential ~~for a stock~~ is ~~spread over a multi-~~concentrated in one

year period).), and stocks for which data are not available either to set reference points based on MSY or MSY proxies, or manage to reference points based on MSY or MSY proxies. In these circumstances, Councils may propose alternative approaches for satisfying the NS1 requirements of the Magnuson-Stevens Act other than those set forth in these guidelines. Councils must document their rationale for any alternative approaches for these limited circumstances in an FMP or FMP amendment, which will be reviewed for consistency with the Magnuson-Stevens Act.

(i) *Fisheries data*. In their FMPs, or associated public documents such as SAFE reports as appropriate, Councils must describe general data collection methods, as well as any specific data collection methods used for all stocks in the fishery, and EC speciesstock complexes in their FMPs, including:

(1) Sources of fishing mortality (both landed and discarded), including commercial and recreational catch and bycatch in other fisheries;

(2) Description of the data collection and estimation methods used to quantify total catch mortality in each fishery, including information on the management tools used (i.e., logbooks, vessel monitoring systems, observer programs, landings reports, fish tickets, processor reports, dealer reports, recreational angler surveys, or other methods); the frequency with which data are collected and updated; and the scope of sampling coverage for each fishery; and

(3) Description of the methods used to compile catch data from various catch data collection methods and how those data are used to determine the relationship between total catch at a given point in time and the ACL for stocks and stock complexes that are part of a fisheryrequire conservation and management.

(j) *Council actions to address overfishing and rebuilding for stocks and stock complexes in the fishery*—

(1) *Notification*. The Secretary will immediately notify in writing a Regional Fishery Management Council whenever it is determined that:

(i) Overfishing is occurring;

(ii) A stock or stock complex is overfished;

(iii) A stock or stock complex is approaching an overfished condition; or

(iv) Existing remedial action taken for the purpose of ending previously identified overfishing or rebuilding a previously identified overfished stock or stock complex has not resulted in adequate progress.

(2) *Timing of actions*—

(i) *If a stock or stock complex is undergoing overfishing*. Upon notification that a stock or stock complex is undergoing overfishing, a Council should immediately begin working with its SSC (or agency scientists or peer review processes in the case of Secretarially-managed fisheries) to ensure that the ABC is set appropriately to end overfishing. Councils should evaluate the cause of overfishing, address the issue that caused overfishing, and reevaluate their ACLs and AMs to make sure they are adequate. FMPs or FMP amendments must establish ACL and AM mechanisms in 2010, for stocks and stock complexes determined to be subject to overfishing, and in 2011, for all other stocks and stock complexes (*see* paragraph (b)(2)(iii) of this section). To address practical implementation aspects of the FMP and FMP amendment process, paragraphs (j)(2)(i)(A) through (C) of this section clarifies the expected timing of actions.

(A) In addition to establishing ACL and AM mechanisms, the ACLs and AMs themselves must be specified in FMPs, FMP amendments, implementing regulations, or annual specifications beginning in 2010 or 2011, as appropriate.

(B) For stocks and stock complexes still determined to be subject to overfishing at the end of 2008, ACL and AM mechanisms and the ACLs and AMs themselves must be effective in fishing year 2010.

(C) For stocks and stock complexes determined to be subject to overfishing during 2009, ACL and AM mechanisms and ACLs and AMs themselves should be effective in fishing year 2010, if possible, or in fishing year 2011, at the latest.

(ii) *If a stock or stock complex is overfished or approaching an overfished condition*. (A) For notifications Upon notification that a stock or stock complex is overfished or approaching an overfished condition made before July 12, 2009, a Council must prepare an FMP, FMP amendment, or proposed regulations within one year of notification. If the stock or stock complex is overfished, the purpose of the action is to specify a time period for ending overfishing and rebuilding the stock or stock complex that will be as short as possible as described under section 304(e)(4) of the Magnuson-Stevens Act. If the stock or stock complex is approaching an overfished condition, the purpose of the action is to prevent the biomass from declining below the

~~MSST.(B) For notifications that a stock or stock complex is overfished or approaching an overfished condition made after July 12, 2009~~, a Council must prepare and implement an FMP, FMP amendment, or proposed regulations within two years of notification, consistent with the requirements of section 304(e)(3) of the Magnuson-Stevens Act. Council actions should be submitted to NMFS within 15 months of notification to ensure sufficient time for the Secretary to implement the measures, if approved. ~~If the stock or stock complex is overfished and overfishing is occurring, the rebuilding plan must end overfishing immediately and be consistent with ACL and AM requirements of the Magnuson-Stevens Act.~~

(3) *Overfished fishery*.—

(i) Where a stock or stock complex is overfished, a Council must specify a time period for rebuilding the stock or stock complex based on factors specified in Magnuson-Stevens Act section 304(e)(4). This target time for rebuilding (T_{target}) shall be as short as possible, taking into account: ~~The~~the status and biology of any overfished stock, the needs of fishing communities, recommendations by international organizations in which the U.S. participates, and interaction of the stock within the marine ecosystem. In addition, the time period shall not exceed 10 years, except where biology of the stock, other environmental conditions, or management measures under an international agreement to which the U.S. participates, dictate otherwise. SSCs (or agency scientists or peer review processes in the case of Secretarial actions) shall provide recommendations for achieving rebuilding targets (see Magnuson-Stevens Act section 302(g)(1)(B)). The above factors enter into the specification of Ttarget as follows:

(A) *The ~~"~~minimum time for rebuilding a stock~~"~~ (Tmin).* T_{min} means the amount of time the stock or stock complex is expected to take to rebuild to its MSY biomass level in the absence of any fishing mortality. In this context, the term "expected" means to have at least a 50 percent probability of attaining the Bmsy~~.~~, where such probabilities can be calculated. The starting year for the T_{min} calculation should be the first year that the rebuilding plan is expected to be implemented.

~~(B) For scenarios under paragraph (j)(2)(ii)(A) of this section, the starting year for the T_{min} calculation is the first year that a rebuilding plan is implemented. For scenarios under paragraph (j)(2)(ii)(B) of this section, the starting year for the T_{min} calculation is 2 years after notification that a stock or stock complex is overfished or the first year that a rebuilding plan is implemented, whichever is sooner.~~

(B) *The maximum time for rebuilding a stock or stock complex to its B_{msy} (T_{max}).*

(*1~~C~~*) If T_{min} for the stock or stock complex is 10 years or less, then ~~the maximum time allowable for rebuilding (T_{max}) that stock to its B_{msy}~~ is 10 years.

(*2~~D~~*) If T_{min} for the stock or stock complex exceeds 10 years, then ~~the maximum time allowable for rebuilding a stock or stock complex~~one of the following methods can be used to ~~its B_{msy} is~~determine T_{max}:

(i) T_{min} plus the length of time associated with one generation time for that stock or stock complex. "Generation time" is the average length of time between when an individual is born and the birth of its offspring~~.~~.

(ii) The amount of time the stock or stock complex is expected to take to rebuild to B_{msy} if fished at 75 percent of MFMT, or

(iii) T_{min} multiplied by two.

(3) When selecting a method for determining T_{max}, a Council must provide a rationale for its decision based on the best scientific information available.

~~(E) T_{target} shall not exceed T_{max}, and should be calculated based on the factors described in paragraph (j)(3).~~

(C) Target time to rebuilding a stock or stock complex (T_{target}). T_{target} is the specified time period for rebuilding a stock that is considered to be in as short a time as possible, while taking into account the factors described in paragraph (j)(3)(i) of this section. T_{target} shall not exceed T_{max}, and the fishing mortality associated with achieving T_{target} is referred to as $F_{rebuild}$.

~~(ii) If a stock or stock complex reached the end of its rebuilding plan period and has not yet been determined to be rebuilt, then the rebuilding F should not be increased until the stock or stock complex has been demonstrated to be rebuilt. If the rebuilding plan was based on a T_{target} that was less than T_{max}, and the stock or stock complex is not rebuilt by T_{target}, rebuilding measures should~~

~~be revised, if necessary, such that the stock or stock complex will be rebuilt by T_{max}. If the stock or stock complex has not rebuilt by T_{max}, then the fishing mortality rate should be maintained at $F_{rebuild}$ or 75 percent of the MFMT, whichever is less.~~

(ii~~i~~) Council action addressing an overfished fishery must allocate both overfishing restrictions and recovery benefits fairly and equitably among sectors of the fishery.

(ii~~i~~v) For fisheries managed under an international agreement, Council action addressing an overfished fishery must reflect traditional participation in the fishery, relative to other nations, by fishermen of the United States.

(iv) *Adequate Progress.* The Secretary shall review rebuilding plans at routine intervals that may not exceed two years to determine whether the plans have resulted in adequate progress toward ending overfishing and rebuilding affected fish stocks (MSA section 304(e)(7)). Such reviews could include the review of recent stock assessments, comparisons of catches to the ACL, or other appropriate performance measures. The Secretary may find that adequate progress is not being made if $F_{rebuild}$ or the ACL associated with $F_{rebuild}$ are exceeded, and AMs are not correcting the operational issue that caused the overage and addressing any biological consequences to the stock or stock complex resulting from the overage when it is known (see paragraph (g)(3) of this section). A lack of adequate progress may also be found when the rebuilding expectations of a stock or stock complex are significantly changed due to new and unexpected information about the status of the stock. If a determination is made under this provision, the Secretary will notify the appropriate Council and recommend further conservation and management measures, and the Council must develop and implement a new or revised rebuilding plan within two years (see MSA sections 304(e)(3) and (e)(7)(B)). For Secretarially-managed fisheries, the Secretary would take immediate action necessary to achieve adequate progress toward ending overfishing and rebuilding.

(v) While a stock or stock complex is rebuilding, revising rebuilding timeframes (i.e., T_{target} and T_{max}) or $F_{rebuild}$ is not necessary, unless the Secretary finds that adequate progress is not being made.

(vi) If a~~the~~ stock or stock complex has not rebuilt by T_{max}, then the fishing mortality rate should be maintained at its current $F_{rebuild}$ or 75 percent of the MFMT, whichever is less, until the stock or stock complex is rebuilt or the Secretary finds that adequate progress in not being made.

(4) *Emergency actions and interim measures.* ~~The Secretary, on his/her own initiative or in response to a Council request, may implement interim measures to reduce overfishing or promulgate regulations to address an emergency (Magnuson-Stevens Act section 304(e)(6) or 305(c)). In considering a Council request for action, the Secretary would consider, among other things, the need for and urgency of the action and public interest considerations, such as benefits to the stock or stock complex and impacts on participants in the fishery.~~ If a Council is developing a rebuilding plan or revising an existing rebuilding plan due to a lack of adequate progress (see MSA section 304(e)(7)), the Secretary may, in response to a Council request, implement interim measures that reduce, but do not necessarily end, overfishing (see MSA section 304(e)(6)) if all of the following criteria are met:

(i) The interim measures are needed to address an unanticipated and significantly changed understanding of the status of the stock or stock complex;

(ii) Ending overfishing immediately is expected to result in severe social and/or economic impacts to a fishery; and

(iii) The interim measures will ensure that the stock or stock complex will increase its current biomass through the duration of the interim measures.

~~(i) These measures may remain in effect for not more than 180 days, but may be extended for an additional 186 days if the public has had an opportunity to comment on the measures and, in the case of Council-recommended measures, the Council is actively preparing an FMP, FMP amendment, or proposed regulations to address the emergency or overfishing on a permanent basis.~~

~~(ii) Often, these measures need to be implemented without prior notice and an opportunity for public comment, as it would be impracticable to provide for such processes given the need to act quickly and also contrary to the public interest to delay action. However, emergency regulations and interim measures that do not qualify for waivers or exceptions under the Administrative Procedure Act would need to follow proposed notice and comment rulemaking procedures.~~

(5) *Discontinuing a rebuilding plan based on new scientific information*. A Council may discontinue a rebuilding plan for a stock or stock complex before it reaches B_{msy}, if all of the following criteria are met:

(i) The Secretary determines that the stock was not overfished in the year that the overfished determination (see MSA section 304(e)(3)) was based on; and

(ii) The biomass of the stock is not currently below the MSST.

(6) *Management measures for depleted stocks*. In cases where an overfished stock or stock complex is considered to be "depleted" (see paragraph (e)(2)(i)(F)), a Council may identify in its rebuilding plan additional management measures or initiatives that could improve the status of the stock, such as: reevaluating SDCs to determine if they are representative of current environmental conditions, recommending the restoration of habitat and other ameliorative programs, identifying research priorities to improve the Councils understanding of the impediments to rebuilding, or partnering with Federal and state agencies to address non-fishing related impacts.

(k) *International overfishing*. If the Secretary determines that a fishery is overfished or approaching a condition of being overfished due to excessive international fishing pressure, and for which there are no management measures (or no effective measures) to end overfishing under an international agreement to which the United States is a party, then the Secretary and/or the appropriate Council shall take certain actions as provided under Magnuson-Stevens Act section 304(i). The Secretary, in cooperation with the Secretary of State, must immediately take appropriate action at the international level to end the overfishing. In addition, within one year after the determination, the Secretary and/or appropriate Council shall:

(1) Develop recommendations for domestic regulations to address the relative impact of the U.S. fishing vessels on the stock. Council recommendations should be submitted to the Secretary.

(2) Develop and submit recommendations to the Secretary of State, and to the Congress, for international actions that will end overfishing in the fishery and rebuild the affected stocks, taking into account the relative impact of vessels of other nations and vessels of the United States on the relevant stock. Councils should, in consultation with the Secretary, develop recommendations that take into consideration relevant provisions of the Magnuson-Stevens Act and NS1 guidelines, including section 304(e) of the Magnuson-Stevens Act and paragraph (j)(3)(~~iv~~iii) of this section, and other applicable laws. For highly migratory species in the Pacific, recommendations from the Western Pacific, North Pacific, or Pacific Councils must be developed and submitted consistent with Magnuson-Stevens Reauthorization Act section 503(f), as appropriate.

(3) *Considerations for assessing "relative impact."* "Relative impact" under paragraphs (k)(1) and (2) of this section may include consideration of factors that include, but are not limited to: Domestic and international management measures already in place, management history of a given nation, estimates of a nation's landings or catch (including bycatch) in a given fishery, and estimates of a nation's mortality contributions in a given fishery. Information used to determine relative impact must be based upon the best available scientific information.

(l) *Relationship of National Standard 1 to other national standards— General*. National Standards 2 through 10 provide further requirements for conservation and management measures in FMPs~~, but do not alter the requirement of NS1 to prevent overfishing and rebuild overfished stocks~~ (see MSA section 301(a)), and guidelines for these standards are provided in §§ 600.315 – 600.355. Below is a description of how some of the other National Standards intersect with National Standard 1.

(1) *National Standard 2* (see § 600.315). Management measures and reference points to implement NS1 must be based on the best scientific information available. When data are insufficient to estimate reference points directly, Councils should develop reasonable proxies to the extent possible (also ~~*see*paragraph~~see paragraph (e)(1)(~~iv~~v)(B) of this section). In cases where scientific data are severely limited, effort should also be directed to identifying and gathering the needed data. SSCs should advise their Councils regarding the best scientific information available for fishery management decisions.

(2) *National Standard 3* (see § 600.320). Reference points should generally be specified in terms of the level of stock aggregation for which the best scientific information is available (also see ~~paragraph (e)(1)(iii) of this section). Also, scientific assessments must be based on the best information about the total range of the stock and potential biological structuring of the stock into biological sub-units, which may differ from the geographic units on which management is feasible.~~paragraphs (e)(1)(ii) and (iii) of this section).

(3) *National Standard 6* (see § 600.335). Councils must build into the reference points and control rules appropriate consideration of risk, taking into account uncertainties in estimating harvest, stock conditions, life history parameters, or the effects of environmental factors.

(4) *National Standard 8* (see § 600.345). National Standard 8 ~~directs the Councils to apply~~addresses economic and social ~~factors towards sustained participation of fishing communities~~considerations and minimizing to the extent practicable~~, minimize~~ adverse economic impacts on ~~such~~fishing communities within the context of preventing overfishing and rebuilding overfished stocks as required under National Standard 1. ~~Therefore, calculation~~ Calculation of OY as reduced from MSY ~~should include~~also includes consideration of economic and social factors, but the combination of management measures chosen to achieve the OY must principally be designed to prevent overfishing and rebuild overfished stocks.

(5) *National Standard 9* (see § 600.350). Evaluation of stock status with respect to reference points must take into account mortality caused by bycatch. In addition, the estimation of catch should include the mortality of fish that are discarded.

(m) *Exceptions to requirements to prevent overfishing*. Exceptions to the requirement to prevent overfishing could apply under certain limited circumstances. Harvesting one stock at its optimum level may result in overfishing of another stock when the two stocks tend to be caught together (This can occur when the two stocks are part of the same fishery or if one is bycatch in the other's fishery). Before a Council may decide to allow this type of overfishing, an analysis must be performed and the analysis must contain a justification in terms of overall benefits, including a comparison of benefits under alternative management measures, and an analysis of the risk of any stock or stock complex falling below its MSST. The Council may decide to allow this type of overfishing if the fishery is not overfished and the analysis demonstrates that all of the following conditions are satisfied:

(1) Such action will result in long-term net benefits to the Nation;

(2) Mitigating measures have been considered and it has been demonstrated that a similar level of long-term net benefits cannot be achieved by modifying fleet behavior, gear selection/configuration, or other technical characteristic in a manner such that no overfishing would occur; and

(3) The resulting rate of fishing mortality will not cause any stock or stock complex to fall below its MSST more than 50 percent of the time in the long term, although it is recognized that persistent overfishing is expected to cause the affected stock to fall below its Bmsy more than 50 percent of the time in the long term.

§ 600.320 National Standard 3—Management Units.

(a) *Standard 3*. To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.
(b) *General*. The purpose of this standard is to induce a comprehensive approach to fishery management. The geographic scope of the fishery, for planning purposes, should cover the entire range of the stocks(s) of fish, and not be overly constrained by political boundaries. Wherever practicable, an FMP should seek to manage interrelated stocks of fish.
(c) *Unity of management*. Cooperation and understanding among entities concerned with the fishery (e.g., Councils, states, Federal Government, international commissions, foreign nations) are vital to effective management. Where management of a fishery involves multiple jurisdictions, coordination among the several entities should be sought in the development of an FMP. Where a range overlaps Council areas, one FMP to cover the entire range is preferred. The Secretary designates which Council(s) will prepare the FMP~~, under~~ (see section 304(f) of the Magnuson-Stevens Act~~.~~).
(d) *Management unit*. The term "management unit" means a fishery or that portion of a fishery identified in an FMP as relevant to the FMP's management objectives. Stocks in the fishery management unit are considered to be in need of conservation and management (see § 600.305(c)).

(1) *Basis*. The choice of a management unit depends on the focus of the FMP's objectives, and may be organized around biological, geographic, economic, technical, social, or ecological perspectives. ~~For example:~~

~~(i) *Biological*—could be based on a stock(s) throughout its range.~~
~~(ii) *Geographic*—could be an area.~~
~~(iii) *Economic*—could be based on a fishery supplying specific product forms.~~
~~(iv) *Technical*—could be based on a fishery utilizing a specific gear type or similar fishing practices.~~
~~(v) *Social*—could be based on fishermen as the unifying element, such as when the fishermen pursue different species in a regular pattern throughout the year.~~
~~(vi) *Ecological*—could be based on species that are associated in the ecosystem or are dependent on a particular habitat.~~

(2) *Conservation and management measures*. FMPs should include conservation and management measures for that part of the management unit within U.S. waters, although the Secretary can ordinarily implement them only within the EEZ. The measures need not be identical for each geographic area within the management unit, if the FMP justifies the differences. A management unit may contain~~, in addition to regulated species,~~ stocks of fish for which there is not enough information available to specify MSY and OY or ~~to establish management measures, so that data on these species may be collected under the FMP.~~their proxies.

(e) *Analysis*. ~~To document that an~~An FMP ~~is as comprehensive as practicable, it~~ should include ~~discussions~~discussion of the following:

(1) The range and distribution of the stocks, as well as the patterns of fishing effort and harvest.
(2) Alternative management units and reasons for selecting a particular one. A less-than-comprehensive management unit may be justified if, for example, complementary management ~~exits~~exists or is planned for a separate geographic area or for a distinct use of the stocks, or if the unmanaged portion of the resource is immaterial to proper management.
(3) Management activities and habitat programs of adjacent states and their effects on the FMP's objectives and management measures. Where state action is necessary to implement measures within state waters to achieve FMP objectives, the FMP should identify what state action is necessary, discuss the consequences of state inaction or contrary action, and make appropriate recommendations. The FMP should also discuss the impact that Federal regulations will have on state management activities.
(4) Management activities of other countries having an impact on the fishery, and how the FMP's management measures are designed to take into account these impacts. International boundaries may be dealt with in several ways. For example:

(i) By limiting the management unit's scope to that portion of the stock found in U.S. waters;
(ii) By estimating MSY for the entire stock and then basing the determination of OY for the U.S. fishery on the portion of the stock within U.S. waters; or
(iii) By referring to treaties or cooperative agreements.

§ 600.340 National Standard 7—Costs and Benefits.

(a) *Standard 7*. Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

~~(b) *Necessity of Federal management.*~~

~~(1) *General*. The principle that not every fishery needs regulation is implicit in this standard. The Magnuson-Stevens Act requires Councils to prepare FMPs only for overfished fisheries and for other fisheries where regulation would serve some useful purpose and where the present or future benefits of regulation would justify the costs. For example, the need to collect data about a fishery is not, by itself, adequate justification for preparation of an FMP, since there are less costly ways to gather the data (see § 600.320(d)(2). In some cases, the FMP preparation process itself, even if it does not culminate in a document approved by the Secretary, can be useful in supplying a basis for management by one or more coastal states.~~

~~(2) *Criteria*. In deciding whether a fishery needs management through regulations implementing an FMP, the following general factors should be considered, among others:~~

~~(i) The importance of the fishery to the Nation and to the regional economy.~~

~~(ii) The condition of the stock or stocks of fish and whether an FMP can improve or maintain that condition.~~

~~(iii) The extent to which the fishery could be or is already adequately managed by states, by state/Federal programs, by Federal regulations pursuant to FMPs or international commissions, or by industry self-regulation, consistent with the policies and standards of the Magnuson-Stevens Act.~~

~~(iv) The need to resolve competing interests and conflicts among user groups and whether an FMP can further that resolution.~~

~~(v) The economic condition of a fishery and whether an FMP can produce more efficient utilization.~~

~~(vi) The needs of a developing fishery, and whether an FMP can foster orderly growth.~~

~~(vii) The costs associated with an FMP, balanced against the benefits (see paragraph (d) of this section as a guide).~~

(b~~e~~) *Alternative management measures*. Management measures should not impose unnecessary burdens on the economy, on individuals, on private or public organizations, or on Federal, state, or local governments. Factors such as fuel costs, enforcement costs, or the burdens of collecting data may well suggest a preferred alternative.

(c~~d~~) *Analysis*. The supporting analyses for FMPs should demonstrate that the benefits of fishery regulation are real and substantial relative to the added research, administrative, and enforcement costs, as well as costs to the industry of compliance. In determining the benefits and costs of management measures, each management strategy considered and its impacts on different user groups in the fishery should be evaluated. This requirement need not produce an elaborate, formalistic cost/benefit analysis. Rather, an evaluation of effects and costs, especially of differences among workable alternatives, including the status quo, is adequate. If quantitative estimates are not possible, qualitative estimates will suffice.

(1) *Burdens*. Management measures should be designed to give fishermen the greatest possible freedom of action in conducting business and pursuing recreational opportunities that are consistent with ensuring wise use of the resources and reducing conflict in the fishery. The type and level of burden placed on user groups by the regulations need to be identified. Such an examination should include, for example: Capital outlays; operating and maintenance costs; reporting costs; administrative, enforcement, and information costs; and prices to consumers. Management measures may shift costs from one level of government to another, from one part of the private sector to another, or from the government to the private sector. Redistribution of costs through regulations is likely to generate controversy. A discussion of these and any other burdens placed on the public through FMP regulations should be a part of the FMP's supporting analyses.

(2) *Gains*. The relative distribution of gains may change as a result of instituting different sets of alternatives, as may the specific type of gain. The analysis of benefits should focus on the specific gains produced by each alternative set of management measures, including the status quo. The benefits to society that result from the alternative management measures should be identified, and the level of gain assessed.

Back to Agenda

Framework Action to Eliminate Permit Decals for For-Hire Vessels in the Gulf of Mexico

Including Regulatory Impact Review and Regulatory Flexibility Act Analysis

Abbreviated Framework Action to the Fishery Management Plans for Reef Fish and Coastal Migratory Pelagics in the Gulf of Mexico

March 2015

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ABBREVIATED FRAMEWORK ACTION TO ELIMINATE PERMIT DECALS FOR FOR-HIRE VESSELS IN THE GULF OF MEXICO

Including Regulatory Impact Review and Regulatory Flexibility Act Analysis

Type of Action

( ) Administrative ( ) Legislative
(X) Draft ( ) Final

Responsible Agencies:

National Marine Fisheries Service
(Lead Agency)
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701
727-824-5305
727-824-5308 (fax)
http://sero.nmfs.noaa.gov
Contact: Susan Gerhart
Susan.Gerhart@noaa.gov

Gulf of Mexico Fishery Management Council
2203 North Lois Avenue, Suite 1100
Tampa, Florida 33607
813-348-1630
813-348-1711 (fax)
http://www.gulfcouncil.org
Contact: Ryan Rindone
Ryan.Rindone@gulfcouncil.org

ABBREVIATIONS USED IN THIS DOCUMENT

CMP	Coastal Migratory Pelagics
Council	Gulf of Mexico Fishery Management Council
EEZ	exclusive economic zone
GMFMC	Gulf of Mexico Fishery Management Council
Gulf	Gulf of Mexico
IRFA	Initial Regulatory Flexibility Analysis
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
RA	Regional Administrator
RFA	Regulatory Flexibility Act
RIR	Regulatory Impact Review
SEFSC	Southeast Fisheries Science Center
SERO	Southeast Regional Office of NMFS
SRHS	Southeast Regional Headboat Survey

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CHAPTER 1. INTRODUCTION

1.1 Purpose and Need

The purpose of this proposed action is to consider eliminating the requirement to carry decals for vessels with federal charter vessel and headboat permits in the Gulf of Mexico (Gulf) exclusive economic zone (EEZ). The need for this proposed action is to alleviate unnecessary permit compliance burdens on fishermen, enforcement burdens on law enforcement officers, and administrative burdens and costs on the permit issuing agency.

1.2 Background

Gulf federal permits are required for charter vessels and headboats (Gulf for-hire permits) to take passengers that pay a fee and wish to retain species managed under the coastal migratory pelagic (CMP) and reef fish fishery management plans. Gulf for-hire permits were initially required for the CMP fishery in 1987 and for the reef fish fishery in 1997. Reef Fish Amendment 20/CMP Amendment 14 (GMFMC 2003) established a three-year moratorium on these permits effective June 16, 2003. Reef Fish Amendment 25/CMP Amendment 17 (GMFMC 2005) created an indefinite limited access program for for-hire vessels effective June 15, 2006. Regulations require a permit vessel decal be displayed on the port side of the deckhouse or hullfor all vessels with a Gulf for-hire permit.

The National Marine Fisheries Service (NMFS) Permits Office requested the Gulf of Mexico Fishery Management Council (Council) to consider if these decals are necessary. Reasons for removing the requirement for the vessel decals are:

- the decals are affixed permanently to the vessels but the permits are transferable;
- currently, permit numbers for both fisheries are included on one decal, creating problems if only one permit is transferred;
- the permit numbers on the decals are printed in size 14 font, and are practically illegible unless on board the vessel;
- the color codes are a function of issue date and not expiration date, so multiple colors are valid at any given time; and
- the cost of issuing the decals includes the cost of the stickers ($2/sticker, approximately 2,000 per year), the cost/maintenance of a special printer (to add specific permit numbers), and staff time.

The NMFS Office of Law Enforcement representatives have indicated that the vessel decals are of limited use for enforcement purposes. Additionally, although the vessel decals are intended to be permanent, the permits themselves are transerfable between vessels, which could render an individual vessel decal on a vessel inaccurate. This issue is further exacerbated by the fact that a decal may contain more than one permit number and, if one of those permit numbers is transferred to another vessel, then the whole decal becomes inaccurate. Lastly, due to the nature of being offshore in salt water, the vessel decals tend to fade with time, and become largely illegible unless one is in very close proximity to the vessel.

At its June 2014 meeting, the Council reviewed the utility of the vessel decals. The Council ultimately decided to convene the Law Enforcement Advisory Panel to discuss whether the decals were of use to law enforcement officers and, if the decals were eliminated, what effect such an action might have on the enforcement of fisheries regulations. The Law Enforcement Advisory Panel met at the Council's October 2014 meeting, and verified that the vessel decals were of limited law enforcement use, and did not influence which vessels were randomly approached for inspection on the water. Therefore, at their October 2014 meeting, the Council passed a motion to instruct staff to create a document to eliminate the requirement to carry decals for vessels with Gulf for-hire permits.

The following permits currently require decals and would be affected by this action. The term "Gulf for-hire permits" will collectively refer to these permits throughout the rest of the document.

- Gulf of Mexico Charter/ Headboat for Coastal Migratory Pelagics
- Gulf of Mexico Charter/ Headboat for Reef Fish
- Historical Captain Endorsement for Gulf of Mexico Charter/ Headboat for Coastal Migratory Pelagics
- Historical Captain Endorsement for Gulf of Mexico Charter/ Headboat for Reef Fish

1.3 Current Regulations

Reef Fish

Title 50 § 622.20 Permits and endorsements.

(b) Charter vessel/headboat permits. For a person aboard a vessel that is operating as a charter vessel or headboat to fish for or possess Gulf reef fish, in or from the EEZ, a valid charter vessel/headboat permit for Gulf reef fish must have been issued to the vessel and must be on board.

(1) Limited access system for charter vessel/headboat permits for Gulf reef fish. No applications for additional charter vessel/headboat permits for Gulf reef fish will be accepted. Existing permits may be renewed, are subject to the restrictions on transfer in paragraph (b)(1)(i) of this section, and are subject to the renewal requirements in paragraph (b)(1)(ii) of this section.

(iii) Requirement to display a vessel decal. Upon renewal or transfer of a charter vessel/headboat permit for Gulf reef fish, the RA will issue the owner of the permitted vessel a vessel decal for Gulf reef fish. The vessel decal must be displayed on the port side of the deckhouse or hull and must be maintained so that it is clearly visible.

CMP

Title 50 § 622.373 Limited access system for charter vessel/headboat permits for Gulf coastal migratory pelagic fish.

(d) Requirement to display a vessel decal. Upon renewal or transfer of a charter vessel/headboat permit for Gulf coastal migratory pelagic fish, the RA will issue the owner of the permitted vessel a vessel decal for that fishery. The vessel decal must be displayed on the port side of the deckhouse or hull and must be maintained so that it is clearly visible.

CHAPTER 2. REGULATORY IMPACT REVIEW

2.1 Introduction

NMFS requires a Regulatory Impact Review (RIR) for all regulatory actions that are of public interest. The RIR does three things: 1) it provides a comprehensive review of the level and incidence of impacts associated with a proposed or final regulatory action; 2) it provides a review of the problems and policy objectives prompting the regulatory proposals and an evaluation of the major alternatives that could be used to solve the problem; and, 3) it ensures that the regulatory agency systematically and comprehensively considers all available alternatives so that the public welfare can be enhanced in the most efficient and cost-effective way. The RIR also serves as the basis for determining whether the proposed regulations are a "significant regulatory action" under the criteria provided in Executive Order (E.O.) 12866. This RIR analyzes the expected economic impacts of a proposed rule that would eliminate the requirement for vessels issued a Gulf for-hire permit to display a vessel decal for that fishery.

2.2 Problems and Objectives

The problems and objectives for this proposed action are discussed in Chapter 1.

2.3 Description of the Fishery

This proposed action will only affect vessels issued a Gulf for-hire permit. A description of the for-hire component of the CMP fishery is contained in GMFMC (2014a), and a description of the for-hire component of the reef fish fishery is contained in GMFMC (2014b). These descriptions are incorporated herein by reference.

Information on Gulf charter vessel and headboat operating characteristics is included in Savolainen et al. (2012) and is incorporated herein by reference.

On March 3, 2015, there were 1,334 vessels with a valid (non-expired) or renewable for-hire CMP permits and 1,320 vessels with a valid or renewable for-hire reef fish permits. A renewable permit is an expired permit that may not be actively fished, but is renewable for up to one year after expiration. Most for-hire vessels permitted to operate in either of these fisheries are expected to have both permits. Although the permit application collects information on the primary method of operation, the permit itself does not identify the permitted vessel as either a headboat or a charter vessel and vessels may operate in both capacities. However, only federally permitted headboats are required to submit harvest and effort information to the NMFS Southeast Region Headboat Survey (SRHS). Participation in the SRHS is based on determination by the Southeast Fishery Science Center (SEFSC) that the vessel primarily operates as a headboat. Sixty-seven vessels were registered in the SHRS as of April 8, 2014 (K. Brennen, NMFS SEFSC, pers. comm.). The average charter vessel is estimated to receive approximately $82,000 (2014 dollars) in annual revenue. The average headboat is estimated to receive approximately $249,000 (2014 dollars) in annual revenue.

2.4 Management Measures Contained in this Proposed Action

This proposed action would eliminate the requirement for vessels issued a Gulf for-hire permit to display a vessel decal for that fishery.

2.5 Economic Impacts of the Proposed Action

The only impact that would be expected to occur as a result of this proposed action is a minor reduction in the time and labor associated with the receipt, handling, and display of the respective vessel decals when received. No fee is attached to the permit application to account for the administrative cost of these decals and no additional information is required in the application process beyond that required for the permit. As a result, the cost of the permit to fishermen would be unaffected by the proposed elimination of the decal requirement. The time and labor associated with the receipt, handling, and display of these decals are expected to be minimal. Nevertheless, for-hire vessel operators would no longer have to expend this time or associated labor costs. Additionally, the administrative costs of purchase and processing these decals would be eliminated. Otherwise, no economic impacts would be expected to occur as a result of this proposed action.

2.6 Public and Private Costs of Regulations

The preparation, implementation, enforcement, and monitoring of this or any federal action involves the expenditure of public and private resources that can be expressed as costs associated with the regulations. Costs associated with this specific action include:

Council costs of document preparation, meetings, public hearings, and information dissemination	$5,000
NMFS administrative costs of document preparation, meetings, and review	$10,000
TOTAL	$16,000

The estimate of public costs provided above does not include any law enforcement costs. The proposed elimination of the vessel decal requirements may result in a minor reduction in enforcement burden because agents would no longer need to examine these decals.

2.7 Determination of Significant Regulatory Action

Pursuant to E.O. 12866, a regulation is considered a "significant regulatory action" if it is likely to result in: 1) An annual effect of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities; 2) create a serious inconsistency or otherwise interfere with an action taken or planned by another agency; 3) materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights or obligations of recipients thereof; or 4) raise novel legal or policy issues arising out of

legal mandates, the President's priorities, or the principles set forth in this executive order. Based on the information provided above, this proposed action has been determined to not be economically significant for the purposes of E.O. 12866.

CHAPTER 3. REGULATORY FLEXIBILITY ACT ANALYSIS

3.1 Introduction

The purpose of the Regulatory Flexibility Act (RFA) is to establish a principle of regulatory issuance that agencies shall endeavor, consistent with the objectives of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of businesses, organizations, and governmental jurisdictions subject to regulation. To achieve this principle, agencies are required to solicit and consider flexible regulatory proposals and to explain the rationale for their actions to assure such proposals are given serious consideration. The RFA does not contain any decision criteria; instead the purpose of the RFA is to inform the agency, as well as the public, of the expected economic impacts of various alternatives contained in the FMP or amendment (including framework management measures and other regulatory actions) and to ensure the agency considers alternatives that minimize the expected impacts while meeting the goals and objectives of the FMP and applicable statutes.

With certain exceptions, the RFA requires agencies to conduct an initial regulatory flexibility analysis (IRFA) for each proposed rule. The IRFA is designed to assess the impacts various regulatory alternatives would have on small entities, including small businesses, and to determine ways to minimize those impacts. An IRFA is conducted to primarily determine whether the proposed action would have a "significant economic impact on a substantial number of small entities." The IRFA provides: 1) A description of the reasons why action by the agency is being considered; 2) a succinct statement of the objectives of, and legal basis for, the proposed rule; 3) a description and, where feasible, an estimate of the number of small entities to which the proposed rule will apply; 4) a description of the projected reporting, record-keeping, and other compliance requirements of the proposed rule, including an estimate of the classes of small entities which will be subject to the requirements of the report or record; and, 5) an identification, to the extent practicable, of all relevant federal rules, which may duplicate, overlap, or conflict with the proposed rule.

3.2 Statement of the need for, objectives of, and legal basis for the rule

A discussion of the need for and objectives of this proposed action is provided in Chapter 1. In summary, the purpose of this proposed action is to eliminate the requirement for vessels issued a Gulf for-hire permit to display a vessel decal for that fishery. The objective of this proposed rule is to reduce the regulatory burden associated with this requirement. The Magnuson-Stevens Fishery Conservation and Management Act provides the statutory basis for this proposed action.

3.3 Description and estimate of the number of small entities to which the proposed action would apply

This proposed action would directly apply to all vessels with a Gulf for-hire permit. Headboats, which charge a fee per passenger, and charter vessels, which charge a fee on a whole vessel basis, are types of vessel operations that participate in the for-hire fishing sector. A Gulf for-hire permit is required for for-hire vessels to harvest CMP and reef fish species in federal waters in the Gulf. On March 3, 2015, there were 1,334 vessels with a valid (non-expired) or renewable for-hire CMP permits and 1,320 vessels with a valid or renewable for-hire reef fish permits. A renewable permit is an expired permit that may not be actively fished, but is renewable for up to one year after expiration. Many for-hire vessels permitted to operate in either of these fisheries have both permits, but the number of unique vessels across both fisheries is unknown at the time of this analysis. Nevertheless, assuming not all vessels with a for-hire reef fish permit have a CMP permit, this proposed action would directly apply to more than 1,334 vessels.

Although the permit application collects information on the primary method of operation, the Gulf for-hire permit itself does not identify the permitted vessel as either a headboat or a charter vessel and vessels may operate in both capacities. However, only federally permitted headboats are required to submit harvest and effort information to the NMFS Southeast Region Headboat Survey (SRHS). Participation in the SRHS is based on determination by the Southeast Fishery Science Center (SEFSC) that the vessel primarily operates as a headboat. Sixty-seven vessels were registered in the SHRS in 2014 (K. Brennen, NMFS SEFSC, pers. comm.).

NMFS has not identified any other small entities that might be directly affected by this proposed action.

The Small Business Administration has established size criteria for all major industry sectors in the U.S., including fish harvesters. A business involved in the for-hire fishing industry is classified as a small business if it is independently owned and operated, is not dominant in its field of operation (including its affiliates), and has combined annual receipts not in excess of $7.5 million (NAICS code 487210, for-hire businesses) for all its affiliated operations worldwide. The average charter vessel is estimated to receive approximately $82,000 (2014 dollars) in annual revenue and the average headboat is estimated to receive approximately $249,000 (2014 dollars) in annual revenue. Therefore, all for-hire businesses expected to be directly affected by this proposed action are believed to be small business entities.

3.4 Description of the projected reporting, record-keeping and other compliance requirements of the proposed rule, including an estimate of the classes of small entities which will be subject to the requirement and the type of professional skills necessary for the preparation of the report or records

This proposed action would eliminate the requirement that vessels issued a Gulf for-hire permit to display a vessel decal for that fishery. As a result, this proposed action would simplify compliance requirements and no special professional skills would be expected to be required.

3.5 Identification of all relevant federal rules, which may duplicate, overlap or conflict with the proposed rule

No duplicative, overlapping, or conflicting federal rules have been identified.

3.6 Significance of economic impacts on small entities

Substantial number criterion

This proposed action would be expected to directly apply to more than 1,334 small business entities.

Significant economic impacts

The outcome of "significant economic impact" can be ascertained by examining two factors: disproportionality and profitability.

Disproportionality: Do the regulations place a substantial number of small entities at a significant competitive disadvantage to large entities?

All entities expected to be directly affected by the measures in this proposed action are believed to be small business entities, so the issue of disproportionality does not arise in the present case.

Profitability: Do the regulations significantly reduce profits for a substantial number of small entities?

This proposed action, if implemented, would be expected to result in a minor reduction in the time and labor associated with the receipt, handling, and display of vessel decals on fishing vessels issued Gulf for-hire permits. No fee is attached to the permit application to account for the administrative cost of these decals and no additional information is required in the application process beyond that required to receive the permit. As a result, the cost of the permit or time-burden to vessel operators applying for these permits would be unaffected. The time and labor associated with the receipt, handling, and display of these decals are expected to be minimal. Nevertheless, for-hire vessel operators would no longer have to expend this time or

incur the associated labor costs and, though minor, the expected economic effects on small entities would be positive. As a result, this proposed action would not be expected to significantly reduce the profits of a substantial number of small entities.

3.7 Description of significant alternatives to the proposed action and discussion of how the alternatives attempt to minimize economic impacts on small entities

This proposed action, if implemented, would not be expected to have a significant direct adverse economic effect on the profits of a substantial number of small entities. As a result, the issue of significant alternatives is not relevant.

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Tab B, No. 5(b)

For the reasons set out in the preamble, 50 CFR part 622 is proposed to be amended as follows:

PART 622--FISHERIES OF THE CARIBBEAN, GULF OF MEXICO, AND SOUTH ATLANTIC

1. The authority citation for part 622 continues to read as follows:

Authority: 16 U.S.C. 1801 *et seq*.

2. In § 622.20, remove and reserve paragraph (b)(1)(iii) to read as follows:

§ 622.20 Permits and endorsements.

* * * * *

(b) * * *

(1) * * *

(iii) [Reserved]

* * * * *

3. In § 622.373, remove and reserve paragraph (d) to read as follows:

§ 622.373 Limited access system for charter vessel/headboat permits for Gulf coastal migratory pelagic fish.

* * * * *

(d) [Reserved]

* * * * *

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Tab E, No. 6a

Ecosystem Based Fishery Management Working Group
Gulf of Mexico Fishery Management Council
Gulf Council Conference Room
Tampa, Florida
September 19, 2014
8:00 a.m. – 5:00 p.m.

Work group members present:

Cameron Ainsworth	Columbus Brown	Mandy Karnauskas	Will Patterson
Harry Blanchet	Matt Freeman	Walter Keithly	Sean Powers
Benjamin Blount	Steven Jacob	Kai Lorenzen	James Simons

Gulf Council Staff:	**Council Members:**	**NMFS Staff:**	**Public:**
Steven Atran	Roy Williams	Mike Jepson	Chad Hanson
John Froeschke			Frank Gable
Morgan Kilgour			
Karen Hoak			

A meeting of the Ecosystem Based Fisheries Management Working Group (group) was held on September 19, 2014.

The Council had two charges for the group: (1) to develop a set of suggested goals and objectives of an ecosystem based fisheries management plan that considers measurable targets and (2) to develop approaches for identifying and prioritizing ecosystem and socioeconomic information needs for fisheries managed by the Council.

The group was presented with a brief overview of past workshops addressing ecosystem based fisheries management (EBFM) including stakeholder and modeling workshops. In the past, there were attempts to develop an EBFM plan, but efforts and priorities changed and the plan was never fully developed. The recommendations from these workshops were also presented to the group. The group evaluated what "EBFM" means and determined that an EBFM does not necessarily need its own fishery management plan but should incorporate ecosystem components into these assessments.

Human community profiles typically are constructed through a combination of secondary data and social data collected by researchers who work directly in the communities. The latter process, however, can be very time consuming and expensive. Profiles can also be established through rapid assessment procedures, in which only a week or two is spent in a community, but those are not sufficiently quantitative for ecosystem assessments. Rapid assessment can be used effectively to correct time-lagged data in large secondary data sets, secondary in the sense that the data were collected for other needs. Using secondary data and short-term field research to establish social indicators, multiple communities can be evaluated and can produce quantitative results. Social indicators relate to issues such as: fishery dependence, population, resiliency and vulnerability and disaster indicators (hurricanes, tornadoes, sea level rise), and gentrification.

The group discussed understanding what analyses are available and what is tangibly accessible to address EBFM in the near future. Several examples of particular assemblages/species complexes were discussed (shrimp fishery, coastal pelagics, grouper complexes). The group discussed that there are current efforts to address ecosystem components into assessments, but most of these attempts are lacking the human dimension component.

The group agreed that stock assessments should continue to incorporate environmental covariates and use these models to give scientific advice on the probability of specific status determinations based on environmental factors. Some human dimension data could be used such as fisherman behavior in response to specific events. The ABC control rule could also have reduced uncertainty/discounts with the incorporation of environmental components that may drive recruitment and survival; this could lead to better projections and not just the current state of the stock. The MSE work on red grouper is currently attempting to address this scenario. MSE projections are sensitive to the future state of recruitment and changes in fisher behavior affecting the stocks. Additionally, the current state of some stocks may be affecting other stocks (e.g. gray triggerfish may be hindered by the expansion of the red snapper population).

Most of the assessment and management is at the stock level. The fishery is usually managed by taking information from the target stock and catches. To incorporate the ecosystem into management, factors from the environment and responses to regulations/management in fishing behavior is also important should be included. The group reviewed the Hobday et al. 2011 approach. The group felt that the Hobday et al. 2011 approach could easily be completed and an MSE be used to evaluate how different projections could affect the stock. For example, if projections are very sensitive to fishing behavior, then the priority research needs would be to address understanding fishing behavior. There are different levels of analyses that can be used, and the regional or community level should be focused on, especially for social analyses. Travel costs, shortened season costs, number of days lost fishing, etc. would all be region and sector specific. It was suggested that existing data could be used to address many of the questions such as how fishing behavior changes with episodic events, open-access versus IFQ fishing regulations, or changes in fish abundance.

The group discussed the desire for stability and how stability is an ambiguous term. If the objective is to have stable access, then having higher yields is not effective. Increased biomass could lead to more stability in terms of yield and resilience to episodic events. In the for-hire and commercial sectors, there is desire to predict quota. The recreational fishery desires are season length and access. There was discussion on needing direction from the Council about what its desired management objectives are (e.g. higher bag limits vs. fishing all year; open access vs. higher CPUE). Understanding these questions will help the group optimize the tools. It would be beneficial if the group could communicate the tradeoffs to the Council for balancing the modeling approach. The group should identify questions to present to the Council to streamline the process.

The group discussed the utility of the Hobday et al. 2011 approach and suggested adding specific modifications as appropriate for the Gulf. There is currently an effort to develop an MSE for red grouper; the outputs of this MSE could be useful for implementing the approach that was presented. Some of the red grouper work is unfunded, but there is effort to complete the work along with the assessment. Atlantis is also being used to test the harvest control rule for the grouper complex.

The social the economic goals and objectives need to be considered such as fisher behavior. The dynamics of the socioeconomic realm is what is important for the Hobday et al. approach. There were two episodic events that could be investigated with fishing behavior response, red tides and hard freezes. These data could be incorporated and investigated, but more systematic investigation for changes in fishing behavior in response to specific regulations is warranted. The social science data may already be available for many of these metrics.

The short term goals were to incorporate the Hobday et al. approach with specific fisheries. Fisheries that were presented were red snapper, shrimp, data poor species, and lionfish. The fisheries that have been identified as being particularly useful are shrimp and red grouper. Lionfish was suggested as a useful non-fishery species. The shrimp fishery has economic, effort, and other data that will be straightforward to apply to the framework; however, there are also complex fisheries interactions such as bycatch and trawling impacts that are not easily accounted for. The red grouper fishery is already under investigation by the integrated ecosystem assessment team. Lionfish was discounted mainly because it is not a managed species, but the effects of lionfish on managed species from predation as a covariate would be appropriate. There was considerable discussion about the importance of habitat for many of these fisheries. Diet studies were also addressed as important for filling in gaps.

The group discussed the metrics table for information needs for Gulf fisheries (Appendix A). Overall, a better communication of the tradeoffs to the Council would be the best approach.

Short term goals

- To identify the four categories of information needs for the shrimp fishery as a preliminary example of how this approach can work (by January SSC meetings)
    - March 5 draft due to group
    - Group input due March 12, 2015
- To identify the four categories of information needs for the red grouper fishery as a preliminary example of how this approach can work (by January SSC meetings)
    - March 5 draft due to group
    - Group input due March 12, 2015
- Next to fill in the Hobday et al. approach (and modify as necessary) for the different fisheries (working group to present to SSC in March)
- Conduct an analysis using this framework (end of 2015) and clearly communicate the consequences for short term versus long term effects for management (2016)
- Consider how to incorporate this process (framework) into the management process (2016)

Long term goals

- To continue to give scientific advice with respect to the probability of overfishing in light of environmental factors as modeled in single-species assessments.
- To conduct management strategy evaluations to examine the efficacy of current management approach and control rules to avoid overfishing in light of environmental covariates.
- To employ existing and soon-to-be online ecosystem models to examine factors effecting productivity of exploited resources as well as measures of overall ecosystem health.

    - Ecosystem models being developed or have been developed for GOM should continue to identify and incorporate ecosystem components into the assessment process and into management objectives
- To understand what the factor the Council would like as having low variability from year to year (e.g. # of days, # of fishermen, quota, yield, money, people/access, habitat and limiting factors)
- Complete the stepwise approach suggested in the Hobday et al. paper and adjust as needed for use in the Gulf of Mexico (e.g. hazard identification at each steps).
- Separate out the ecosystem and human dimensions for operational reasons

References

Hobday, A.J., Smith,A.D.M., Stobutzki, I.C., Bulman, C., Daley, R., Dambacher, J.M., Deng, R.A., Dowdney, J., Fuller, M., Furlani, D., Griffiths, S.P., Johnson, D., Kenyon, R., Knuckey, I.A., Ling, S.D., Pitcher, R., Sainsbury, K.J., Sporcic, M., Smith, T., Turnbull, C., Walker, T.I., Wayte, S.E., Webb, H., Williams, A., Wise, B.S., Zhou, S. 2011. Ecological Risk Assessment. Fisheries Research 108: 372-384.

Appendix A.

	Influences on the fishery	Impacts of fishery/management
Socio-economic	- Fishing behavior responses (changing location, high grading, species targeted, season, gear, discards, price, technology) - Fishery components - Fishing behavior drivers: regulations (season length, catch shares, gear) - Work force - Number/location of processors	- Recreational fishery - For-hire recreational fishery - Commercial fishery - Catch shares - Changes in fishery selectivity - Motivation to assist data collection/ management decisions - Ecosystem services? - Regulations (season length, catch shares)
Ecosystem	- Climate (temp, salinity, hurricane frequency, freshwater inflow, etc) - Currents - Weather (hurricanes, rain, etc) - Episodic events (e.g. Red tide mortality, hypoxia, freezes) - Anthropogenic events (pollution, oil spills, etc) - Indicators? - Habitat - Bycatch - Species interactions - Invasive species	- Bycatch from one fishery on another - Protected species bycatch - Diet data (predator prey dynamics) - Gear impacts - Habitat impacts (restoration, damage)

Ecosystem SSC Summary
Gulf Council Office
Tampa, FL
February 25, 2015
9:00 a.m. - 5:00 p.m

Members Present:
Cameron Ainsworth, Vice-chair
Joan Browder
Columbus Brown
Stephen Holiman
Alan Matherne
Glenn Thomas
Wei Wu

Council Staff
Morgan Kilgour
Charlotte Schiaffo

Council Member
Roy Williams

NMFS-SERO Staff
Nick Farmer

Others present
J.P. Brooker
Felicia Coleman
Chad Hanson
Frank Helies
Will Heyman
Chris Hoenig
Tom Wheatley

The Ecosystem SSC February 25, 2015 agenda was adopted as written.

There were some minor edits to the Ecosystem SSC minutes from June 3-5, 2014, and the minutes from the last meeting were approved as revised.

The Ecosystem SSC was presented information on the shelf-edge fishing reserves in the Southeastern U.S. from 2003-2009. Both Madison-Swanson and Steamboat Lumps were identified as "fished out" before the reserves were put into place. The steep edges of the reserves (particularly Madison-Swanson) have spawning aggregations of gag, scamp and red snapper. Steamboat lumps is a series of terraces where red grouper build excavation pits along the edge. Red snapper use same spawning sites as gag grouper on Madison-Swanson. For gag grouper in Madison-Swanson, males declined in the population relative to fishing pressure, and males remain offshore while females migrate relative to spawning season. For gag grouper there is a higher percentage of transitional males post spawning-aggregation than pre or during the spawning aggregation, and sex change is initiated during the spawning time. These transitional males take about 2-3 months to transition from female to male. There has been no observed change in sex ratio for red grouper since the 1960s. The number of known red grouper pits has increased over time, and lionfish (more abundant on Pulley Ridge) are using red grouper excavation pits. Scamp grouper were the same size and abundance inside and outside the reserves, but all other fish were bigger and more numerous inside the reserve than outside the reserve.

These reserves are functioning by protecting: juvenile, adult and spawning habitat; sex ratios, age and size structure; reproductive output of other species. The reserves also allow for monitoring baselines, habitat protection and benefit fisherman by spillover. It was recommended to the Ecosystem SSC that other areas along the shelf edge at intervals should also be made into reserves to protect groupers and other taxa.

Poaching was observed on the reserve at night. The Ecosystem SSC discussed law enforcement issues such as poaching, prosecution of poachers, using VMS as an enforcement tool, and education to reduce poaching. There was concern that increasing the number of reserves would limit protection as enforcement would be overextended.

The Ecosystem SSC was presented additional work on four areas: Madison-Swanson, Steamboat Lumps, Twin Ridges and the Edges. Stations at each location were selected by strata and sites were sampled using baited cameras. Scamp, red porgy, almaco jack, and red snapper were observed in 50% or more of the observations from Madison-Swanson. The Edges had the fewest red snapper, gag grouper and red grouper. The multi-beam coverage is scarce in the Edges so adequate site selection may explain the lack of fish observations. Gag grouper were most closely association with coral formations and steep edge habitats. Red grouper and red snapper were associated with sessile invertebrates. The average abundance for gag appears to be higher in Madison-Swanson, but the result was not significant. However, the size of gag grouper on Madison-Swanson was significantly higher. Red grouper seemed to be more numerous on Steamboat Lumps, but the result was not significant. The area to the north of Steamboat Lumps was recommended to be considered as a spawning area in the future.

There was considerable discussion on the effects of coastal development and anthropogenic forces on juvenile habitat. The Ecosystem SSC felt that there should be more of an effort to protect juvenile habitat areas.

Based on the discussion about law enforcement in the reserve areas, the Ecosystem SSC recommends: **To have the Council have the Law Enforcement Committee look at options for improving enforcement including looking at the tables of penalties for fishing in Marine Protected Areas and at problems associated with building viable cases for prosecution. Motion carried with no opposition.**

The Ecosystem SSC recommends: **To have the Council have the Outreach & Education Committee review mechanisms for public outreach with respect to benefits of MPAs and compliance with MPA regulations.**

Motion carried with no opposition.

The Ecosystem SSC discussed asking the Council to review options for preventing species of special concern from being caught such as hook restrictions, etc. The Ecosystem SSC discussed the ongoing problem with fishing in Madison Swanson and Steamboat Lumps because fishing is allowed at certain times of year. The Ecosystem SSC discussed how more MPAs and reduced fishing pressure may help improve the spillover effects of the marine reserves (such as Madison-Swanson). It was further discussed that the presence of vessels in reserves with some type of

allowable harvest provides an opportunity for illegal catch. The Ecosystem SSC made the following recommendations:

On the basis of the encouraging news the SSC heard from two scientific studies on reef fish stock recoveries in Madison Swanson and Steamboat Lumps MPAs, the Ecosystem SSC recommends that the Council consider other opportunities to establish MPAs.

Approved by consensus.

The Ecosystem SSC recommends that the Council establish year-round closures for all species in the Madison Swanson, Steamboat Lumps, and the Edges Reserves.

Approved by consensus.

The Ecosystem SSC recommends that the Council recommend to the HMS Management Division that they close the following Reserves (Madison-Swanson, Steamboat Lumps, and the Edges) to fishing year round.

Approved by consensus.

The Ecosystem SSC was presented with information on collaborative fish spawning aggregation studies and closures in the Caribbean. Fisherman helped with the process and areas were closed to prevent fishing on spawning aggregations. The fishermen were part of the process which has led to the success of the closures. Similar attempts at protecting spawning aggregations are in effect in the South Atlantic. The South Atlantic Fishery Management Council has established an MPA expert working group to help identify important areas. In the Gulf of Mexico, there are attempts to identify more spawning aggregations with fisherman.

It was discussed that different fish require different MPA sizes. To protect gag grouper aggregations, an area of sufficient size is necessary. Red grouper do not aggregate, they live in a "permanent aggregation" where a male is surrounded by many females. The goal for ecosystem management would be to find the best areas to protect. The group also discussed how each life stage needs to have protection. The Ecosystem SSC wanted to be clear that juvenile habitat is critical and was concerned that the Council address protection of juvenile habitat. The Ecosystem SSC made the following recommendation:

Borrowing from a powerful approach to identifying and protecting spawning aggregations of reef fish and other associated species already implemented in Belize and elsewhere in the Caribbean and underway in the South Atlantic, the Ecosystem SSC recommends that the Council form an MPA Working Group made up of scientists, fishermen, law enforcement, managers and other stakeholders to work together, each using their best tools and knowledge, to make recommendations for the creation of an effective MPA network in the Gulf of Mexico.

Approved by consensus.

The Ecosystem SSC discussed that juvenile habitat should be further deliberated with the new SSC formation. The group expressed concern that the juvenile habitat would be overlooked with no specific recommendations.

The Ecosystem SSC was presented with the summary of the Ecosystem Based Fishery Management Working Group.

The Ecosystem SSC recommends: **That the Ecosystem Based Fishery Management Working Group continue working on developing a set of suggested goals and objectives of an ecosystem based fisheries management plan that considers measurable targets.**

Motion carried with no opposition.

A report on the meeting of Lenfest Task Force Meeting was given. The objective of the meeting was to come up with case studies to look at what ecosystem plans would look like and the end goal would be a policy statement paper.

The meeting adjourned at 5:00 p.m.

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Summary of Ecosystem SSC meeting on Feb. 25, 2015

Who were there

Members Present
Cameron Ainsworth, Vice-chair
Joan Browder
Columbus Brown
Stephen Holiman
Alan Matherne
Glenn Thomas
Wei Wu

Council Staff
Morgan Kilgour
Charlotte Schiaffo

Council Member
Roy Williams

NMFS-SERO Staff
Nick Farmer

Others present
J.P. Brooker
Felicia Coleman
Chad Hanson
Frank Helies
Will Heyman
Chris Hoenig
Tom Wheatley

Madison-Swanson and Steamboat Lumps Marine Reserves Reports

The Ecosystem SSC was presented information on the shelf-edge fishing reserves in the Southeastern U.S. from 2003-2009.

Shelf-edge reserves can protect threatened reef fish species and fishery production (Chris Koening and Felicia Coleman)

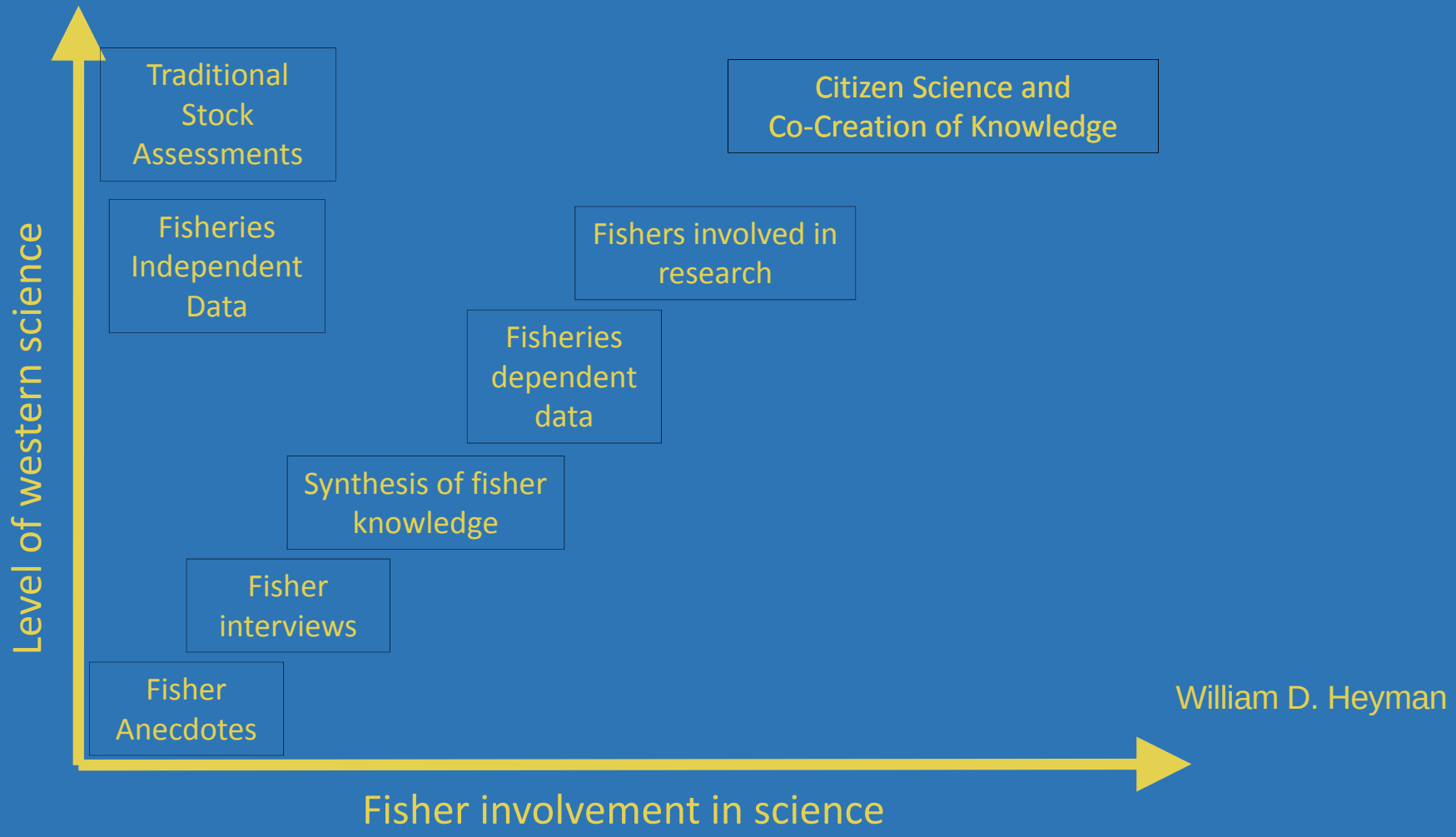
- Benefits for threatened & critically endangered species:
  - Protect juvenile, adult and spawning habitat
  - Provide research opportunities to increase protection & recovery.
- Benefits for shallow water species.
  - Protect sex ratios, and reproductive output of Gag
  - Protect age & size structure of spawners (BOFFS).
  - Protect reproductive output of other species (e.g., Red Snapper)
- Benefits to fishermen
  - Spillover: increase fishery production around reserves.
  - Protection of future recruitment.
- Benefits to scientific research and management
  - Monitor shifting baselines (reserves must be large enough)
  - Habitat protection
  - Controls for environmental impacts (e.g., oil spills)
  - Ecology of exploited species
  - Fishery impacts on trophic cascades etc.
  - Impacts of invasive species (e.g., Lionfish)

Performance of MPAs

(Andrew David)

- Indices of abundance have a high variance so trends are difficult to detect. No statistically significant differences were detected between areas, however within areas some years were different from others.
- The average abundance for gag appears to be higher in Madison-Swanson than the other survey areas, but is not significant. Similarly red grouper abundance appears higher in Steamboat Lumps than other areas, but is also not significant. Red snapper means show greater interannual variability.
- Gag, red grouper and red snapper were larger within MPAs compared to the eastern Gulf. Within the MPAs, gag and red snapper lengths were similar, however red grouper were larger in in Madison-Swanson than Steamboat Lumps. All show apparent gradual increases during the survey period.
- Compliance with fishing regulations has varied, along with the level of enforcement. VMS for commercial vessels was instituted in 2008.

Maximizing legitimacy of information



William D. Heyman

Recommendation 1

To have the Council have the Law Enforcement Committee look at options for improving enforcement including looking at the tables of penalties for fishing in Marine Protected Areas and at problems associated with building viable cases for prosecution.

Motion carried with no opposition.

Recommendation 2

To have the Council have the Outreach & Education Committee review mechanisms for public outreach with respect to benefits of MPAs and compliance with MPA regulations.

Motion carried with no opposition.

Recommendation 3

On the basis of the encouraging news the SSC heard from two scientific studies on reef fish stock recoveries in Madison Swanson and Steamboat Lumps MPAs, the Ecosystem SSC recommends that the Council consider other opportunities to establish MPAs.

Motion carried with no opposition.

Recommendation 4

The Ecosystem SSC recommends that the Council establish year-round closures for all species in the Madison Swanson, Steamboat Lumps, and the Edges Reserves.

Approved by consensus.

Recommendation 5

The Ecosystem SSC recommends that the Council recommend to the HMS Management Division that they close the following Reserves (Madison-Swanson, Steamboat Lumps, and the Edges) to fishing year round.

Approved by consensus.

Recommendation 6

Borrowing from a powerful approach to identifying and protecting spawning aggregations of reef fish and other associated species already implemented in Belize and elsewhere in the Caribbean and underway in the South Atlantic, the Ecosystem SSC recommends that the Council form an MPA Working Group made up of scientists, fishermen, law enforcement, managers and other stakeholders to work together, each using their best tools and knowledge, to make recommendations for the creation of an effective MPA network in the Gulf of Mexico.

Approved by consensus.

Recommendation 7

That the Ecosystem Based Fishery Management Working Group continue working on developing a set of suggested goals and objectives of an ecosystem based fisheries management plan that considers measurable targets.
Motion carried with no opposition.

Approved by consensus.

NOAA FISHERIES

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DRAFT

CLIMATE SCIENCE STRATEGY

NATIONAL MARINE FISHERIES SERVICE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

U.S. DEPARTMENT OF COMMERCE

Draft for Public Review

January 2015

Editors:

Jason Link, Roger Griffis, Shallin Busch

Contributors:

Karen Abrams, Jason Baker, Rusty Brainard, Michael Ford, Jon Hare, Amber Himes-Cornell, Anne Hollowed, Kenric Osgood, Nate Mantua, Sam McClatchie, Michelle McClure, Mark Nelson, Mike Rust, Vincent Saba, Mike Sigler, Valerie Termini, Chris Toole, Eric Thunberg, Robin Waples, Seth Sykora-Bodie

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For more information please visit
http://www.st.nmfs.noaa.gov/
or contact NOAA Fisheries Service Office of Science and Technology
(301-427-8134)

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Objective 1: Identify appropriate, climate-informed reference points for managing living marine resources (LMRs).

Objective 2: Identify robust strategies for managing LMRs under changing climate conditions.

Objective 3: Design adaptive decision processes that can incorporate and respond to changing climate conditions.

Objective 4: Identify future states of marine and coastal ecosystems, LMRs, and LMR - dependent human communities in a changing climate.

Objective 5: Identify the mechanisms of climate impacts on LMRs, ecosystems, and LMR-dependent human communities.

Objective 6: Track trends in ecosystems, LMRs and LMR-dependent human communities and provide early warning of change.

Objective 7: Build and maintain the science infrastructure needed to fulfill NOAA Fisheries mandates with changing climate conditions.

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EXECUTIVE SUMMARY

The climate and oceans are changing. These changes are impacting the nation's living marine resources (LMRs), the services they provide, and the people, businesses, and economies that depend on them. These changes also impact the information and actions necessary to fulfill the National Marine Fisheries Service (NOAA Fisheries) LMR stewardship mission—to sustain LMRs and their environments for the benefit of the nation through science-based conservation and management. To fulfill this mission, NOAA Fisheries needs information on the impacts of changing conditions on LMRs, and the best approaches for sustaining LMRs and resource-dependent communities in a changing climate.

The goal of this Climate Science Strategy is to increase the production, delivery, and use of climate-related information to apprise and fulfill NOAA Fisheries' LMR stewardship mission. Although the information needed to understand, prepare for, and respond to climate change impacts on LMRs is diverse, this Strategy identifies common themes and priorities for action. The Strategy identifies seven key objectives to meet the science information requirements for fulfilling NOAA Fisheries' mandates in a changing climate.

Objective 1: Identify appropriate, climate-informed reference points for managing LMRs.

Objective 2: Identify robust strategies for managing LMRs under changing climate conditions.

Objective 3: Design adaptive decision processes that can incorporate and respond to changing climate conditions.

Objective 4: Identify future states of marine, coastal, and freshwater ecosystems, LMRs, and LMR -dependent human communities in a changing climate.

Objective 5: Identify the mechanisms of climate effects on ecosystems, LMRs, and LMR-dependent human communities.

Objective 6: Track trends in ecosystems, LMRs, and LMR-dependent human communities and provide early warning of change.

Objective 7: Build and maintain the science infrastructure needed to fulfill NOAA Fisheries mandates under changing climate conditions.

The Strategy provides a nationally consistent path for regional efforts to address common climate-LMR science needs that support better informed decision-making and fulfillment of NOAA Fisheries' mandates. For each of the Objectives, the Strategy identifies specific actions to

help achieve the Objective. The Strategy also identifies a set of priority recommendations that are common across mandates, regions, LMRs, and objectives that have high and immediate return on investment. The cross-cutting priority actions include:

1. Conduct climate vulnerability analyses in each region for all LMRs.
2. Establish and strengthen ecosystem indicators and status reports in all regions.
3. Develop capacity to conduct management strategy evaluations regarding climate change impacts on management targets, priorities, and goals.

The Strategy also identifies specific near- and medium-term recommendations to advance the seven objectives. The recommended near-term actions are grouped under the following categories:

1. Strengthen climate-related science capacity regionally and nationally.
2. Develop regional implementation plans to execute this Strategy, led by the regional Science Centers in coordination with the regional offices and other partners.
3. Ensure that adequate resources are dedicated to climate-related, process-oriented research.
4. Establish standard, climate-smart terms of reference to apply to all of NOAA Fisheries' LMR management, environmental compliance requirements, and other processes that cross multiple mandates and core policy areas.

This Strategy provides a nation-wide blueprint to help guide regional implementation plans tailored to address the specific issues, needs and priorities of each region. Implementation of the Strategy over the next 5 years is crucial for effective fulfillment of NOAA Fisheries' mission and mandates in a changing climate. Implementing these recommendations will efficiently and effectively increase the production, delivery, and use of climate-related information in NOAA Fisheries' LMR management, and thereby help reduce impacts and increase resilience of LMRs and the communities that depend on them.

LIST OF ACRONYMS

BRP – Biological Reference Point

EBM – Ecosystem-Based Management

ESA – Endangered Species Act

ESR – Ecosystem Status Report

FATE - Fisheries and the Environment

FMP – Fisheries Management Plan

FTE – Full-Time Employee

IEA – Integrated Ecosystem Assessment

LME – Large Marine Ecosystem

LMR – Living Marine Resource

MMPA – Marine Mammal Protection Act

MSE – Management Strategy Evaluation

MSA – Magnuson-Stevens Fishery Conservation and Management Act

NEPA – National Environmental Policy Act

NOAA Fisheries – National Marine Fisheries Service

NOAA - National Oceanic and Atmospheric Administration

CHAPTER 1

NOAA FISHERIES MISSION AND THE NEED FOR CLIMATE-RELATED SCIENCE

The climate and oceans are changing, and these changes are already affecting the nation's valuable marine, estuarine, and aquatic living resources (hereafter termed living marine resources or LMRs[1]). Changes in the climate system (including climatic changes and other impacts such as ocean acidification and alterations of aquatic systems; hereafter referred to as *climate change*) are affecting the services LMRs provide and the many people, businesses, and communities that depend on them (e.g., Osgood 2008; Doney et al. 2012; Melillo et al. 2014). Even at current concentrations of atmospheric greenhouse gases, these changes are affecting the products, services, uses, and benefits people derive from these ecosystems and are expected to continue affecting them for decades and centuries to come (Intergovernmental Panel on Climate Change 2013; Melillo et al. 2014). These impacts will affect NOAA's LMR management efforts and LMR-dependent sectors at a variety of levels: local, state, regional, national, and international.

Given the scale of U.S. dependence on LMRs and the scope and pace of climate-related change in marine, coastal, and freshwater ecosystems, immediate action is needed to better understand, prepare for, and respond to these changes in ways that reduce impacts and increase resilience of LMRs for current and future generations (Osgood 2008; Intergovernmental Panel on Climate Change 2013; Melillo et al. 2014). Meeting this need requires increased production, delivery, and use of science-based information related to climate change in nearly all aspects of LMR stewardship. Addressing these information needs is critical to fulfilling the NOAA National Marine Fisheries Service's (NOAA Fisheries) mission to sustain LMRs and their ecosystems for the benefit of the nation through science-based conservation and management.

The goal of this NOAA Fisheries Climate Science Strategy (hereafter referred to as the Strategy) is to identify key steps to inform and fulfill NOAA Fisheries' mission in a changing climate. It identifies seven objectives to increase the production, delivery, and use of climate-related information in fulfilling NOAA Fisheries stewardship mandates, and provides specific strategies to address them over the next 5 years.

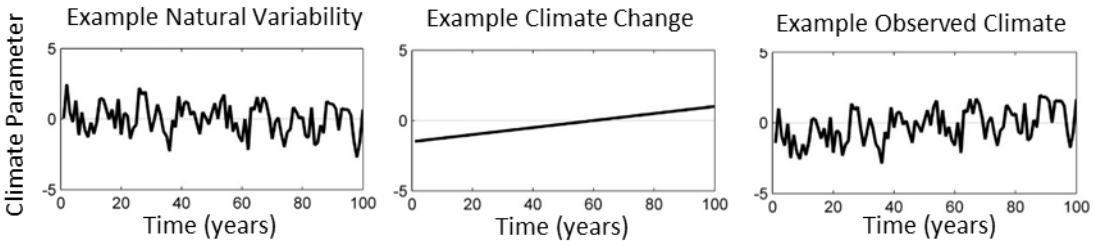
[1] Living marine resources are defined as species (and their habitats) under NOAA Fisheries' responsibility, including species that spend part of their life cycle in estuarine or freshwater, such as diadromous fishes.

The difference between natural variability and multi-decadal climate change

Natural variability is an inherent part of the Earth's climate system, and this variability acts over a range of time and space scales. At shorter time scales, this natural variability is termed weather: one day it is raining and the next day it is sunny. Seasonal natural variability occurs at the scales of months and is pronounced across temperate and boreal latitudes, where temperatures can vary by 10 to 50 ^{o}C and precipitation can vary from rain to snow. Climate also varies naturally on the inter-annual scale: one winter is mild and the next is harsh. Furthermore, there is natural climate variability at the scale of decades: El Niño Southern Oscillation (ENSO) represents multi-year variability in the surface temperature of the tropical eastern Pacific Ocean. ENSO variability has global effects; for example, it causes changes in rainfall patterns across parts of North America, Africa, and the Indian subcontinent. Other forms of inter-annual and decadal natural climate variability include the Pacific Decadal Oscillation, the North Pacific Gyre Oscillation, and the North Atlantic Oscillation, each with known basin-scale effects on weather, pelagic food webs, and fisheries.

All of these forms of natural variability in the Earth's climate system act simultaneously and in association with ongoing climate change, which is defined as a long-term change in the climate system (>50 years). Recent climate change involves global warming, ocean acidification, and changes in precipitation, winds, and ocean circulation patterns. These long-term changes will affect the average climate, but they may also change the frequency and magnitude of the processes responsible for natural variability, such as ENSO events.

The climate we experience is a combination of natural variability and long-term change. Climate change is not detectable day-to-day or year-to-year. It is detectable in the long-term trends in daily and annual temperatures. These long-term changes in the Earth's climate system pose challenges for the management of living marine resources. Information on the impacts of both climate variability and change on LMRs is very important to developing effective management approaches across multiple time scales.



Impacts of a Changing Climate on Marine and Coastal Ecosystems

The impacts of both climate variability and change on the physical, chemical, biological, and even social components of marine, coastal, and freshwater ecosystems are well documented (Doney et al. 2012; Griffis and Howard 2013; Intergovernmental Panel on Climate Change 2013; Melillo et al. 2014). Some of the major observed and expected changes to the physical and chemical characteristics of marine and coastal environments are illustrated in Figure 1 and include the following (Doney et al. 2012; Intergovernmental Panel on Climate Change 2013; Melillo et al. 2014):

- Warmer ocean temperature.
- Reduced sea-ice thickness and extent.
- Altered storm tracks and intensity.
- Precipitation changes.
- Altered freshwater input.
- Sea level rise.
- Reduced ocean pH (i.e., acidification).
- Reduced dissolved oxygen.

These changes can result in a variety of altered conditions, including the following (Rykaczewski and Dunne 2010; Doney et al. 2012; Intergovernmental Panel on Climate Change 2013; Melillo et al. 2014):

- Salinity.
- Ocean circulation.
- Mixed layer depth.
- Upper-ocean stratification.
- Wind mixing.
- Intensity of upwelling and downwelling.
- Ecosystem connectivity.
- Nutrient availability.

These changes to the marine and coastal physical and chemical environments are known to be occurring, and their cascading effects on species, habitats, and biodiversity in these systems are expected to increase with continued changes in the climate system (Figure 1). The variety of observed or expected effects include changes to ecosystem productivity (Polovina et al. 2008; Polovina et al. 2011; Hollowed et al. 2013); the timing and magnitude of phytoplankton blooms (Steinacher et al. 2010; Behrenfeld 2011; Sigler et al. In press); thermal tolerance and habitat volumes available for LMRs (Baker et al. 2007; Nye et al. 2009b; Baker et al. 2012; Hazen et al. 2013; Pinsky et al. 2013; Lynch et al. In press); and vital rates [reproductive rate, emigration,

immigration] and life history characteristics (Hare et al. 2010; Saba et al. 2012). These effects can have direct or indirect impacts on species' survival, abundance, distribution, fecundity, reproductive success, and function in an ecosystem, and thereby modify the provision of ecosystem goods and services (Ruckelshaus et al. 2013). These factors may influence the frequency, intensity, and duration of interactions among species, species phenology, distributions and abundance, and the dynamics of invasive and endangered species. We are already witnessing species range shifts (Nye et al. 2009a; Nye et al. 2009b; Cheung et al. 2010; Kotwicki and Lauth 2013; Pinsky et al. 2013), and these shifts are expected to continue, posing challenges and perhaps opportunities for resident and shifting species as they enter or leave an ecosystem.

Climate-related alterations to freshwater and estuarine systems—such as changes in the amount, location, and timing of precipitation or changes to air or sea temperatures—can affect riverine-dependent diadromous species and the many species that use estuarine habitats (Intergovernmental Panel on Climate Change 2013; Intergovernmental Panel on Climate Change 2014; Melillo et al. 2014). For example, along the U.S. West Coast, the combination of more extreme events coupled with higher temperatures causes more precipitation to fall as rain rather than as snow, which significantly changes the hydrology for listed salmon and steelhead in the region, including (Mote et al 2014):

- More flooding and scouring flows in winter (increasing sedimentation, erosion, and potentially washing out deposited eggs).
- Earlier spring freshet (likely to change juvenile migration timing with potential mismatch to estuarine and ocean conditions).
- Higher water temperatures and lower stream flows in summer and fall (reducing juvenile rearing habitat quality and quantity, potentially increasing predation and disease transmission).
- More frequent exceedance of lethal/sublethal temperature thresholds for juveniles and adults.
- Modified riparian vegetation (contributing to higher stream temperatures) by factors including greater fire frequency and insect infestation..

In many coastal areas, transformation of shorelines and estuarine habitats with sea level rise and coastal inundation can also impact coastal-dependent species. Threats also arise from ocean acidification, with particular concern for species with calcareous shells [composed of calcium carbonate] or exoskeletons (Cooley and Doney 2009; Bednaršek et al. 2014), which

currently comprise about two-thirds of U.S. marine aquaculture production[2] and more than half of U.S. domestic fishery landings by value (National Marine Fisheries Service 2014) and provide habitat for many species (e.g., coral and oyster reefs).

Climate-related changes will also interact with other stressors, such as pollution, fishing, bycatch, and changes in human use of these systems (e.g., rapid increase in human use of the Arctic) to affect LMRs. Some examples of climate-related impacts on LMRs and the people who depend on them are included as case studies throughout this document. In some circumstances, mitigating other stressors that are under local or regional control (e.g., fishing impacts and pollution) may help increase the persistence of species sensitive to climate change, by increasing overall resilience and reducing synergistic impacts between climate-related and non-climate-related stressors.

Climate-related changes in physical and chemical conditions are expected to have a variety of impacts on LMRs across a range of spatial and temporal scales (Stock et al. 2011; Melillo et al. 2014). To assume that the effects of climate change will be uniform and consistent across species and ecosystems is imprudent and inconsistent with our scientific understanding. Several studies (e.g., Mueter et al. 2011; Howella and Austerb 2012; Wilderbuer et al. 2013) suggest that in any one region, some species will experience improving environmental conditions that may result in increased species productivity and increased available habitat, while other species will experience the opposite and perhaps decline in abundance. Furthermore, the sensitivity of species to climate change and the nature of the effect may vary with life stage. Understanding how climate change will affect wide-ranging species is challenging, as they may experience positive effects of climate change in one habitat during one life stage and negative effects in another distantly located habitat in another life stage. Because not all climate changes will affect LMR species in the same way, there is an urgent need for careful evaluation of the impacts of climate as well as non-climate stressors in the design, implementation, and evaluation of LMR management efforts. For example, changes in species' abundance, productivity, distribution, and diversity due to a changing environment may require changes to the biological reference points and socio-economic benchmarks used in LMR management.

The combined physical, chemical, and biological effects of climate change on LMRs will modify the products and services people derive from marine ecosystems, including food, jobs, recreation, medicinal products, aesthetics, tourism, and even health benefits (Ruckelshaus et al. 2013). For example, the species available for harvest or culture in a given region could change in space and time, requiring fishermen to develop new harvesting strategies (e.g., switching

[2] http://www.nmfs.noaa.gov/aquaculture/faqs/faq_aq_101.html#11whatkinds

their target species and gear types) or developing strategies for reducing bycatch of species new to their fishing grounds (Heenan et al. 2013). Shifts in the distribution and/or abundance of species may affect where fishermen target fish, the location of fishing industries, working waterfronts, supply chains, and the social and economic dynamics of LMR-dependent coastal communities, cultures, and industries. Changes in target species and fishing methods will likely pose challenges for shore-side support services from ports to processing plants, which will also be significantly influenced by climate-related factors such as sea level rise, coastal storms, and inundation (e.g. flooding). Shifts in aquaculture practices may be needed, including rethinking what species may be best suited to meet societal demands under changing climate and ocean conditions. These and many other climate-related effects will impact NOAA Fisheries' stewardship of LMRs (e.g., for ESA-related issues see special section on climate change and NOAA Fisheries ESA work in December 2013 issue of *Conservation Biology*: Boughton and Pike 2013; Brainard et al. 2013; Busch et al. 2013; Gregory et al. 2013; Jorgensen et al. 2013; McClure et al. 2013; Seney et al. 2013; Snover et al. 2013; Wainwright and Weitkamp 2013; Walters et al. 2013) .

NOAA Fisheries Stewardship Mandates

NOAA Fisheries is responsible for the stewardship of the nation's LMRs and their habitats, interactions, and ecosystems. As discussed above, climate change is expected to have a variety of impacts on marine, coastal, and freshwater ecosystems, LMRs, and their uses, which will affect both the information and the actions required to fulfill this mission. NOAA Fisheries' main mandates are derived from numerous statutes, including the Magnuson-Stevens Fishery Conservation and Management Act (MSA), Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA), National Aquaculture Act, Coral Reef Conservation Act, and the National Environmental Policy Act (NEPA) (Table 1).

- Under the MSA, NOAA Fisheries assesses and predicts the past, current, and future status of fishery stocks and harvest rates; evaluates the implications of proposed catch on the sustainability of marine resources; and analyzes impacts on essential fish habitat. This information is used to maintain, conserve, and rebuild fishery resources. A primary objective of the MSA is to use the best scientific information available to optimize yield on a continuing basis.
- The MMPA directs NOAA Fisheries to assess marine mammal stocks, reduce fisheries bycatch of marine mammals, protect key habitats, and conduct stranding response and other activities. This includes the estimation of abundance, distribution, and mortality.
- Under the ESA, NOAA Fisheries works to identify, protect, and recover threatened and endangered species, including marine mammals, sea turtles, marine and anadromous

fishes, marine invertebrates, and marine plants, and their critical habitat.

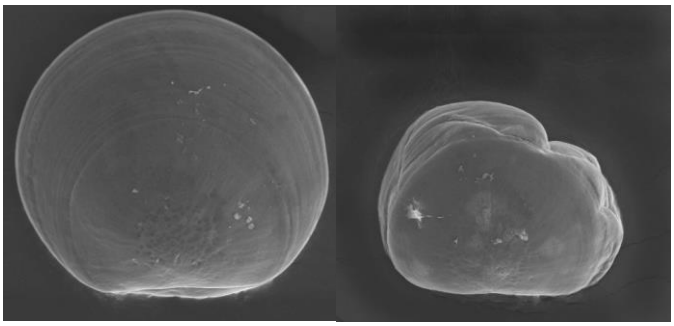
- Under the National Aquaculture Act, NOAA Fisheries provides for the development of aquaculture in the United States. Under the Coral Reef Conservation Act, NOAA Fisheries facilitates local action strategies for preserving coral reef habitat.
- Under NEPA and the National Ocean Policy, NOAA Fisheries evaluates environmental and socio-economic impacts of a variety of federally permitted activities in marine and coastal systems. This places particular emphasis on the evaluation of cumulative impacts to LMRs and their habitats, connections, and ecosystems. Similar work evaluating environmental effects of various activities is done through the MSA, ESA, Fish and Wildlife Coordination Act, and the Federal Power Act.

In designing management approaches to meet the LMR objectives listed above, NOAA Fisheries is required under many of the mandates (and others) to consider how these decisions may affect human systems, including coastal communities and economic and social impacts.

Pacific Northwest oyster hatcheries and ocean acidification

The first known case of an industry being directly affected by ocean acidification occurred in the Pacific Northwest's oyster hatcheries. Ocean acidification along the U.S. West Coast has been well documented, including its effects on aragonite saturation state of upwelled waters [a proxy used to estimate calcification rates] (Feely et al. 2008). In 2006, the mortality rate of cultured larvae of Pacific oyster (*Crassostrea pacifica*) at Oregon's Whiskey Creek shellfish hatchery was 80 percent greater than usual (Kelly et al. 2013). High larval mortality rates persisted at the Whiskey Creek hatchery and occurred at other hatcheries in Washington State for a few years. Wild recruitment of Pacific oysters was below levels needed to support commercial harvest in Washington's Willapa Bay during the same time period (Dumbauld et al. 2011). Hatchery managers and scientists explored a variety of possibilities for the high oyster larvae mortality, but turned their attention to ocean acidification when all of the typical causes of mortality could be ruled out. NOAA and other scientists collaborated with Pacific Northwest hatcheries to monitor the carbon chemistry of the seawater used to grow oysters and explored the link between ocean carbon chemistry and larval mortality in the hatchery. At the Whiskey Creek Hatchery, scientists found that larval production was directly correlated with aragonite saturation state of the seawater in which larval oysters were spawned and reared for the first 48 hours of life (Barton et al. 2012). Using data from carbon chemistry monitoring equipment, this hatchery and others have since successfully adapted their practices to mitigate the effects of ocean acidification on production. For example, they can now avoid drawing low pH water into the hatchery during spawning events. The shellfish industry, in collaboration with NOAA and other scientists, is exploring other adaptation practices for hatcheries, and the scientific community is exploring the feasibility of adaptation practices that could support oyster harvest from wild recruitment. Both are necessary to support the viability of the Pacific Northwest oyster industry.

Larvae of Pacific oysters at 4 days after hatching when reared in pH 8.0 (left) and pH 7.4 (right) seawater. Credit: E. Brunner and G. Waldbusser, Oregon State University.



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Fulfilling these mandates requires a range of science-based information and services to provide the foundation for management action. NOAA Fisheries' responsibilities under the MSA, ESA, MMPA, NEPA, and other mandates include a set of common science activities such as documenting, assessing, and projecting past, present, and future abundance, distribution, production, mortality, and utilization of LMRs. Briefly, this sequence can be described as follows (Figure 2):

- Providing contextual information to characterize all taxa of interest and their role in the ecosystem and for fisheries.
- Providing observational and experimental data to build an understanding of LMR abundance and dynamics given past and current environmental and socio-economic conditions.
- Modeling and synthesizing data to understand patterns in ecosystem and LMR population dynamics and make projections about how they will respond to action.
- Reviewing model outputs to validate the science.
- Providing management advice, typically in the form of reference points and catch recommendations.

Science is essential for effective LMR management, and it becomes even more important as climate change alters the historical characteristics of marine ecosystems. Currently, we lack key scientific information needed to inform LMR management decisions in a changing climate.

With changing climate and LMR conditions, there are a variety of increasing information needs to inform and fulfill NOAA Fisheries LMR stewardship mandates (Osgood 2008). Some of the major climate-related information needs (Figure 2) for effective LMR management in a changing climate are:

- Standardized data on past and current changes in marine, coastal, and freshwater ecosystems.
- Studies to develop a mechanistic understanding of contemporary and historical climate impacts on LMRs.
- Assimilation and synthesis of climate information into models used to determine stock and ecosystem status and monitoring systems.
- Future projections of the state and expected human use of marine, coastal, and freshwater ecosystems (based on contemporary and historical climate sensitivities).
- Evaluation of alternative management strategies to reduce current and future impacts of climate change on LMRs, the goods and services they provide, and the communities that depend on them.

Coral community sensitivity to climate change

In 2009, NOAA Fisheries was petitioned to list 83 species of coral as threatened or endangered under the ESA based on widespread degradation of coral reefs over the past three decades (Gardner et al. 2003; Pandolfi et al. 2003; De'ath et al. 2012) and on predicted declines in available habitat for the coral species (Hoegh-Guldberg et al. 2007; Carpenter et al. 2008), citing anthropogenic climate change and ocean acidification as the lead factors. An extensive NOAA Fisheries review of the available scientific information and analyses of the status and extinction risk of the 83 candidate coral species (Brainard et al. 2011) considered ocean warming, disease, and ocean acidification to be the most influential threats in posing extinction risks to the coral species evaluated. Over the past three decades there have been numerous widespread mass coral bleaching and mortality events around the globe associated with anomalously warm water temperatures (Eakin et al. 2009; Burke et al. 2011), and it is expected that these coral bleaching events will continue, likely with increased frequency and severity, with ocean warming driven by climate change (Hoegh-Guldberg et al. 2007; Eakin et al. 2010; Hoeke et al. 2011). In addition to mortality caused directly by the bleaching, incidences of coral disease increase as a function of increasing temperature (Bruno and Selig 2007; Harvell et al. 2007). Corals and coral reefs are also considered to be among the most vulnerable taxa and ecosystem types to the impacts of ocean acidification, as numerous experiments have demonstrated significantly reduced ability of reef-building corals and crustose coralline algae (red algae in the order Corallinales) to calcify and create their calcium carbonate skeletons (reefs) under low pH and low aragonite and calcite saturation states [The availability of carbonate ions is crucial for marine calcifying organisms to form their skeletons or shells that are made of different crystalline forms of calcium carbonate, such as calcite and aragonite. Aragonite is more soluble than calcite. Thus, the saturation state of aragonite can be taken as an indicator for ocean acidification. http://iprc.soest.hawaii.edu/users/tobiasf/Outreach/OA/Ocean_Acidification.html] predicted this century (Langdon and Atkinson 2005; Hoegh-Guldberg et al. 2007; Kuffner et al. 2007). Finally, additional studies have indicated that thermal and acidification stresses often act synergistically, resulting in even greater impacts to corals and coral reefs (Anthony et al. 2008).

In August 2014, NOAA Fisheries made a final decision to list 20 of the candidate species as threatened. This ESA decision-making process has demonstrated the need for both field and experimental time-series observations, and projections of climate and ocean changes and the resulting ecosystem impacts of those changes. Improvements in our ability to quantify the environmental factors, their variability, and their influence on survival and reproduction of living marine resources are essential for ESA decision-making.

Meeting these changing science requirements will be challenging given the scale and scope of NOAA Fisheries' mission and expected climate-related impacts in marine, coastal, and freshwater ecosystems. For example, NOAA Fisheries is responsible for providing a range of science-based assessments and management advice for the stewardship of more than 449 regulated stocks/stock complexes,[3] 102 threatened or endangered species, and 117 marine mammal species.[4] In addition, NOAA Fisheries provides science-based information to conduct more than 2,000 habitat restoration projects nationwide[5] and protect hundreds of thousands of square kilometers of habitat. NOAA Fisheries also oversees research and siting for a growing number of sustainable marine aquaculture activities, including some designed to mitigate for climate change. To meet NEPA requirements, in 2012 alone, NOAA Fisheries conducted 106 environmental assessments, wrote 12 environmental impacts statements, and issued hundreds of categorical exclusions.[6] Under the MSA, in 2011, NOAA Fisheries provided conservation recommendations to federal and state agencies on over 4,500 individual projects.

Overall, NOAA Fisheries has direct stewardship responsibilities for LMRs in 11 Large Marine Ecosystems, comprising 16.5 million km^2, an area 1.7 times the land area of the continental United States and roughly 5 percent of the world ocean's surface area,[7] plus other stewardship responsibilities of the ESA-listed species that occur in all of the world's Large Marine Ecosystems. NOAA Fisheries also has stewardship responsibilities on the high seas and for operation of U.S. fishing vessel in other countries' EEZs through international treaties and regional fishery management organizations. Due to complex trophic interactions of marine ecosystems, climate change will likely affect marine ecosystems, including all of the managed species. In addition, climate change will likely affect consumptive and recreational human use as well as conservation of managed species. Effective stewardship of LMRs will require information related to climate change for use in the design and execution of a broad range of management actions. In addition, effective stewardship will require an understanding of how fisheries, ocean industries (e.g., shipping, military activities, shoreline development), and other human activities might modify their use of LMRs in the face of projected and actual climate-related changes in marine, coastal, and freshwater ecosystems over time.

NOAA Fisheries needs to address all these mandates simultaneously, and to do so the agency is

[3] https://www.st.nmfs.noaa.gov/sis/
[4] http://www.nmfs.noaa.gov/pr/species/index.htm
[5] http://www.habitat.noaa.gov/restoration/restorationatlas/index.html
[6] Categorical exclusion refers to a category of actions that do not individually or cumulatively have a significant effect on the human environment and for which, therefore, neither an environmental assessment nor an environmental impact statement is required.
[7] http://www.lme.noaa.gov/index.php?option=com_content&view=category&id=41&Itemid=53

implementing its LMR stewardship responsibilities in an ecosystem context (Figure 3). NOAA Fisheries has adopted a policy of ecosystem-based management (EBM) to more efficiently and effectively fulfill its mandates and promote consideration of not only cumulative effects, but also trade-offs across various management regimes and human uses, as well as the impacts of these management decisions on human systems (Executive Order 13547 of July 19th 2010; Ocean Research Advisory Panel 2013).

EBM is a national priority and leading business practice within NOAA Fisheries, NOAA, U.S. natural resource management agencies, and many leading international natural resource management organizations (MacLeod and Leslie 2009; Executive Order 13547 of July 19th 2010; National Ocean Council 2013; Ocean Research Advisory Panel 2013; U.S. Office of Science and Technology Policy 2013). It is an idea that has existed for decades in the literature (Slocombe 1993), but has only more recently begun to be implemented in practice. Within each of NOAA Fisheries' mandates, the need and benefits of considering a wide range of factors that can influence LMRs is clear. But even more so, across all of these mandates, the need to implement EBM is apparent; NOAA Fisheries will be unable to consider the full range of trade-offs, interactions, and cumulative effects required across all of the mandates under a changing climate if it proceeds otherwise (MacLeod and Leslie 2009; Link 2010). Climate and ocean change impacts are a critical part of this discussion, and adopting common approaches to climate change science that are applicable across all NOAA Fisheries LMR mandates is an important area to leverage resources and gain efficiencies via this Strategy.

Without adequately incorporating climate change, NOAA Fisheries' conservation and management efforts are likely to be ineffective, produce negative results, or miss positive opportunities. Any of these could have a variety of environmental, social, economic, cultural, and legal consequences. For example, the commercial and recreational fishing industry is important to the U.S. economy (added $199 billion to the U.S. economy in 2012) and to social systems (generated 1.7 million jobs in 2012) (NMFS 2014). The recreational fishing industry alone contributes $56 billion a year to the U.S. economy and 364,000 jobs (NMFS 2014). Furthermore, subsistence and personal use fisheries are known to be vital to families and households across the nation, including tribal communities. Beyond fisheries, LMRs help protect coastal communities from storm waves and tsunamis, support the existence of imperiled and charismatic species [charming and widely known], regulate climate, and mitigate climate change effects (e.g., carbon sequestration and storage by coastal habitats).

Although the value of these services is challenging to quantify, they are vital and impossible to replace (Ruckelshaus et al. 2013). The social, cultural, and economic consequences are vast. Given the pace and scope of expected climate impacts on marine, coastal, and freshwater

ecosystems, the ability to understand, plan for, and respond to climate impacts on the nation's valuable LMRs and the people that depend on them is fundamental to fulfilling NOAA Fisheries mandates in a changing climate.

The Need for a NOAA Fisheries Climate Science Strategy

The demand for more information related to climate change is great and increasing among managers and stakeholders as evidence continues to mount of climate-related impacts on marine and coastal ecosystems, fish, protected species, aquaculture, and habitats. Many sectors are taking significant action to better understand, plan for, and respond to climate impacts (e.g., defense, transportation, land management, water management, public health, and others). This includes natural resource agencies such as the U.S. Forest Service (Solomon et al. 2009), U.S. Fish and Wildlife Service (U.S. Fish and Wildlife Service 2010), National Park Service (National Park Service 2010; National Park Service 2012), U.S. Department of Agriculture (USDA 2011), and the U.S. Geological Survey (Burkett et al. 2013). Increasing the production, delivery, and use of climate-related information in LMR advisory and regulatory documents (e.g., assessments, decisions, and opinions) produced each year in fulfilling NOAA Fisheries stewardship responsibilities is a significant challenge. Moving forward, NOAA Fisheries must include climate-related information in their decision-making and management advice. To do so, NOAA Fisheries should develop new types of information products and new approaches to advise managers, policymakers, and stakeholders (e.g., U.S. Army Corps of Engineers 2009).

Fortunately, many quantitative tools needed to incorporate climate change into NOAA Fisheries scientific advice already exist, though improvements are needed in the use and application of these tools. Other needed tools remain undeveloped. NOAA Fisheries has a network of internal and external partnerships that could be better mobilized to help address many of these needs (in fact, partners are critical to fill some of the science and information needs; Table 2). However, many challenges remain. For example, many of the data sets needed to parameterize coupled climate-LMR or ecosystem models are not available; additional efforts are needed to collect relevant climate-related data as a regular part of the information base supporting LMR management (Osgood 2008; Hollowed et al. 2009; Stock et al. 2011). Additional action is needed to effectively structure and employ models and tools that utilize climate, biological, and ecological information. Research to better understand key mechanisms and processes linking climate-induced changes to LMRs is also needed. There is a need to identify and test how to effectively insert climate-related information into LMR management processes (Figure 2). Given that many of NOAA Fisheries' LMR mandates have common needs for climate-related information, identifying these common products and responses that can be used across

all mandated needs should be a top priority. Finally, all these endeavors require adequate science infrastructure, coordination, and financial support in both the near term and the long term.

This Strategy identifies seven key areas where action by NOAA Fisheries and partners over the next 5 years can efficiently and effectively provide the information and approaches required to fulfill NOAA Fisheries' LMR stewardship mandates in a changing climate. The goal of the Strategy is to increase the production, delivery, and use of such information in these seven priority areas (Figure 4). These priority areas focus on seven main questions that need to be addressed to ensure effective LMR management in a changing climate:

1. How can climate-related effects be incorporated into LMR reference points?
2. What are robust LMR management strategies in the face of climate change?
3. How can climate-related effects be incorporated into adaptive LMR management processes?
4. How will the abundance and distribution of LMRs and marine ecosystems change in the future, and how will these changes affect LMR-dependent communities?
5. How and why does climate change alter LMRs, ecosystems, and LMR-dependent human communities?
6. What are the observed trends in climate and LMRs?
7. What science infrastructure is needed to produce and deliver this information?

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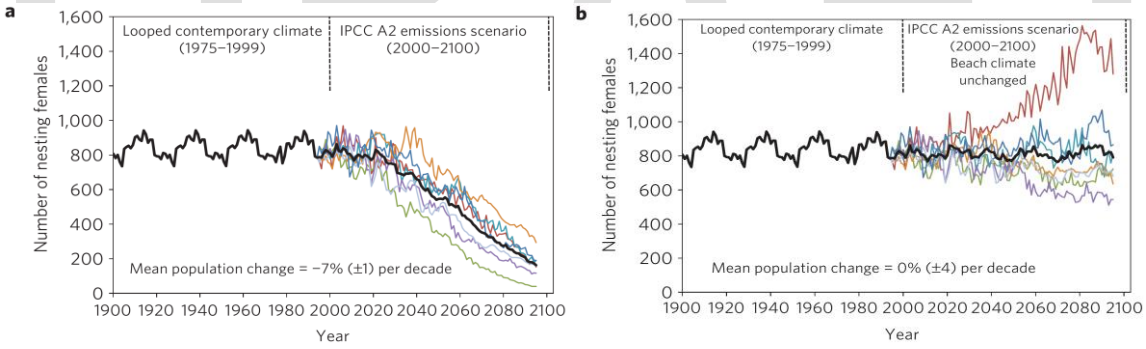
Projections of the response of leatherback turtles to changing climate and ocean conditions

Leatherback turtle (*Dermochelys coriacea*) population dynamics are differentially sensitive to changes in climate and ocean conditions. Population projections under an Intergovernmental Panel on Climate Change emissions scenario indicate a 7 percent decline per decade when both ocean and nesting beach climate conditions change. A 2 to 3^{o} C warming of the nesting beach was the primary driver of the decline through reduced hatching success and hatchling emergence rate. Adjusting nesting phenology or changing nesting sites may not entirely prevent the decline, but could offset the decline rate. However, if future observations show a long-term decline, mitigation efforts such as shading and irrigation of nests may be able to preserve the nesting population (Saba et al. 2012). Predicted sea level rise could significantly impact nesting beaches through impacts from ocean inundation, loss of suitable habitat, and increased completion for best nesting sites.

Leatherback turtle nesting population projections at Playa Grande, Costa Rica in the Eastern Pacific Ocean. Colored lines are population projections based on individual global climate models and the solid black line is the projection ensemble. From Saba et al. 2012.



CHAPTER 2

INCREASING PRODUCTION, DELIVERY, AND USE OF CLIMATE-RELATED INFORMATION TO FULFILL NOAA FISHERIES MISSION

The goal of this Strategy is to increase the production, delivery, and use of climate-related information to inform and fulfill NOAA Fisheries' LMR stewardship mission. NOAA Fisheries needs to better understand the response of marine organisms and ecosystems to climate change in order to better understand the impacts of climate change on LMRs and human use of LMRs. NOAA Fisheries also needs information to design and implement management approaches that are robust to the uncertainties of changing marine, coastal, and freshwater ecosystems. The Strategy is designed to provide a national framework that can be regionally tailored and implemented through NOAA Fisheries science centers, regional offices, and their partners over the next 5 years.

This Strategy is intended to identify key climate-related information needs (Table 1). These needs were derived from existing assessments and related sources (e.g., Murawski and Matlock 2006; Osgood 2008; Griffis and Howard 2013), then generalized across mandates to identify analytical products and the science enterprise to support management needs. Finally, consideration was given to the infrastructure needed to produce and deliver the needed science.

While each NOAA Fisheries mandate has specific requirements, four main findings played a key role in shaping the content of this Strategy:

1. There are common information needs that exist across all major mandates.
2. The science-to-management process is relatively consistent across mandates, making advances in climate-related science and information applicable across multiple mandates.
3. Advances in the science and practice of ecosystem-based management are considered the most effective approach to achieve the desired objectives of all the respective mandates simultaneously.
4. There are common, climate-related tools, approaches, or information that can efficiently and effectively inform all of NOAA Fisheries' mandates.

While it is clear that there are also mandate- and region-specific needs, this Strategy is designed to provide a national blueprint that can provide tangible solutions to a variety of priority common needs and also help address the more unique science and information needs of each mandate and region. This Strategy capitalizes on these common elements and suggests an over-arching framework for action to build the needed science enterprise.

This chapter identifies seven priority areas of information and activities needed to fulfill NOAA Fisheries' mission using highly interdependent objectives, and provides strategies to address them over the next 5 years. The first three are management-oriented objectives, and the final four are science-oriented objectives:

Objective 1: Identify appropriate, climate-informed reference points for managing LMRs.

Objective 2: Identify robust strategies for managing LMRs under changing climate conditions.

Objective 3: Design adaptive decision processes that can incorporate and respond to changing climate conditions.

Objective 4: Identify future states of marine, coastal, and freshwater ecosystems, LMRs, and LMR-dependent human communities in a changing climate.

Objective 5: Identify the mechanisms of climate impacts on ecosystems, LMRs, and LMR-dependent human communities.

Objective 6: Track trends in ecosystems, LMRs, and LMR-dependent human communities and provide early warning of change.

Objective 7: Build and maintain the science infrastructure needed to fulfill NOAA Fisheries mandates under changing climate conditions.

To meet these seven objectives, NOAA Fisheries needs to identify and fill data or information gaps; maintain and bolster ongoing efforts that are climate-relevant; explore novel ways to produce and deliver salient information; and develop climate-smart management approaches. This chapter describes the information needed to address each of our objectives, plus the germane products, strategies, and delivery of each (Table 3).

Each of the seven objectives is described in the following pages. Each objective begins with a description of the LMR management objectives and/or the type of science-based information or advice needed in the form of decision criteria. The objectives are highly interdependent; the science and information from any one objective contributes to or is essential to one or more of the other objectives.

These objectives were ordered according to the main mandated responsibility areas (Table 1), deriving known management needs, generalizing across mandates, identifying analytical products and the science enterprise to support those management needs, and finally noting the infrastructure needed to support that science (Figure 4). Thus, all subsequent objectives support the objectives above it (Figure 4). Building this nested and interdependent science foundation is the core of this Strategy.

Objective 1: Identify appropriate, climate-informed reference points for managing LMRs.

Reference points are the thresholds upon which LMR management decisions are made. Because stocks, protected species, habitats, aquaculture, and ecosystems are expected to respond to climate change, the reference points for these species, systems, and human uses may need to change to reflect those different conditions; ongoing scrutiny of these reference points has already indicated the need to bolster climate-related information in the development of this management advice. Development of biological reference points (BRPs) is a primary objective for much of the science conducted by NOAA Fisheries to meet its mandates. Be they single-species measures of maximum sustainable yield, thresholds for habitat designations, potential biological removal of marine mammals, multispecies fishing rates, thresholds for ecosystem-level indicators, protected species recovery criteria, or a host of others (Table 1), these reference points are used as limits or decision criteria to guide sustainable management of LMRs and their habitats. These reference points are typically developed via modeling exercises that synthesize a broad suite of observational and experimental information and are peer-reviewed. This careful vetting ensures that decision criteria are effective at achieving sustainable management, species recovery, or other stewardship goals. Strengthening NOAA Fisheries' ability to incorporate consideration of climate change into all the steps that lead to providing reference points is critical.

A number of products can be routinely created to meet this objective. Novel or updated LMR management plans and documents are typically produced for each management action. Usually, documents such as Fishery Management Plans, Fishery Ecosystem Plans, Biological Opinions, Species Recovery Plans, Environmental Impact Assessments, and Social Impact Assessments inform Ecosystem Assessments, ESA Status Assessments, MMPA and MSA Stock Assessment Reports, habitat assessments, restoration reports, and EFH designations. These plans and documents provide the scientific basis for the management of LMRs (Table 1). They are regularly used by NOAA Fisheries, Regional Fishery Management Councils; Regional Ocean Councils; Regional Planning Boards; State Fishery Commissions; Regional Fishery Management Organizations; many federal, state, and local agencies and organizations; and other managers in decision making.

Most current assessments, and the reference points produced by them and included in management plans, assume that natural variability will reflect the range of conditions observed in the past. Such reference points often do not account for the fact that ecosystems and the LMRs in them will change with the directional forcing of climate change. Therefore, stock assessments, biological reference points, and fisheries management plans based on these assessments may not adequately capture the future population dynamics in a changing ocean. In other situations, mandates allow managers to shift their reference points in response to shifts in the environment, such as regime shifts [large, abrupt, persistent changes in the structure and function of an eco-system. A regime is a characteristic behavior of a system which is maintained by mutually reinforced processes or feedbacks]. However, unlike regime shifts—for which estimates of past and current conditions exist—climate change is expected to create

novel conditions not captured by past datasets, making identification of baseline conditions and reference points more difficult. In these circumstances, the key is to establish reference points that are robust to shifting status of managed species (Punt et al. In press) and associated ecosystems.

Moving forward, LMR management plans (e.g., Fishery Management Plans, Fishery Ecosystem Plans, Species Recovery Plans) need to document that decision criteria explicitly include climate-related considerations. Accounting for and, where appropriate, including the best available climate-related science to inform reference points is a necessity to avoid misaligned management targets. Additionally, many of these plans need to include socio-economic analyses that show the consequences of neglecting climate change in establishing biological reference points. Such analyses are challenging but feasible. Moreover, they are critical to demonstrating the value (both biologically and socio-economically) of managing LMRs using reference points that consider the effects of climate change. Misaligned reference points may result in foregone revenue or missed opportunities (e.g., biological, social, economic, cultural) due to climate-induced changes in production, distribution, or other dynamics of LMRs that have been unaccounted for.

Finally, a reporting tool, accessible to all stakeholders, that simultaneously tracks the status of stocks, ecosystems, and social and economic conditions over time would provide useful products for adequately achieving this objective. NOAA Fisheries has the building blocks for developing such a reporting tool, but does not currently collect information in such a comprehensive way.

Important strategies to bolster and better deliver climate-smart reference points include:

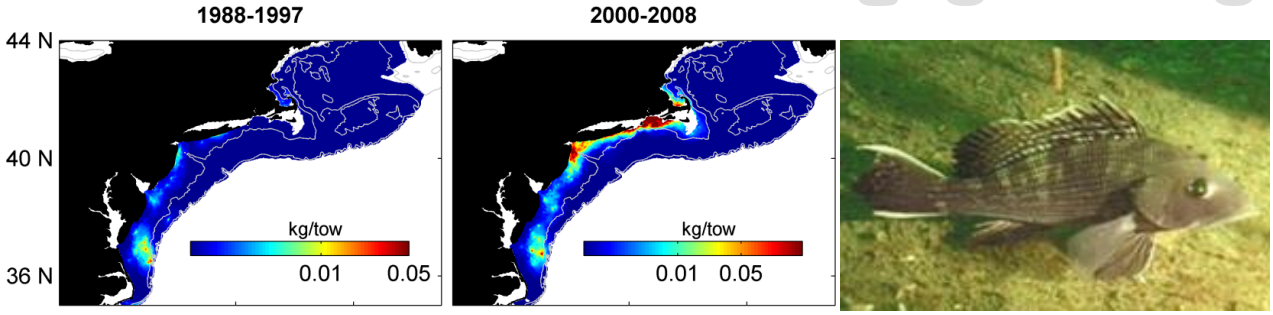
- Identify ecosystem-based reference points that include climate change and ecosystem information for all LMR management plans and strategies.
- Modify existing biological reference points that fail to include ecosystem considerations and assume that environmental conditions of the past will persist into the future.
- Communicate that ecosystem-based biological reference points improve accuracy, especially under climate change.
- Foster innovation in climate-smart scenario testing.
- Elucidate the positive opportunities associated with emerging LMRs.
- Develop scientific underpinning for Environmental Impacts Statements for climate change in each region, including comprehensive socio-economic impact analyses.

Changing fisheries behavior in response to climate-induced changes to LMRs

Climate-forced changes in species distributions are causing changes in both fishery operations and fisheries management. These changes are currently reactions; i.e., unplanned changes that are made as a result of climate change. This Strategy seeks to enable fisheries adaptation to climate change; i.e., planned changes that reduce the vulnerability of social and biological systems to climate change (Quentin Grafton 2010). Fisheries along the Northeast United States serve as an example of reactions to climate change. Fish and shellfish populations are shifting predominantly northward or to deeper waters, consistent with expected biological responses to warming waters (Nye et al. 2009b; Pinsky et al. 2013). These changes in species distribution have led to changes in the distribution of landings (Pinsky and Fogarty 2012); landings of lobster, yellowtail flounder, summer flounder, and red hake shifted northward but at a slower rate than species distributions, which suggests an increasing disconnect between fishing and species distributions.

Many fishery species are managed in part with spatial allocation systems. Along the Northeast, the Atlantic States Marine Fisheries Commission uses a state allocation system based on historical patterns in landings. As species distributions change, landings distribution change, and the state allocation system can become out of sync with the distribution of landings, fishing effort, and the distribution of the resource. NOAA Fisheries scientists are providing products to the Commission to inform their discussions about potential changes in the state allocation system. These products include maps of species distribution when the allocations were set and analyses documenting the extent and examining the case of distribution changes (Bell et al. In review). This support is ongoing and is an initial effort to develop climate adaptation for fisheries in the region.

Distribution of black sea bass in the fall over the period when state allocations were set (1988–1997) and more recently (2000–2008). A black sea bass pictured in Stellwagen Bank National Marine Sanctuary in 2001. Photo credit: NOAA Stellwagen Bank National Marine Sanctuary.



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Objective 2: Identify robust strategies for managing LMRs under changing climate conditions.

Identifying LMR management approaches and options that will remain biologically and socio-economically sustainable in the face of a changing climate is a critical need. In addition, we need to acknowledge and affirm that the best management practices for LMRs today may not be the best management practices in the future with changing climate and ocean conditions.

To identify management strategies that are robust to future change, various ecosystem, socio-economic, and LMR models can be coupled with scenarios of climate change to test the performance of current and alternate management practices under future conditions (Battin et al. 2007; Crozier et al. 2008; Ianelli et al. 2011; Boughton and Pike 2013; Nye et al. 2013; Szuwalski and Punt 2013; Wilderbuer et al. 2013). Such management strategy evaluations (MSE) will assist in the design and evaluation of management options and adaptive management strategies for LMRs, and should help identify management options that are robust to a wide range of predicted future conditions. Additionally, they could be used to identify the time scale of change and adaptation, allowing us to better focus resources and emphasis. Similar models for cultivated LMRs exist for aquaculture and can be used to predict changes in production due to changing ocean conditions and consumptive and non-consumptive uses (Shelton 2014). Conversely, models of shellfish and seaweed physiology could be used to evaluate the potential for aquaculture systems to provide refuge to LMRs from changing climate and to remove carbon from the coastal ocean.

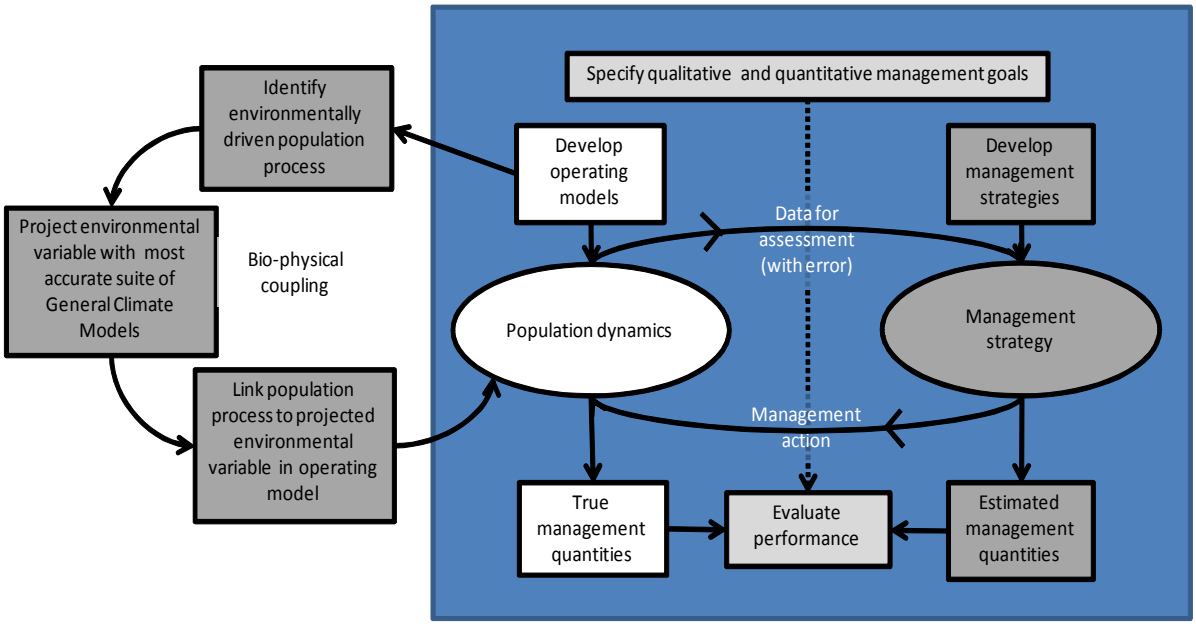
NOAA Fisheries has considerable experience in designing and evaluating strategies for sustainable management of LMRs. Incorporation of expected climate-related changes to marine, coastal, and freshwater ecosystems, as well as human uses of those ecosystems, will help identify management practices and mitigation strategies that may be necessary in the future. Fulfilling NOAA Fisheries' various mandates have specific timelines and processes for providing scientific information to managers and other stakeholders. Through these processes, NOAA Fisheries can provide information on the effectiveness of current management practices and the design and performance of alternative management practices that may be superior. For example, management strategy evaluations for fisheries management practices, recovery plans for ESA-listed species, management practices for aquaculture, use of aquaculture as mitigation, and designation of essential or critical habitat should incorporate understanding of the impacts of climate change into the design of effective management strategies. Such management strategy evaluations would support development of sound adaptive management practices.

A number of products could be routinely created to meet this objective. Reports of such management strategy evaluation efforts that cover the full range of climate, harvest, mitigation, and adaptation scenarios are needed. Within these reports, documented

Management Strategy Evaluations

There are many forms of management strategy evaluations. They range from qualitative assessments of the implications of a proposed change in management to highly technical simulations of the performance of a proposed strategy relative to a suite of performance metrics (e.g., maintaining a stock above a suite of biological reference points). In the context of climate change, the full range of management strategy evaluations is relevant. For example, in the near term, considerable insight can be derived from a qualitative assessment of the vulnerability of a suite of stocks to the combined impacts of climate change and fishing. NOAA Fisheries can use these vulnerability assessments to prioritize research on adaptation strategies for the most vulnerable resources.

Schematic of a typical stock-focused MSE. Taken, with permission, from Punt et al. (in press), and adapted from Smith et al. (1999), Schnute et al. (2007), and Szuwalski and Punt (2012).

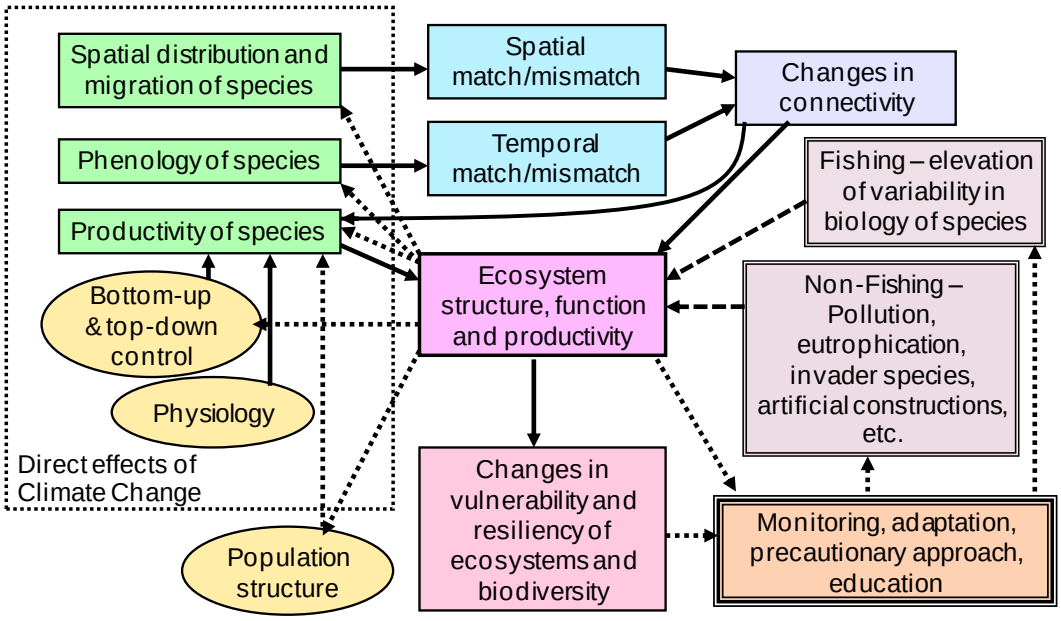


The more formal simulation modeling approach is emerging as a primary tool for delivery of adaptation strategies for the sustainable management of LMRs. Management strategy evaluations vary in complexity and biological realism, ranging from fully coupled bio-physical models of regional ecosystem responses to climate forcing, to climate-enhanced single- or multi-species projection models. These approaches incorporate bottom-up and top-down forcing through time.

Management Strategy Evaluations continued

The fully coupled ecosystem models formally capture species interactions in space and time through first principles of bio-energetics, predation, and probability of encounter with prey. Examples include size spectrum models, food-web models, full life-cycle individual-based models, and gradient tracking spatial models that incorporate predator-prey interactions and bio-energetics. Climate-enhanced single- or multi-species projection models use time trajectories of physics (reproductive success), prey availability (growth and survival), predation (mortality), and bioenergetics (growth and maturation) to inform functional responses, model parameterizations, model structure, and even covariates for modeled stocks into the future.

Schematic of many factors that can go into ecosystem-level management strategy evaluations. Adapted from Smith et al. 1999, Fulton et al. 2013.



changes to biological reference points across a range of scenarios warrants examination, including a catalog of associated LMR and socio-economic responses. Reports generated from these management strategy evaluations need to clearly and simply identify the most robust strategies that will not weaken LMR sustainability. Management strategy evaluations reports should also identify protection and mitigation measures, harvest control rules, and related management options that are compulsory to best manage across a suite of LMRs or systems. Specific consideration should be given to fisheries prosecuted by fishermen and vessels that originate from multiple regions (e.g., multiple North Pacific fisheries are prosecuted by both West Coast and Alaska fishermen and vessels) because disruptions of these fisheries have the potential for broad-reaching socio-economic and management implications. The best levels of

these biological reference points, reflective of a range of possible risk tolerances, need to be examined to better inform risk-based policies.

Many LMRs and ecosystems are experiencing changes in realized production or shifting distributions (Pinsky and Fogarty 2012). Exploration of these situations warrants particular attention. Some LMRs will move into ecosystems with more favorable environmental conditions. Management strategy evaluations to determine how to handle these opportunities also warrant exploration.

Important strategies to bolster and better deliver climate-smart management strategies include:

- Conduct management strategy evaluations and generate other information to allow risk-based policies to be re-evaluated under a changing climate.
- Establish science-based approaches and policies for determining biological reference points and LMR and ecosystem productivities with changing climate and ecosystem conditions.
- Establish science-based thresholds and policies for dealing with the immigration and emigration of LMRs to/from ecosystems.
- Conduct more routine and regular LMR management strategy evaluations with NOAA Fisheries partners and constituents to provide science-based assessments of management options in a changing climate.
- Examine efficacy of proposed mitigation strategies.
- Include human behavioral response or motivations into management design.

Objective 3: Design adaptive decision processes that can incorporate and respond to changing climate conditions.

The procedures used to examine, vet, and provide scientific advice to support management strategies and decisions can be as important as the management advice itself. As depicted simply in Figure 2, the science and information delivery process for any of the main NOAA Fisheries mandates (Table 1) follows a similar sequence: synthesizing available data, reviewing outputs, and providing information to determine the status of LMRs, habitats, or ecosystems. The resulting management advice provided at the end of the process is only as good as the weakest link in that process. If climate-related information is not included in this management advice process, decisions based on it may not result in sustainable management (e.g., Beechie et al. 2013; McClure et al. 2013).

Copious works have documented, described, and evaluated management systems for LMRs and natural resources, in general (Holling 1978; Walters 1986; Hilborn and Mangel 1998). We do not repeat that work here; rather we build on it and note one key point: climate-related information may need to be incorporated into the management process to effectively achieve management and conservation goals. Doing so would require a number of steps. Clearly an openness to incorporate considerations of climate-related information is a huge first step. Second, knowing where the best insertion points are for specific types of climate-related information is critical. Third, building adaptability into the management process is necessary to allow inclusion of new understanding related to climate change and information related to the rate of environmental change.

Easing the integration of climate science into the management process may necessitate some changes to the management process itself, requiring close collaboration between managers and scientists. For example, robust strategies for managing LMRs under climate change may require both regular updates in the short term based on performance tracking and periodic evaluation against rigorous management strategy evaluations that employ fully coupled sets of system models. In this example, both the close interaction between managers and scientists and the need for managers to be able to adapt on a routine basis (without scientists having to execute detailed analyses each time) are highlighted. Recent scientific inquiry suggests that detailed analyses are needed to assess whether current management strategies are robust to climate change. Research also suggests that LMR management strategies that are successful under climate change include adaptive management cycles with control rules for changing conditions and monitoring programs to develop and track necessary status indicators.

The primary output for this objective would be scientific support for management processes that are adaptive and flexible in both the short and long term under the various NOAA Fisheries mandates. These processes would need to be measured by key performance metrics related to their timeliness and accuracy with respect to the ecosystem, LMR, and socio-economic impacts of climate change.

Further, identification of where in the management process climate-smart information could

best be incorporated is needed, recognizing that there may be multiple insertion points (e.g, Sutton-Grier et al. 2014). This could be established under different management strategy evaluations (Figure 4).

Important strategies to bolster and better deliver climate-smart, adaptive management processes include:

- Design scientifically sound review-evaluation protocols that could ensure consideration of climate change as a standard part of LMR management advice.[8]
- Develop and document the scientific basis for the need for climate change considerations in legislation or technical guidance.
- Identify the many ways that information and understanding related to climate change can be inserted into the management process.
- Establish climate-ecosystem criteria that could become a standard part of review of LMR advice.

[8] Developing review-evaluation protocols that ensure consideration of climate change could be quite involved, but initially could take the form of changing the standing terms of reference in the management process to include consideration of a dynamic climate. Making this change for stock assessments, recovery plans, biological opinions, and other NOAA Fisheries management contexts would ensure that any resultant biological reference points include considerations of climate change. This change in criteria would also hold for external review panels, such as Scientific and Statistical Committees and Scientific Review Groups; for permitting, siting and review of essential fish and critical habitat, aquaculture, and NEPA consultations; and for Integrated Ecosystem Assessment scoping and reviews.

Objective 4: Identify future states of marine, coastal, and freshwater ecosystems, LMRs, and LMR-dependent human communities in a changing climate.

Simulation of LMR dynamics using climate forecasts are needed to develop management protocols that can adapt to climate change. Forward-looking management of LMRs depends on robust projections of future ocean conditions; marine, coastal, and freshwater ecosystems and LMR responses; and human socio-economic systems and their responses to changing climatic conditions and related LMR responses. Linking changes in the physio-chemical system to marine resources and ecosystems represents a major challenge. Making additional linkages to climate effects on human communities and economies is a second major challenge.

Robust, model-based projections of the effects of climate change on marine, coastal, and freshwater ecosystems, LMRs, and human communities have the potential to provide useful information for natural-resource decision-making on appropriate temporal and spatial scales. However, coupling across these models is not trivial.

Key projection considerations include:

1. A capability to downscale and bias-adjust global climate and earth system models to better resolve regional responses of marine and coastal ecosystems to large-scale climate changes.
2. Different climate scenarios to examine the effect of management choices on population dynamics, population viability, bioenergetics, multispecies interactions, biodiversity, and species distributions, as well as primary and secondary production, habitat structure, energy budgets, and ecosystems. This requires coupling for a full suite of models.
3. Social and economic models can predict how future change in LMRs may affect working waterfronts; commercial, recreational, and subsistence fishermen; anglers; aquaculture operations; the seafood industry; seafood consumers; and preferences for consumptive and non-consumptive uses of LMRs, but warrant further development and coupling with other LMR and ecosystem models. Coupling these suites of models is also needed.
4. Hotspots for change in marine, coastal, and freshwater physical condition and biogeochemistry, LMRs, and habitat, including aquaculture mitigation considerations, can be identified from data as well as via projections with coupled models.
5. Indicators that provide early warnings of rapid or impending change to LMRs, marine habitats, and ecosystems (e.g., large shifts in species phenology and distribution) need to be developed, and routinely monitored and projected as outputs of models.

Arctic seals and the ESA

In 2007–2008, NOAA Fisheries was petitioned to list ribbon, spotted, bearded, and ringed seals under the Endangered Species Act (ESA), based primarily on concerns about loss of sea ice in a disrupted, warming Arctic climate. All four of these seal species are strongly associated with sea ice as habitat for critical functions such as whelping and nursing of pups, and annual molting.

- In 2008 and 2013, NOAA Fisheries determined that the ribbon seal did not warrant listing under the ESA.
- In 2010, NOAA Fisheries determined that listing spotted seals in the Distinct Population Segments (DPSs) of the Bering Sea and the Sea of Okhotsk was not warranted. However, the Southern DPS of spotted seals (in the Yellow Sea and Sea of Japan) was listed as threatened under the ESA.
- In 2012, NOAA Fisheries determined that the bearded seal subspecies *E. b barbatus*, which occupies the Atlantic sector of the Arctic, did not warrant ESA listing. The subspecies *E. b. nauticus*, which occupies the Pacific sector, was further divided into the Okhotsk DPS (Sea of Okhotsk) and the Beringia DPS (Bering, Chukchi, Beaufort, and East Siberian Seas), both of which were listed as threatened because sea ice is projected to decline dramatically during this century in substantial areas of shallow water that are important for benthic foraging. However, these listings were vacated by a federal judge in Alaska in July 2014 (*Alaska Oil and Gas Association v. Pritzker*, 13-18-RRB, D. Alaska).
- Also in 2012, NOAA Fisheries determined that the ringed seal subspecies *P. h. saimensis* (Lake Saimaa, Finland) should retain its 1993 listing as endangered under the ESA and that *P. h. ladogensis* (Lake Ladoga, Russia) should also be listed as endangered. Ringed seal subspecies *P. h. botnica* (Baltic Sea), *P. h. ochotensis* (Sea of Okhotsk), and *P. h. hispida* (Arctic Ocean and surrounding seas) were listed as threatened. In addition to a loss of sea-ice habitat, these subspecies were listed because snow depth on sea ice during the early spring is projected to diminish during this century below the critical depth required for birthing and nursing lairs that shelter ringed seal pups from polar bear predation and hypothermia.

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Arctic seals and the ESA continued

ESA decisions such as these depend heavily on observations and projections of climate-driven change in sea ice, snow, ocean chemistry, and other key environmental factors. Too often, the best available scientific information is sufficient to support only qualitative assessments of extinction risk. Improvements in our ability to quantify the environmental factors, their variability, and their influence on survival and reproduction of living marine resources are paramount for rational ESA decision-making.

These examples show how climate change effects are being considered in an ESA context, how such effects are going to differ across species and locations, and the challenges of incorporating climate change for such arctic species in future years.

Bearded seal, ring seal pup, ribbon seal. Photo credit: Michael Cameron, NOAA Fisheries.

This list provides a sense of the magnitude, scope, and types of data-driven modeling efforts required to better understand projections of LMRs under future conditions. Any such projections need to be downscaled appropriately and temporally resolved to achieve robust projections of the state of future marine ecosystems. These projections should focus on short-, medium-, and longer-term time scales. Many NOAA Fisheries mandates require projections of population status, and working with climate scientists to provide the climate-related projections is increasingly needed to help fill these needs. Earth system models and global climate models do not project best at scales of days to weeks, but rather at scales of multiple decades to centuries (Stock et al. 2011). The 3– to 10-year projections often needed for LMR management fall between the time scales that climate models predict well, and this poses a challenge for the future.

In addition to these model-based needs, other important products can be routinely created to meet this objective. One of the key outputs from these projections should be the identification

of realistic future scenarios and feasible management strategies. These can set the stage for management actions by bounding future ranges of probable climate conditions. Doing so can minimize exploration of unrealistic scenarios and, thus, ineffective strategies.

NOAA Fisheries should work with researchers in academia and in the Office of Oceanic and Atmospheric Research to enhance its climate modeling capacity by establishing regional and national modeling teams focused on impacts to ecosystems and management of LMRs, specifically in the context of climate change scenarios. Regional modeling teams could, for example, develop and refine models, linkages among models, and scenarios that allow end-to-end modeling exercises to project the impacts of changes to climate condition on LMRs and ultimately how human communities then modify and adapt their uses of LMRs and ecosystems. They could also provide technical advice on the quality and applicability of modeling output. National teams of NOAA Fisheries experts could develop best practices for integrating changing climate conditions into modeling exercises (e.g., ensemble approach) and help the regions tackle climate change-related efforts in a coordinated and consistent way. These teams would also serve as the experts for linking new research and understanding into the development of advice.

Important strategies to bolster and better deliver climate-smart projections include:

- Develop a standard modeling toolbox (or at least documented best practices) to link future ocean and freshwater states and LMRs, with ability to couple models across types.
- Establish best practices for modeling under uncertainty (e.g., multi-model inference).
- Research socio-economic consequences of future climate scenarios and LMR, and explore range of probable human LMR-use responses.
- Build on past National Ecosystem Modeling Workshops (NEMoWs).

Collaborations on modeling are necessary for developing projections of the future

Models play an important role in understanding climate change and projecting future climate conditions given different scenarios of human behavior (e.g., different trajectories of CO_2 emissions). NOAA, through the Office of Oceanic and Atmospheric Research (OAR), is a global leader in climate modeling and provides advice to the United States and the international community in the form of understanding, attribution, and the consequences of climate change to various aspects of the Earth's system. NOAA, through NOAA Fisheries, is responsible for providing advice regarding the management of the nation's LMRs. Much of this advice is based on assessments of current status and then the forecasting of future status given different scenarios of human behavior (e.g., fishing levels). This advice is then used to set catch levels, to develop species recovery plans, or to determine the effect of a specific action on LMRs (e.g., fishing effort impacts on sea turtles). The challenge is to couple these two operational infrastructures to incorporate climate information into the advice that NOAA Fisheries is legally mandated to provide to numerous partners and stakeholders.

NOAA Fisheries and OAR researchers have worked closely together for the past decade to develop and demonstrate potential links. Climate effects have been coupled into single-species models (Fogarty et al. 2008; Hollowed et al. 2009; Hare et al. 2010); these studies show that climate will affect the reference points used in management. Climate models themselves have moved into simulating basic biological components of the Earth system (Stock et al. 2014); these models suggest that ocean biomes may shift and change in size, with potential implications for many LMRs (Polovina et al. 2011). These examples show paths forward for greater linkages between climate models and fisheries advice.

NOAA Fisheries scientists have also been working with a group of end-to-end models that link changes in the physical environment to changes in LMRs to changes in the socio-economics of fisheries (Fulton et al. 2011). These models represent the trophic interactions of ecosystems as well as the physics and human pressures. As examples, work on the West Coast demonstrates the potential cascading effects of ocean acidification on groundfish species (Kaplan et al. 2010) and, on the East Coast, the potential effect of warming on large predators (Keister et al. 2011; Nye et al. 2013). These models accommodate the interactive effects of climate change and fishing to be evaluated together and offer a powerful tool for examining the complexity of climate change and LMR dynamics. The next steps are to further improve these models and to develop greater integration between climate models and population and ecosystem models. This integration will allow the impacts of climate change on LMRs to be regularly incorporated into the scientific advice for management practices developed by NOAA Fisheries.

Objective 5: Identify the mechanisms of climate impacts on ecosystems, LMRs, and LMR-dependent human communities.

Information on how and why a changing climate is likely to affect LMRs and LMR-dependent human communities provides the foundation for projecting possible future impacts, and identifying possible strategies to reduce impacts and increase resilience. Process research, conducted both in the laboratory and the field, elucidates the mechanisms underlying how and why species, ecosystems, habitats, and human systems are or may be affected by climate change. Understanding the processes that cause these impacts can help managers identify which LMRs and ecosystems may be most vulnerable climate change and what actions may reduce climate impacts on LMRs, and can provide robust projections of changes to species, habitats, ecosystems, and human systems.

Filling key gaps in the understanding of these underlying processes will improve both NOAA Fisheries science and management, including the models used to develop projections of the future. Vulnerability assessments, improved using newly obtained knowledge of LMR sensitivity to climate change, can help identify focal areas for NOAA Fisheries scientific and management efforts. Process research informs the design of observing systems and underlies the models that project future states. Finally, process research provides the foundational knowledge for developing mitigation strategies to increase species' adaptive capacity and resilience to environmental change and/or to selectively breed climate-adapted stocks for aquaculture.

In short, climate change can affect LMRs via changes in:

- Genotype (natural selection, selective breeding).
- Vital rates (reproductive rate, emigration, immigration).
- Physiology rates (growth, consumption, respiration, metabolism, thermal tolerance).Susceptibility to disease.
- Trophic interactions.

These changes can result in a variety of subsequent changes such as:

- Mortality.
- Productivity.
- Species distribution.
- Nutritional value of prey.
- Movement of migratory species.
- Habitat structure and location.

And those changes can in turn impact other parameters such as:

- Species relative abundance.
- Community composition and predator-prey overlaps.
- Food web structure.
- Energy and matter fluxes.
- Invasive species.
- Life history.

Because of the sensitivity of species physiology to environmental conditions, changing environmental conditions may affect the distribution, migration, depth, and behavior of some species (see text boxes). Improving our understanding of how and why this change may occur provides mechanistic understandings needed for development and implementation of robust NOAA Fisheries management strategies. Laboratory and field investigations can be targeted to reduce uncertainty about species tolerance, response, and adaptive capacity to changing climate conditions and to the rate of change of environmental conditions. Laboratory experiments can examine the direct effects of single climate factors, the direct combined effect of multiple climate factors, and the indirect effects of changing climate conditions on species interactions, energetics, and resilience. Field studies on the response of managed and ecologically important species to different environmental conditions can range from targeted, hypothesis-driven work to analysis of long-term survey data with relevant environmental parameters. Studies of ecological communities build knowledge on the functional role of biodiversity in maintaining ecological and ecosystem resilience. Likewise, ethnographic fieldwork can be done to capture the processes that fishing-dependent communities use to respond and adapt to changing environmental conditions. Additionally, socio-economic analysis of LMR-user behavior over time can help explain historical patterns in resource use and how that use may change given future conditions.

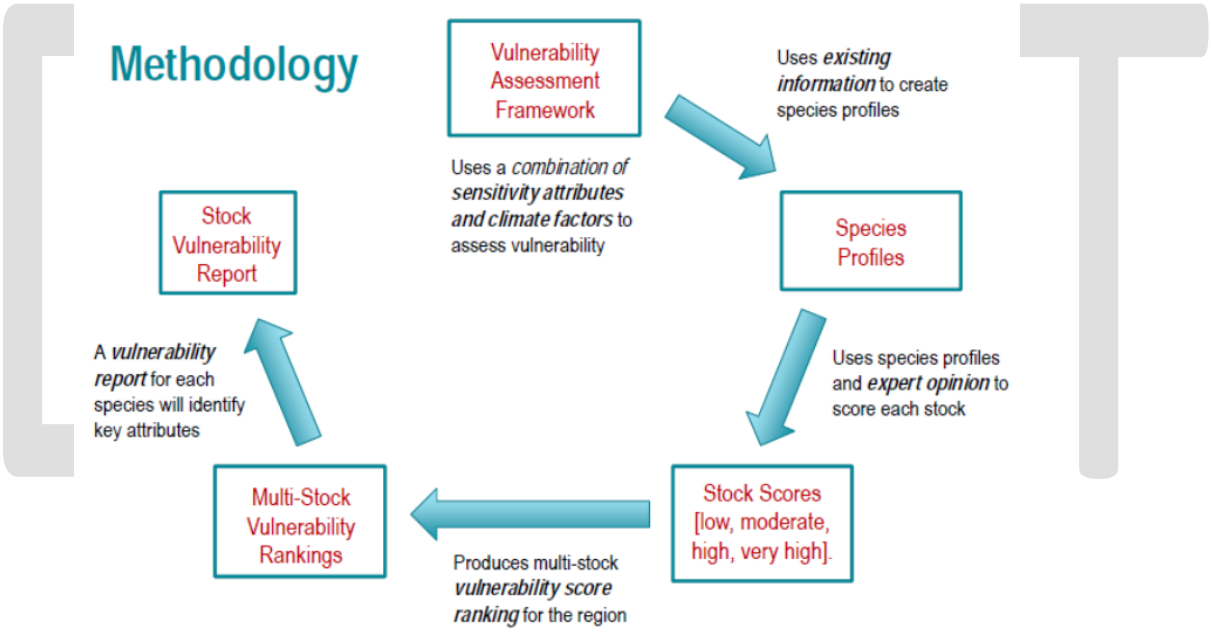
NOAA Fisheries' current capacity to conduct process-based research will not meet the demand for understanding how aquatic species, ecosystems, and LMR-dependent human communities may respond, acclimate, or adapt to climate change. Developing this capacity will require significant financial investment in state-of-the-art experimental facilities for rearing organisms under expected future conditions, the equipment needed to conduct research in field settings, and the up-to-date laboratory equipment required to process samples rapidly. In some cases, NOAA Fisheries has the needed assets, but needs the support and change in priority to apply these assets to process studies related to climate change. NOAA Fisheries needs to articulate the need for process-based research throughout the organization and beyond, then incorporate new understanding from this research into management advice. Strong partnerships with research institutions and funding agencies (e.g., National Science Foundation, National Aeronautics and Space Administration, Environmental Protection Agency, Department of Energy, Department of the Interior, and other NOAA line offices; Table 2) are also critical.

Further, process research that is integrated at the level of the ecosystem links ocean dynamics, biodiversity, and trophic interactions with managed species and the human communities using LMRs, and provide a comprehensive understanding of species response to changing climate conditions. For example, it is not enough to simply understand the temperature preferences of a species if warming also affects the abundance or distribution of their prey, predators, and competitors. Within NOAA Fisheries' current portfolio of research activities, observation-based integrative studies and translations of climate change are handled more comprehensively than

Vulnerability assessments

Vulnerability assessments identify LMRs, habitats, or human communities that are especially sensitive (or especially resilient) to climate change. Such assessments combine exposure to physical conditions with sensitivity to these conditions and aim to identify vulnerability. Vulnerability assessments should be viewed as iterative, with an update frequency linked to the International Panel on Climate Change Assessment Reports (4 to 5 years). They have been developed for fisheries stocks (Mueter et al. 2011; Wainwright and Weitkamp 2013) and communities (Gaichas et al. In press), marine mammals (Boveng et al. 2009), highly migratory species, habitats, ecosystems, and human social and economic systems. These assessments essentially utilize globally established best practices in risk assessment, particularly considering multiple criteria. They are a robust, feasible approach to help "triage" species and habitats in an ecosystem.

Methodology used by the NOAA Fisheries Fish Stock Vulnerability Assessment project, which has been piloted for Northeast fisheries stocks.



laboratory and field investigations of life history traits, genetics, and other physiological consequences of climate change. While these types of research are touched upon in some programs, NOAA Fisheries would need to build capacity to create the volume of targeted research necessary to achieve results commensurate with this aspect of NOAA Fisheries' science mission and the mechanisms for integrating this knowledge into ecosystem-level understanding.

A number of products could be routinely created to meet this objective. One of the key items in targeted research is to know what research is needed. An assessment that identifies the major

Migration of Adult Sockeye Salmon

Sockeye salmon, like other anadromous fishes, lay eggs in freshwater, migrate to the ocean as juveniles, and return to their natal waters to spawn 2 to 4 years later. Like other salmonids, they tend to be highly locally adapted to the combination of conditions in their freshwater and marine environments. The Columbia River basin was historically home to many populations of lake-spawning sockeye salmon; several populations of these remain, with the largest population found in the Okanogan Basin, Canada. Since the Columbia River was dammed, however, these fish have faced changes in temperature and flow that have altered the natural environment. Currently, the Columbia River reaches biologically important temperatures over 2 weeks earlier than it did in the 1950s, and experiences a mean temperature in June and July, when sockeye migrate, that is about 1.5^{o}C warmer. In addition, mean flow during migration periods is over 50 percent lower than it was historically (Quinn and Adams 1996; Quinn et al. 1997). In response, sockeye salmon have changed both the speed and timing of their migration – arriving nearly 11 days earlier at dams along the Columbia than they did in the 1950s. Crozier and colleagues (2011) used a modeling approach to determine that an evolutionary response to thermal selection explained up to two-thirds of this trend in earlier arrival time, translating to a shift of about 0.3 days per generation. Most of the remainder of this trend appears to be due to a plastic response to changes in flow. The increase in temperature in this system is attributable to both impoundments (e.g., dams) and climate change; it is likely to continue as global temperatures increase. Importantly, these fish are subject to selective pressures in all of their environments, which may impose constraints on the species' ability to adapt to ongoing rises in temperature.

Sockeye salmon spawning aggregation. Photo credit: Lisa Crozier, NOAA Fisheries.

gaps in the research useful for generating data to inform management under climate change is needed for each region. The items above should be compiled into a national inventory of data gaps. Any such research pursuit would be in relation to one of the main climate-change-induced pressures on the physio-chemical environment noted in Figure 1. This would need to be followed by research into the socio-economic responses of human communities to such changes.

Research undertaken to meet this objective can be used to develop updated parameters for LMR and ecosystem models. Providing revisions to model functional form, structure, and parameterization will afford better predictive capabilities of LMR responses to a changing climate and ocean. Additionally, targeted process research can be used to develop mitigation strategies for either reducing climate impacts on LMRs or providing for lost value and services to human communities due to climate change. For example, development and/or restoration of kelp forests and eel grass beds may provide some protection from ocean acidification and low oxygen. Similarly, researchers are testing whether seaweed and shellfish farms may provide similar ecosystem services important in a change climate if expanded over a larger area of the ocean than natural beds (e.g., Chung et al. 2013). Aquaculture provides an opportunity to explore human intervention to reduce climate change impacts to vulnerable life stages and species.

Important strategies to bolster and better deliver climate-smart process research include:

- Identify process research gaps in each region.
- Develop additional NOAA process research capacity internally and through competitive funding opportunities.
- Develop and maintain partnerships to conduct climate-LMR-related research.
- Organize and host regular national climate workshops with LMR emphasis for NOAA employees across line-office and external partners to advance research efforts and promote collaboration.
- Develop and maintain partnerships with international and other organizations to conduct LMR-climate workshops.
- Organize and host regional thematic workshops related to LMR response to climate change (regime shift, distribution shift, vital rates, etc.).
- Conduct research to identify a suite of proposed mitigation strategies, including those targeted at LMR-dependent human communities.

One of NOAA Fisheries' key partnerships is with NOAA Office of Oceanic and Atmospheric Research. NOAA Fisheries and Oceanic and Atmospheric Research scientists have collaborated successfully for decades. Many of these collaborations are at the individual scientist level, but examples of institutional partnerships exist (e.g., between Pacific Marine Environmental Laboratory and Alaska Fisheries Science Center). Such cross-NOAA partnerships are crucial for moving forward with climate-informed LMR management.

- Strengthen core science partnerships with formal mechanisms, especially with academic institutions, NASA, USGS, NSF, EPA, etc.

Although more process research could be conducted to inform management decisions, and although copious uncertainty about species performance in a changing climate context persists, common themes and consistent patterns related to climate change could provide the basis upon which NOAA Fisheries can act. Not knowing a particular functional form, mechanistic detail, or relationship between LMR responses and climate variables should not preclude NOAA Fisheries from acting in situations that have generally known LMR and ecosystem response trajectories.

Changing fisheries behavior in response to climate-induced changes to LMRs

Marine fisheries distributions are changing in response to climate change. Pinsky et al. (2013) found that, in general, changes in species distributions around North America tracked changes in environmental conditions. However, they identified important regional differences. For example, species in the Northeast United States shifted northeast on average, but species in the Gulf of Mexico shifted southwest; the Gulf Coast precludes a northward shift. These results demonstrate how regional geomorphology and oceanography influence how a species or stock responds to climate change.

In the Northeast region specifically, Nye et al. (2009) found that approximately two-thirds of the stocks investigated shifted distribution. A majority of observed shifts were northward (~80%) and into deeper water (~85%). However, some stocks moved to the south and some moved into shallow water. These results demonstrate the importance of the interaction between climate change and individual species life history and ecology.

Changes in fishery distributions can result from shifts in individuals or spatial changes in population productivity. For example, the distribution of Atlantic surfclam has changed on the northeast U.S. shelf (Weinberg et al. 2005). Surfclams are sessile as adults, and the changes in distribution have been linked to increased mortality (decreased productivity) at the southern end of the range owing to increasing temperatures. In contrast, the distribution of Atlantic mackerel has changed, and this is at least partially linked to a change in migration and in overwintering habitats as a result of warming (e.g., changes in individual distribution; Overholtz et al. 2011; Radlinski et al. 2013).

Changes in distribution can be caused by any one of several stressors; the two primary stressors are climate change and fishing. Bell et al. (in review) found that the northward movement of summer flounder was related to increasing age-class structure over time, which is likely a result of decreased fishing and stock rebuilding. In contrast, the northward movement of scup and black sea bass was related to warming. These results emphasize the importance of documenting trends in distributions, studying the mechanisms that cause changes in distribution, and then transitioning this information into advice for use by LMR managers (see Link et al. 2011a; Link et al. 2011b).

Atlantic surfclam, Atlantic mackerel, summer flounder, scup (Credit: NOAA)

Objective 6: Track trends in ecosystems, LMRs, and LMR-dependent human communities and provide early warning of change.

Information on the status and trends of marine, coastal, and freshwater ecosystems, resources, and LMR-dependent human communities is essential to tracking and providing early warning of the impacts of climate change. This information is the foundation of sound science advice and sustainable management of LMRs under changing conditions. NOAA Fisheries has excelled at producing data-based assessments of LMR status and trends for science-based management. Some of these assessments explicitly incorporate climate change data, but most do not. NOAA Fisheries has three main needs related to this objective:

- Monitoring programs to track LMRs, ecosystem dynamics, and LMR-dependent human communities.
- Development of good physical, biological, and socio-economic indicators for tracking trends related to climate change and early warning signals of change.
- Regular reports to present and interpret monitoring data while considering the effects of climate change.

Climate-change-related biophysical data—such as observed trends in sea surface temperature, upwelling indices, sea level height, biogeochemistry, food chain structure, or regional hydrology—need to be regularly incorporated into LMR, ecosystem, and habitat assessments. These form the basis from which links between change in physical conditions and biotic variables can be established (Figure 1). Information on the status and trends of ecosystems, LMRs, and resource-dependent communities is needed to modify management reference points for LMRs, habitats, ecosystems, and human communities to incorporate climate change and its impacts (e.g., NOAA Coastal Services Center 2014).

An important and regular product should be ecosystem status reports (ESRs and related ecosystem advisories, chapters, etc.). ESRs provide multi-dimensional examination of the ecosystem from physical and habitat condition to trends in LMR abundance and resource use by fleets and communities.[9] Typically they include brief narratives describing trends within the numerous time series analyses presented. Even apart from formal modeling through to specific biological reference points, the information provided in these ESR has been useful for providing broader context and leading indicators to inform LMR management. Future ecosystem status reports could be enhanced by interpreting detected changes within the current understanding of ecological processes of each large marine ecosystem. Adding climate change projections to these status reports is an important need and will provide information about the projected future states of the ecosystem. Integrating data sets of climate change that are current, are specific to the management tasks, and represent state-of-the-art understanding requires that synthesis products be developed and regularly updated. Such products are designed to serve multiple NOAA Fisheries management requirements, and do so because of shared information needs on climate-change-related impacts on the physical, chemical, biological, and socio-

[9] http://www.noaa.gov/iea/

economic components of marine, coastal, and freshwater ecosystems. The simple presentation of multidimensional information in ESRs is critical in the production and delivery of climate-change-related information for decision-making. One can readily envision compiling all the regional ESRs to form a national report on climate-related LMR status.

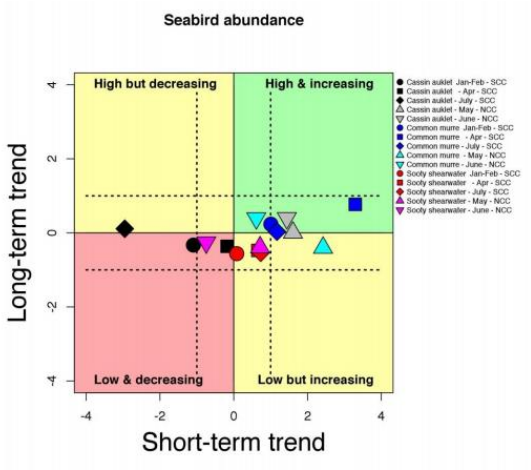
Deciding on which indicators to include in an ecosystem status report requires knowledge of ecosystem structure and function, the biogeochemical processes that influence the ecosystem, human use of and impacts on the ecosystem, and vulnerability of the ecosystem to climate change. Investing time and resources into the evaluation and development of useful indicators is an important task to undertake when designing ecosystem-climate observing systems and ecosystem status reports (Peterson et al. 2013). Necessary new indicators of change could be identified as the impacts of climate change develop.

Further, the biological and physical indicators developed from ESRs can be used to establish future thresholds and decision criteria (Samhouri et al. 2010; Fay et al. 2013; Large et al. 2013). This empirical exploration of ecosystem, habitat, and aggregate groups of LMR BRPs has been solidly rooted in such indicators. The full suite of multidimensional data can be noisy and typically incorporate multiple patterns (e.g., warming trend overlaid on El Niño-Southern Oscillation and Pacific Decadal Oscillation). Complex statistical techniques can distinguish the multiple drivers of change through time series analysis and are used to isolate signals in the data. Such statistical and analytical exercises are relatively novel, and technique development could also advance NOAA

Ecosystem Status Reports

Ecosystem status reports (ESRs) have emerged as useful, common reporting tools in the past few years. ESRs track trends in marine, coastal, and aquatic ecosystems and can be incorporated into the stock assessment process. ESRs exist as the Ecosystems Considerations Report for the Alaska Fisheries Science Center and the State of the California Current Report jointly produced by the Northwest and Southwest Fisheries Science Centers. They are produced annually or biennially, with some regions adding short-term updates between report publication dates. Such ESRs are important as compilations of leading indicators of climate change and climate effects on living marine resources.

Quadratic plot of trends in abundance at sea for the two most common piscivorous birds in the California Current large marine ecosystem (common murre, sooty shearwater) and one of the common planktivores (Cassin's auklet). *From Levin et al. (2013)[Please indicate how this graphic relates to the text in this box]*



Fisheries' understanding of ecosystem state.

The detection and reporting of status and trends of physical and biological data could also provide commonly needed climate-related data inputs for LMR and ecosystem models. These data vectors or matrices can serve as direct inputs, covariates, data modifiers, parameter tuning sets, or similar value in a host of LMR and ecosystem models.

Important strategies to bolster current status estimates include:

- Utilize climate vulnerability risk analyses to conduct triage and prioritization for climate change science related to LMR management.
- Develop and maintain standard climate-LMR report cards to communicate data and understanding available to all stakeholders.
- Conduct regional assessments of strengths, weakness, opportunities, and challenges related to LMR science and management in the face of climate change.
- Emphasize the critical need of ongoing monitoring in science planning and budgeting processes.
- Train staff in time-series analyses.
- Engage in scoping exercises related to LMR science and management in the face of climate change with partners and constituents.

The Pacific Decadal Oscillation, Food Chain Structure, and Salmon Returns to the Columbia River

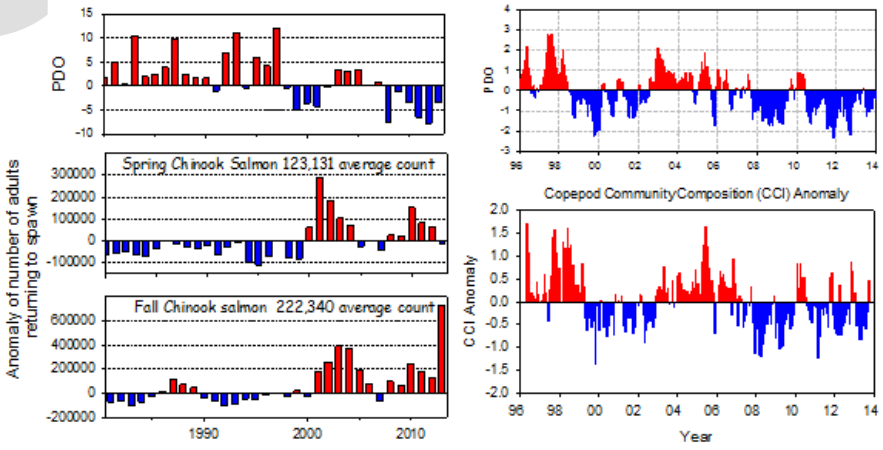
Mantua et al. (1997) showed that changes in the sign of the Pacific Decadal Oscillation (PDO, a basin scale climate indicator) translate into changes in salmon returns (a local response) throughout the North Pacific. When the PDO is in a warm phase, returns are relatively low for salmon that spawn in the Columbia River system and other rivers that discharge into the California Current. The opposite is true during the cool phase of the PDO. This is illustrated below, where it is shown that from 1980 through 1998, the PDO was in warm phase (red bars) and salmon returns were below average (blue bars). When the PDO turned negative (to cool phase) in late 1998, salmon returns rebounded with a 2-year lag for spring Chinook (which spend 2 years at sea) and with a 3-year lag for fall Chinook (which spend 3 years at sea). The PDO changed sign again in 2003 (warm phase) and 2008 (cool phase), and salmon again responded predictably to these changes. (http://www.nwfsc.noaa.gov/ and click on "Salmon Forecasting")

The Pacific Decadal Oscillation, Food Chain Structure, and Salmon Returns continued

A mechanism for these sudden changes in salmon returns was offered recently by Hooff and Peterson (2006) and Keister et al. (2011). They showed that changes in zooplankton (copepod) community composition were closely linked with the PDO. Further, they pointed out that cold-water copepod communities are dominated by species that are relatively large and enriched with lipids, especially omega-3 fatty acids, which are needed and desired by young salmon.

Hooff and Peterson (2006) and Keister et al. (2011) hypothesized that the mechanism linking the PDO with salmon returns is related to the source waters that feed the northern California Current and the species composition of copepods in these source waters. During negative PDO, the bulk of the water entering the northern California Current is from the coastal Gulf of Alaska and the zooplankton are dominated by large lipid-rich copepods; when the PDO is in positive phase, the source waters are from offshore and small subtropical copepods (which lack significant amounts of lipids) are transported to the northern California Current. Salmon returns are high during the cool phase of the PDO because the food chain is bio-energetically enriched with lipids from the cold-water copepods and these lipids are transferred up the food chain, through the krill and forage fish upon which salmon feed.

(Left) PDO and returns of Columbia River spring and fall Chinook over time (NOAA Northwest Fisheries Science Center 2014).(Right) PDO and copepod community composition index anomaly over time (from Keister et al. 2011; Batchelder et al. 2013, with updated data from B. Peterson, NOAA NWFSC).



Objective 7: Build and maintain the science infrastructure needed to fulfill NOAA Fisheries mandates under changing climate conditions.

Adequate scientific infrastructure is critical to the science enterprise described in this Strategy. However, NOAA Fisheries' existing infrastructure is not adequate to meet those science needs. Here, we identify extant programs that could be built upon, better coordinated, or expanded to meet the needs outlined in the Strategy with minimal disruption to NOAA Fisheries as it fulfills its mandates. Clearly there is a general need for increased capacity to link climate change and LMRs. But what would that entail?

Observational data on the physical and chemical conditions that freshwater, coastal, and marine organisms experience in their environment are a fundamental part of understanding species response to ocean and climate change. While NOAA Fisheries supports a variety of biological, physical, and human system monitoring efforts that inform fisheries and ecosystem management (e.g, North Pacific Climate Regimes and Ecosystem Productivity, Integrated Ecosystem Assessments, etc.), these efforts fall short of what is need to adequately track the impacts of climate change. An enhanced system that inventories current observing efforts, identifies gaps in these efforts, fills gaps with new observations, makes data readily available to scientists and stakeholders, and allows integration across data types collected in the system is required to meet NOAA Fisheries' needs today and in the future. Doing so would provide the data needed to deliver core information on the status and trends of marine, coastal, and freshwater ecosystems and human systems under climate change, and could provide early warnings of rapid or impending changes.

Building and maintaining an adequate physical, chemical, and biological observing system will require a variety of critical science infrastructure, including ship time, remote observing assets, establishment of key partnerships, and personnel to collect and process samples. Ideally, a large component of the modified observing system would be ongoing fisheries oceanography and LMR monitoring time series, but paired with simultaneous physical-chemical observations in both marine and freshwater systems. Building and maintaining an adequate observation system for fishing- and LMR-dependent community resource use and overall well-being will require a similar amount of effort given the sheer amount of time required to collect and analyze socio-economic data. Where gaps exist between projected needs and ongoing time series, NOAA Fisheries should increase support for existing activities and initiate, to the extent feasible, new observational time series to generate data relevant to managing LMRs and human communities over the coming decades. Ideally, observing efforts would include concurrent, integrated, interdisciplinary collection of physical, chemical, biological, and socio-economic data.

To succeed in implementing the Strategy, NOAA Fisheries will need to evaluate and possibly adopt novel and advanced sampling approaches and invest in enhanced computing technologies and laboratory assets. Many of the advances made for the next generation of remote and unmanned sampling and ocean observation systems will be operational in the next few years, and others are ready now. Taking advantage of the efficiencies and precision these

devices can provide will open up new data sets requisite for tracking climate change (e.g., underwater gliders to measure physical and chemistry conditions, accurate and precise ocean carbon chemistry sensors, acoustic monitoring of fish populations).

Many of the observing systems and modeling exercises described above, especially future projections and hind-casting, require computing systems that can store large data sets and are fast enough to complete scenarios in a reasonable amount of time. Expansion of computing systems is required to meet these needs. Collection of high-quality, species-response data will require laboratories with specialized equipment and animal holding facilities to elucidate physiological and genetic responses of LMR's to future conditions (e.g., Northwest Fisheries Science Center's ocean acidification experimental system).

Improved data access and data visualization tools are necessary for fully sustaining and supporting the science enterprise outlined in the Strategy and implementing the Strategy successfully over time. Maintaining data archives accessible inside and outside of NOAA Fisheries, as appropriate, with appropriate database infrastructural elements is one step for doing so. Additionally, improving access to data, meta-data, and data servers will likely increase the utility of the data collected, and make it more palatable for use in other facets of the Strategy. Development of data visualization tools would facilitate uptake and understanding data related to climate change.

Staffing considerations are key for addressing this strategy. Dedicated LMR-climate staff are needed in the science centers and regional offices to help produce, deliver, and use climate-related information in fulfilling NOAA Fisheries' mission activities. There is also a need for training and development of analytical capacity for NOAA Fisheries personnel. Research and provision of climate-smart management advice is predicated upon a workforce with the vision, understanding, and capability to analytically address the needs described throughout this Strategy. Additional analytical billets, quantitative training, and increased awareness of climate-change needs are warranted to increase the production, delivery, and use of climate-related information in fulfilling NOAA Fisheries' mission activities.

Many entities outside of NOAA Fisheries collect data, conduct research, build models, and develop predictions that are useful for projecting future states of LMRs, habitats, ecosystems, human communities, and their use of LMRs under climate change (Table 2). Communication of the utility of these resources and their contribution to NOAA Fisheries' LMR mandates should be highlighted by NOAA Fisheries. NOAA Fisheries has a foundation of partnerships within NOAA (e.g., Office of Oceanic and Atmospheric Research, National Ocean Service) and with other entities (e.g., state and other federal agencies, academia, industry etc.; Table 2). Building on and strengthening these internal and external foundations are a critical component of developing an efficient and comprehensive capacity for modeling future states. Gaps in scope and capacity of NOAA Fisheries programs will necessarily need to be filled by expanding existing and establishing new partnerships with programs outside the agency.

Important strategies to bolster and better deliver climate-smart science infrastructure include:

- Increase the Fisheries and the Environment (FATE), Fisheries Oceanography, and IEA program budgets, including investment in socio-economic research.
- Maintain 10 percent of overall NOAA Fisheries science budget directed to process-oriented research.
- Establish dedicated climate-LMR FTEs at each fisheries science center with a portion of their time dedicated to coordinating with managers in NOAA Fisheries Regional Offices through regional teams.
- Bolster NOAA Fisheries climate-LMR coordination nationally.
- Continue and expand NOAA Fisheries' participation in cross-governmental efforts related to climate change.

Chapter 3

MOVING FORWARD

Given the scale of U.S. dependence on LMRs, and the expected pace, scale, and scope of climate-related impacts on marine, coastal, and freshwater ecosystems, immediate action is needed to understand, prepare for, and respond to these changes in ways that reduce impacts and increase resilience of LMRs for current and future generations (Osgood 2008; Intergovernmental Panel on Climate Change 2013; Melillo et al. 2014). This Strategy provides a blueprint for strengthening the production, delivery, and use of the climate-related information needed to fulfill NOAA Fisheries mandates in a changing climate. It is intended to provide a national framework that can be regionally tailored and implemented through NOAA Fisheries Science Centers, Regional Offices, and their partners via existing planning processes. Implementation of the Strategy over the next 5 years is critical for effective fulfillment of NOAA Fisheries mission and mandates in a changing climate.

This Strategy identifies seven priority objectives and strategies to address them. Many of the recommendations are designed to address common needs across mandates, regions, and LMRs, so implementation of these items could have especially high utility and return on investment. While some impacts of climate change on LMRs are shared across regions, each region has a unique combination of climate-related challenges, capabilities, and information needs that will need to be assessed as part of developing Strategy implementation plans for each region. The seven objectives are intended to identify areas that should be addressed by each region, although the specific actions and priorities should be determined by science and management experts in each region.

The Strategy is designed to provide a consistent, national framework that is primarily implemented through regional plans. The regional implementation plans will focus on building regional capacity, products, and services under the seven objectives based on evaluation of regional, climate-related, LMR information needs, and existing strengths, weaknesses, opportunities, and challenges to address them. While the particular timeline for implementation will depend on specific budget realities, regional implementation plans are expected to guide implementation of this Strategy through a variety of means, including adjustments to programs within existing budgets and initiation of additional efforts using new resources.

In developing this Strategy, a variety of science and information needs came up repeatedly as priorities to be addressed because they were common needs across many mandates and regions. Addressing these needs is key to meeting a variety of other requirements and, if filled, would advance climate-ready LMR management over the next 5 years.

The following is a list of recommendations to help implement this Strategy. This list is designed

to help launch and make major strides toward implementation over the next 5 years. Implementing these recommendations will efficiently and effectively increase the production, delivery, and use of climate-related information in NOAA Fisheries LMR management and thereby reduce impacts and increase resilience of LMRs and the people that depend on them in a changing climate.

PRIORITY ACTIONS:

Three main products or activities consistently emerge across all seven objectives of the Strategy. We highlight these here as the major, ongoing, prioritized actions that will best help NOAA Fisheries address its mandates in a more climate-ready manner. We recommend these be adopted and executed as soon as is appropriate, given the other, more time-constrained or infrastructural needs subsequently identified below.

1. Conduct climate vulnerability analyses in each region for all LMRs.
2. Establish and strengthen ecosystem indicators and status reports in all regions.
3. Develop capacity to conduct management strategy evaluations regarding climate change impacts on management targets, priorities, and goals.

PRIORITY NEAR-TERM ACTIONS:

The following are key near-term recommendations to advance implementation of this Strategy in the 6 to 24 months after the release of this report:

1. Strengthen climate-related science capacity within each region and nationwide.
    a. Bolster national and region-level capacity for implementing the Strategy and advancing LMR-ecosystem-climate initiatives to support implementation
    b. Establish dedicated LMR-climate leads at Science Centers and Regional Offices to increase coordination, priority setting, evaluation, and implementation of the Strategy at regional levels.
    c. Establish regional climate-LMR teams composed of Science Center, Regional Office, and external partners to help strengthen the production, delivery, use, and evaluation of climate-related information in LMR management.
    d. Strengthen production and delivery of output from climate-driven regional ocean models used for projecting climate impacts on LMRs
    e. Strengthen production and delivery of output from climate-driven regional models of temperature, precipitation, and other factors used for projecting climate impacts on LMRs in coastal and freshwater habitats.
2. Develop regional-level implementation plans to execute this Strategy based on Science Center, Regional Office, and external partners' assessment of:
    a. Specific climate-LMR issues in the region.
    b. Barriers to producing, delivering, and incorporating climate-related information into LMR management.

   c. Major climate-related data and information gaps in the region.
   d. Existing strengths, weaknesses, opportunities, and challenges to implement the Strategy.
3. Ensure that adequate resources are dedicated to climate-related, process-oriented research.
   a. Initiate or expand partnerships with key science providers (e.g., OAR, NASA, USGS, NSF, IMR) to leverage and attract resources to help meet NOAA Fisheries climate-related science and information needs.
   b. Leverage planned and new initiatives.

4. Establish standard, climate-smart terms of reference to apply to all of NOAA Fisheries LMR management, environmental compliance requirements, and other processes that cross multiple mandates and core policy areas.

PRIORITY MEDIUM-TERM ACTIONS:

The following are key medium-term recommendations to advance implementation of this Strategy. These are intended to be ongoing with significant progress (e.g., first phase completed) within 2-5 years after the release of this report:

Workshops and training

1. Establish regular, NOAA-wide, national, climate-science workshops with LMR emphasis, with a focus on climate-ready BRPs and science for setting Harvest Control Rules, ESA evaluations (section 7 and section 10), essential fish habitat consultations, aquaculture, and NEPA analyses in a changing climate.
2. Increase awareness of and training for NOAA Fisheries science and management staff on the impacts of climate change on LMRs and climate-informed LMR management practices.
3. Organize and conduct regime-shift detection workshops for each region.
4. Organize and conduct distribution shift workshops, with implications for stock and population identification and unit area across all LMRs in each region.
5. Organize and conduct vital rate workshops, with implications for LMR life-history parameters across all LMRs in each region.
6. Organize and conduct workshops aimed at identifying regional data gaps (biological, physical, and socio-economic) related to climate variability and change and devising data collection programs aimed at filling those gaps, especially socio-economic gaps.

Engagement and outreach

7. Develop and execute national and regional science communication plans for increasing dissemination of climate-related LMR science and information to technical users and other interested stakeholder audiences.
8. Expand and support engagement with international partners to advance the production, delivery, and use of climate-related information (e.g., Climate-LMR related workshops, symposia, meetings, etc.) with specific focus on climate-

informed biological reference points, climate-smart Harvest Control Rules, management strategy evaluations for climate-ready LMR management, climate-smart protected species and habitat consultations, and management strategy evaluations for climate-ready species and habitat recovery.

9. Continue and expand NOAA Fisheries' participation in cross-governmental, national efforts to advance climate-related science LMRs.

Science to inform policy

10. Work with partners to re-evaluate risk policies under a changing climate and ocean.
11. Establish science-based approaches for shifting biological reference points to account for changing productivities, distributions, and diversities.
12. Conduct management strategy evaluations on climate scenarios in extant ecosystem and population models in conjunction with NOAA IEA program, NOAA Fisheries Stock Assessment Improvement Plan Update/Next Generation Stock Assessment, NOAA Fisheries Protected Resources Stock Assessment Improvement Plan, and development of ESA Five-Year Status Reviews.
13. Establish science-based thresholds for exiting and entering fisheries.
14. Establish and implement clear policies and practices for incorporating climate change into all NEPA and ESA (i.e., listing, recovery planning, interagency consultations, and permitting) activities.
15. Establish and implement standards and guidelines for incorporating climate change information into Fisheries Management Plans and Fisheries Ecosystem Plans.
16. Develop and implement standards and practices to promote climate resilience and climate mitigation in NOAA Fisheries habitat conservation activities.
17. Develop climate-driven regional ocean models for use in projecting climate impacts on LMRs.

Science planning and management

18. Develop a national inventory of key science and information gaps related to NOAA Fisheries LMR and socio-economic responsibilities, building on regional data/information gap assessments.
19. Increase support for existing programs addressing priority needs and objectives identified in this Strategy (e.g., FATE, Fisheries Oceanography, IEA).
20. Establish common climate-smart input data vectors/matrices for inclusion in LMR assessments in conjunction with NOAA Fisheries Stock Assessment Improvement Plan Update/Next Generation Stock Assessment and Protected Resources Stock Assessment Improvement Plan, and development of ESA Five-Year Status Reviews.
21. Identify and support process research linking changing climate and ocean to LMR dynamics.
22. Identify and maintain capability to execute process-oriented oceanographic cruises for climate-smart observations.
23. Increase capability to undertake climate-smart, socio-economic research projects and analyses of human uses of LMRs and their ecosystems.
24. Develop climate-resilient and climate-mitigating aquaculture strategies.

SUMMARY

In summary, changes in the planet's climate system are already affecting the nation's valuable marine, coastal, and freshwater LMRs. These impacts will affect the services these LMRs provide; the many people, businesses, and communities that depend on LMRs (Osgood 2008; Doney et al. 2012; Melillo et al. 2014); and NOAA Fisheries' LMR management efforts.

This Strategy outlines seven key parts of the operational framework needed to incorporate climate change into the management of LMRs and their associated habitats, ecosystems, and human systems. It is clear that addressing the information and management challenges of climate change will require a cross-cutting effort that spans NOAA Fisheries LMR stewardship mandates (Figure 3) and many partners (Table 2). Thus, in many respects the need to adopt ecosystem-based management is crucial as we move to implement this strategy (MacLeod and Leslie 2009; Link 2010). From the seven objectives of the Strategy, several common items with high utility are identified as priorities with high return for investment. These are approaches that are valuable across mandates, regions, LMRs, and priority areas. The commonality of information needed across mandates should be useful to gain efficiencies in how that material is produced and delivered.

The main recommendations of the Strategy emphasize facets of climate-related LMR science and management that address critical needs and will have a high return on investment. With adequate resources (people, funding, technology), implementation of the Strategy will provide resource managers with the information they need to sustain the nation's valuable LMRs and the people that depend on them in a changing climate.

GLOSSARY

Adaptation: (1) An adjustment in natural or human systems to a new or changed environment that exploits beneficial opportunities or moderates negative effects (Melillo et al. 2014); (2) Minimizing the impact of climate change on fish and wildlife through the application of cutting-edge science in managing species and habitats (U.S. Fish and Wildlife Service 2010).

Biological Reference Point(s): A biological benchmark against which the abundance of the stock or the fishing mortality rate can be measured in order to determine its status. These reference points can be used as limits or targets, depending on their intended usage (Blackhart et al. 2006).

Climate Change: Refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer (Intergovernmental Panel on Climate Change 2007).

Climate System: The climate system is the highly complex system consisting of five major components: the atmosphere, the hydrosphere, the cryosphere, the lithosphere and the biosphere, and the interactions between them. The climate system evolves in time under the influence of its own internal dynamics and because of external forcings such as volcanic eruptions, solar variations and anthropogenic forcings such as the changing composition of the atmosphere and land use change (Intergovernmental Panel on Climate Change 2013).

Climate Variability: Refers to variations in the mean state and other statistics of the climate on all temporal and spatial scales beyond that of individual weather events (Intergovernmental Panel on Climate Change 2007).

Diadromous: Diadromous species spend part of their life-cycle in fresh water and other part in salt water. Diadromous is the term used to refer to anadromous, catadromous, or amphidromous species.

Ecosystem connectivity: Ecosystem connectivity is the degree in which the marine ecosystem facilitates or impedes movement among different habitats. Connectivity includes both structural connectivity (the physical arrangements of habitats) and functional connectivity (the movement of individuals among habitats).The degree to which an ecosystem is connected determines the amount of dispersal there is among habitats, which influences gene flow, local adaptation, extinction risk, colonization probability, and the potential for organisms to move as they cope with climate change.

Ecosystem Based Management: Ecosystem Based Management is an integrated approach to management that drives decisions at the ecosystem level to protect the resilience and ensure the health of the ocean, our coasts and the Great Lakes. Ecosystem Based Management is informed by science and draws heavily on natural and social science to conserve and protect our cultural and natural heritage, sustaining diverse, productive, resilient ecosystems and the services they provide, thereby promoting the long-term health, security, and well-being of our Nation (Ocean Research Advisory Panel 2013).

Fisheries Management Plan: A document prepared under supervision of the appropriate fishery management council for management of stocks of fish judged to be in need of management. The plan must generally be formally approved. A Fisheries Management Plan includes data, analyses, and management measures. A plan containing conservation and management measures for fishery resources, and other provisions required by the Magnuson-Stevens Act, developed by fishery management councils or the Secretary of Commerce (Blackhart et al. 2006).

Greenhouse Gases: A gas in the atmosphere of natural or human origin that absorbs and emits thermal infrared radiation. Water vapour, carbon dioxide, nitrous oxide, methane and ozone are the main greenhouse gases in the Earth's atmosphere. Their net impacts is to trap heat within the climate system (Intergovernmental Panel on Climate Change 2013).

Integrated Ecosystem Assessment: An Integrated Ecosystem Assessment is a formal synthesis and quantitative analysis of information on relevant natural and socioeconomic factors in relation to specified ecosystem management goals. It involves and informs citizens, industry representatives, scientists, resource managers, and policy makers through formal processes to contribute to attaining the goals of an ecosystem approach to management (Levin et al. 2008).

Intensity of upwelling and downwelling: Upwelling intensity depends on wind strength and seasonal variability, as well as the vertical structure of the water, variations in the bottom bathymetry, and instabilities in the currents. Upwelling is the upward motion of cold, nutrient rich deep water along the coast. Downwelling involves the downward motion of warm waters along the coast. (NOAA: http://oceanservice.noaa.gov/facts/upwelling.html)

Large Marine Ecosystem: Large Marine Ecosystems are large areas of ocean space, approximately 200,000 km² or greater, that have been identified for conservation purposes. They are located in coastal waters characterized by unique species, levels of productivity, bathymetry, and hydrography (Blackhart et al. 2006).

Management Strategy Evaluation: The evaluation of a strategy adopted by the management authority to reach established management goals. In addition to the objectives, it includes choices regarding all or some of the following: access rights and allocation of resources to stakeholders, controls on inputs (e.g., fishing capacity, gear regulations), outputs (e.g., quotas,

minimum size at landing), and fishing operations (e.g., calendar, closed areas, and seasons) (Blackhart et al. 2006).

Mitigation: Implementing actions to reduce greenhouse gas emissions or increase the amount of carbon dioxide absorbed and stored by natural and man-made carbon sinks (Melillo et al. 2014).

Mixed layer depth: The surface layer of the ocean that is mixed by the action of waves and tides so that the waters are nearly isothermal and isohaline; underlain by a pycnocline

Nutrient availability: Chemicals (such as nitrogen and phosphorus) that plants and animals need to live and grow. At high concentrations, particularly in water, nutrients can become pollutants.

Ocean acidification: Ocean acidification refers to a reduction in the pH of the ocean over an extended period, typically decades or longer, which is caused primarily by uptake of carbon dioxide from the atmosphere, but can also be caused by other chemical additions or subtractions from the ocean. Anthropogenic ocean acidification refers to the component of pH reduction that is caused by human activity (Intergovernmental Panel on Climate Change 2013).

Ocean Circulation: The large scale movement of waters in the ocean basins. Winds drive surface circulation, and the cooling and sinking of waters in the Polar Regions drive deep circulation.

Potential Biological Removal: Defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. The Potential Biological Removal level is the product of the following factors: the minimum population estimate of the stock; one-half the maximum theoretical or estimated net productivity rate of the stock at a small population size; and a recovery factor of between 0.1 and 1.0 (NOAA Fisheries Office of Protected Resources 2014).

Projection: The potential evolution of a quality or set of quantities, often computed with the aid of a model. Projections are distinguished from predictions in order to emphasize that projections involve assumptions – concerning, for example, future socio-economic and technological developments, that may or may not be realized – and are therefore subject to substantial uncertainty (Intergovernmental Panel on Climate Change 2007)

Resilience: Capacity of a natural system (fisheries community or ecosystem) to recover from heavy disturbance such as intensive fishing (Blackhart et al. 2006).

Salinity: 'Salinity' refers to the weight of dissolved salts in a kilogram of seawater. Because the total amount of salt in the ocean does not change, the salinity of seawater can be changed only

by addition or removal of fresh water. (IPCC, 2013 pg. 265)

Scenario: A plausible and often simplified description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technology change, prices) and relationships. Scenarios are neither predictions nor projections and sometimes may be based on a "narrative storyline." Scenarios may be derived from projections but are often based on additional information from other sources (Blackhart et al. 2006).

Sensitivity: The degree to which a system is affected, either adversely or beneficially, by climate variability or climate change. The effect may be direct (e.g., a change in population size in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise) (adapted from Intergovernmental Panel on Climate Change 2007).

Upper Ocean stratification: Water stratification occurs when water masses with different properties - salinity (halocline), oxygenation (chemocline), density (pycnocline), temperature (thermocline) - form layers that act as barriers to water mixing which could lead to anoxia or euxinia. These layers are normally arranged according to density, with the least dense water masses sitting above the more dense layers. The upper ocean term refers to the density difference between 200m and the surface. (Miller, Charles B. (2004). Biological Oceanography. Blackwell Publishing.)

Vulnerability: The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed and its adaptive capacity (Melillo et al. 2014).

Wind mixing: Wind mixing increases turbulence levels in the water column. It has been shown that turbulent mixing can increase the contact rates between zooplankton and their prey. As turbulence increases, however, the probability of successful prey capture declines. The probability of feeding success therefore is dome-shaped with a maximum at intermediate levels of wind-speed and turbulence. The impact of changes in wind intensity must therefore be evaluated with respect to the optimal wind speeds and levels of turbulence. (http://www.nefsc.noaa.gov/ecosys/ecology/Climate/)

TABLES

Table 1. Key mandates areas for NOAA Fisheries, with notes on authorities, objectives, thresholds, regulatory devices, and analytical frameworks. In general, fulfilling these NOAA Fisheries mandates requires consideration of the impacts of climate and other environmental conditions on LMRs.

	NOAA Fisheries Mandated Areas of Emphasis				
	Fisheries	*Protected Species*	*Aquaculture*	*Habitat*	*Ecosystems*
Primary Authorizing Mandates	Magnuson-Stevens Act	Endangered Species Act Marine Mammal Protection Act	National Aquaculture Act	Magnuson-Stevens Act Endangered Species Act Others*	National Environmental Policy Act National Ocean Policy Others**
Primary Objectives	Prevent overfishing, rebuild overfished stocks, realize full potential benefit to the nation	Conserve, protect, and recover protected marine life and the ecosystems on which they depend	Provide for the development of aquaculture in the United States	Preserve, protect, develop, and where possible, restore or enhance habitat	Consider environmental and socio-economic impacts and evaluate cumulative effects when enacting policies and planning action

Primary Thresholds	Annual Catch Limits (and Targets) linked to Optimal Yield †	Minimum Viable Population linked to Extinction Risk††	Cost-benefit ratio linked to economic and ecological viability	Fractional Areas of Degraded Habitat (or loss of essential habitat features)	Integrative Ecosystem Indicator Thresholds linked to Pressures
		Appreciable reduction in population viability††			
		Recovered Populations (Optimal, Sustainable, Viable) ††			Cumulative Production
What are main regulatory or management delivery delivery-devices to achieve objectives	Fishery Management Plans	Section 4 Listings	Permitting of aquaculture farms	Restoration Plans	Environmental Impact Statements and Social Impact Assessments
		Section 7 consultations, Section 10 take permits		Essential Fish Habitat Designation	
				Section 7 consultations, Section 10 take permits	
	Rebuilding Plans	Conservation (Recovery) Plans	Site Reviews	Conservation (Recovery) Plans	Fishery Ecosystem Plans

			Site Reviews		
What are main analytical frameworks to develop thresholds	Stock Assessments	Stock Assessments (Status Reviews)	Feasibility Assessments	Habitat Assessments	Integrated Ecosystem Assessments

*e.g. Coastal Zone Management Act; Clean Water Act; Federal Power Act; Oil Pollution Act; Fish and Wildlife Coordination Act; Coastal Wetlands Planning, Protection, and Restoration Act; American Recovery and Reinvestment Act

** Many individual Acts have included ecosystem considerations. The challenge is to simultaneously meet ecosystem objectives of each Act.

† proxied by biomass and fishing rate limits

†† or related

Table 2. Information collected by other entities that is useful for NOAA Fisheries' management of living marine resources under a changing climate.

Entity	**Information**
NOAA	
Oceans and Atmospheric Research	Physical and chemical ocean conditions Physical oceanographic models Coupled bio-physical models Climate monitoring and prediction
National Weather Service	Weather monitoring and prediction Storm monitoring and prediction
National Ocean Service	Shoreline monitoring Estuarine monitoring
National Environmental Satellite, Information, and Data Service	Ocean and coastal monitoring Sea ice monitoring Data management services
Integrated Ocean Observing System	Physical and chemical ocean conditions
Federal agencies	
National Aeronautics and Space Administration	Physical ocean monitoring Ocean productivity monitoring Ocean circulation monitoring
Environmental Protection Agency	Coastal monitoring
US Geological Service	Stream monitoring
US Department of Agriculture	Food/Seafood supply and demand
US Army Corps of Engineers	River monitoring
US Census Bureau	Demographics, employment, regional economic conditions
Industry	Fishing effort Bycatch information Aquaculture performance
Academia	Physical and chemical ocean conditions Species response to changing conditions

	Mechanistic studies Climate models Oceanographic models Ecosystem models Life-cycle models Social and economic models Management strategy evaluation
States	Coastal monitoring Data on state-managed fisheries
Tribes	Data on tribal-run fisheries Local traditional knowledge for on the ground changes
Countries	Data on national fisheries Data on fisheries in international waters

Table 3. Recommended strategies to address each objective.

Objective 1: Identify appropriate, climate-informed reference points for managing LMRs. ● identify ecosystem-based reference points that include climate change and ecosystem information for all LMR management plans and strategies. ● modify existing biological reference points that fail to include ecosystem considerations and assume that environmental conditions of the past will persist into the future; ● communicate that ecosystem-based biological reference points improve accuracy, especially under climate change; ● foster innovation in climate-smart scenario testing; ● elucidate the positive opportunities associated with emerging LMRs; and ● develop scientific underpinning for Environmental Impacts Statements for climate change in each region, including comprehensive socio-economic impact analyses.
Objective 2: Identify robust strategies for managing LMRs under changing climate conditions. ● conduct management strategy evaluations and generate other information to allow risk-based policies to be re-evaluated under a changing climate; establish science-based approaches and policies for determining biological reference points and LMR and ecosystem productivities with changing climate and ecosystem conditions; ● establish science-based thresholds and policies for dealing with the immigration and emigration of LMRs to/from ecosystems; ● conduct more routine and regular LMR management strategy evaluations with NOAA Fisheries partners and constituents to provide science-based assessments of management options in a changing climate; ● examine efficacy of proposed mitigation strategies; and ● include human behavioral response or motivations into management design.
Objective 3: Design adaptive decision processes that can incorporate and respond to changing climate conditions. ● design scientifically sound review-evaluation protocols that could ensure consideration of climate change as a standard part of LMR management advice; ● develop and document the scientific basis for the need for climate change considerations in legislation or technical guidance; ● identify the many ways that information and understanding related to climate change can be inserted into the management process; and ● establish climate-ecosystem criteria that could become a standard part of review of LMR advice
Objective 4: Identify future states of marine, coastal, and freshwater ecosystems, LMRs, and LMR -dependent human communities in a changing climate. ● develop a standard modeling toolbox or at least documented best practices to link future ocean and freshwater states and LMRs, with ability to couple models across types; ● establish best practices for modeling under uncertainty (e.g., multi-model inference);

- research socio-economic consequences of future climate scenarios and LMR, and explore range of probable human LMR-use responses; and
- build on past National Ecosystem Modeling Workshops (NEMoWs).

Objective 5: Identify the mechanisms of climate impacts on ecosystems, LMRs, and LMR-dependent human communities.

- identify process research gaps in each region
- develop additional NOAA process research capacity internally and through competitive funding opportunities
- develop and maintain partnerships to conduct climate-LMR-related research;
- organize and host regular national climate workshops with LMR emphasis for NOAA employees across line-office and external partners to advance research efforts and promote collaboration;
- develop and maintain partnerships with international and other organizations to conduct LMR-climate workshops;
- organize and host regional thematic workshops related to LMR response to climate change (regime shift, distribution shift, vital rates, etc.);
- conduct research to identify a suite of proposed mitigation strategies, including those targeted at LMR-dependent human communities; and
- strengthen core science partnerships with formal mechanisms, especially with academic institutions, NASA, USGS, NSF, EPA, etc.

Objective 6: Track trends in ecosystems, LMRs, and LMR-dependent human communities and provide early warning of change.

- utilize climate vulnerability risk analyses to conduct triage and prioritization for climate change science related to LMR management;
- develop and maintain standard climate-LMR report cards to communicate data and understanding available to all stakeholders;
- conduct regional assessments of strengths, weakness, opportunities, and challenges related to LMR science and management in the face of climate change;
- emphasize the critical need of ongoing monitoring in science planning and budgeting processes;
- train staff in time-series analyses; and
- engage in scoping exercises related to LMR science and management in the face of climate change with partners and constituents.

Objective 7: Build and maintain the science infrastructure needed to fulfill NOAA Fisheries mandates under changing climate conditions.

- increase the Fisheries and the Environment (FATE), Fisheries Oceanography, and IEA program budgets, including investment in socio-economic research;
- maintain 10% of overall NOAA Fisheries science budget directed to process-oriented research;

- establish dedicated climate-LMR FTEs at each fisheries science center with a portion of their time dedicated to coordinating with managers in NOAA Fisheries Regional Offices through regional teams;
- bolster NOAA Fisheries climate-LMR coordination nationally; and
- continue and expand NOAA Fisheries participation in cross-governmental efforts related to climate change.

Figure 1: General illustration of possible impacts of climate variability and change on physical/chemical, biological, social, and economic components of marine, coastal, and freshwater ecosystems, along with general avenues of possible human action to promote resilience/adaptation of resources/people, as well as mitigation of emissions and atmospheric changes.

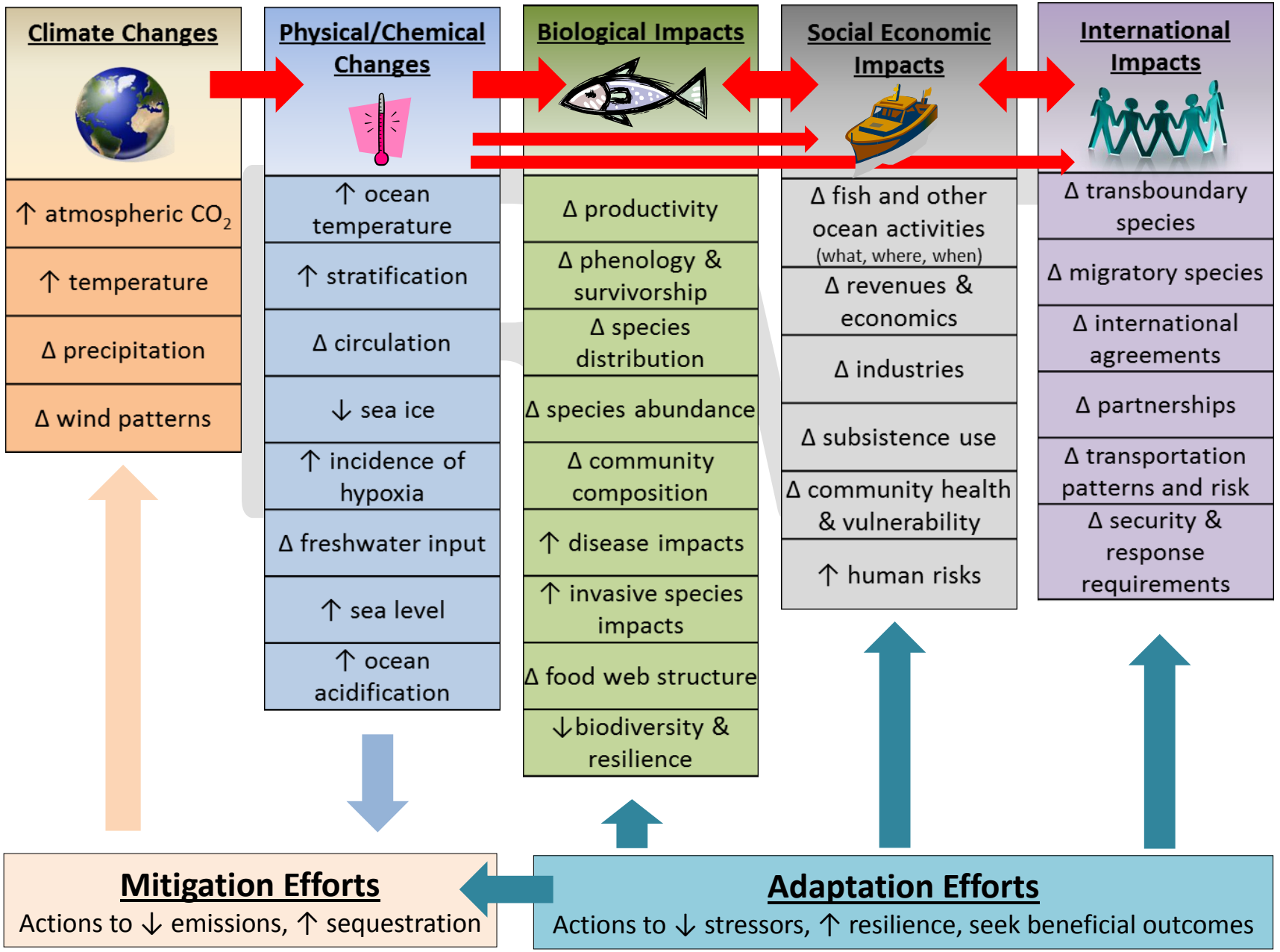


Figure 2. A simplified, generic LMR management process. There are distinctions and caveats across all NOAA Fisheries mandates, but this generalized version depicts the major steps required to produce management (mgt) advice to fulfill NOAA Fisheries mandates. A key point is that climate information can be inserted at each step in the process. It is understood that this process is then iterated to continually improve the information provided to make management decisions.

Figure 3. Meeting NOAA Fisheries mandates in a climate-smart manner requires that climate-related information is produced and inserted into many steps of a generic LMR management process, as well as coordination across them where appropriate. To fully meet all NOAA Fisheries mandates, an ecosystem-based approach to fisheries management (EBFM) is necessary.

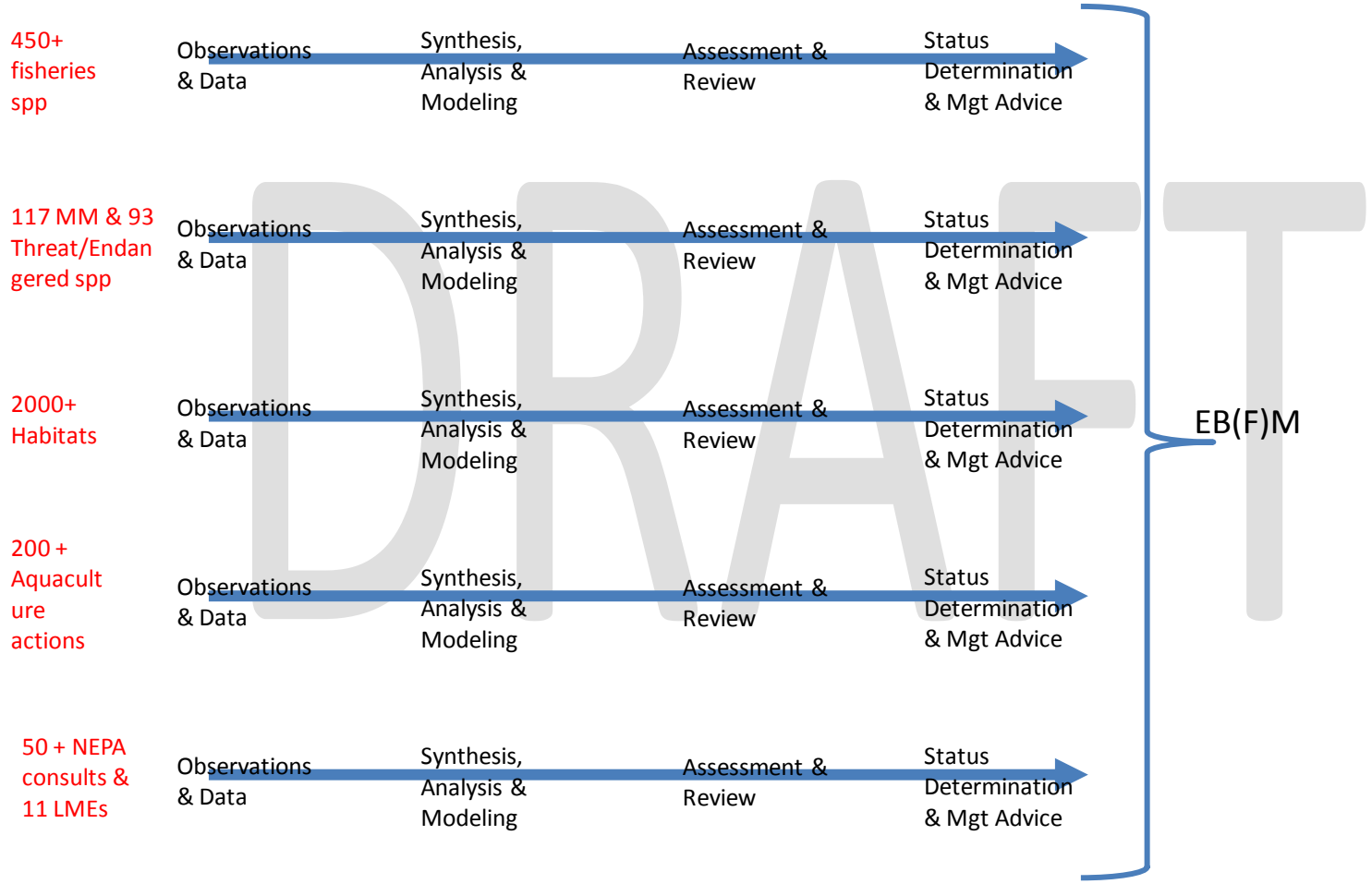
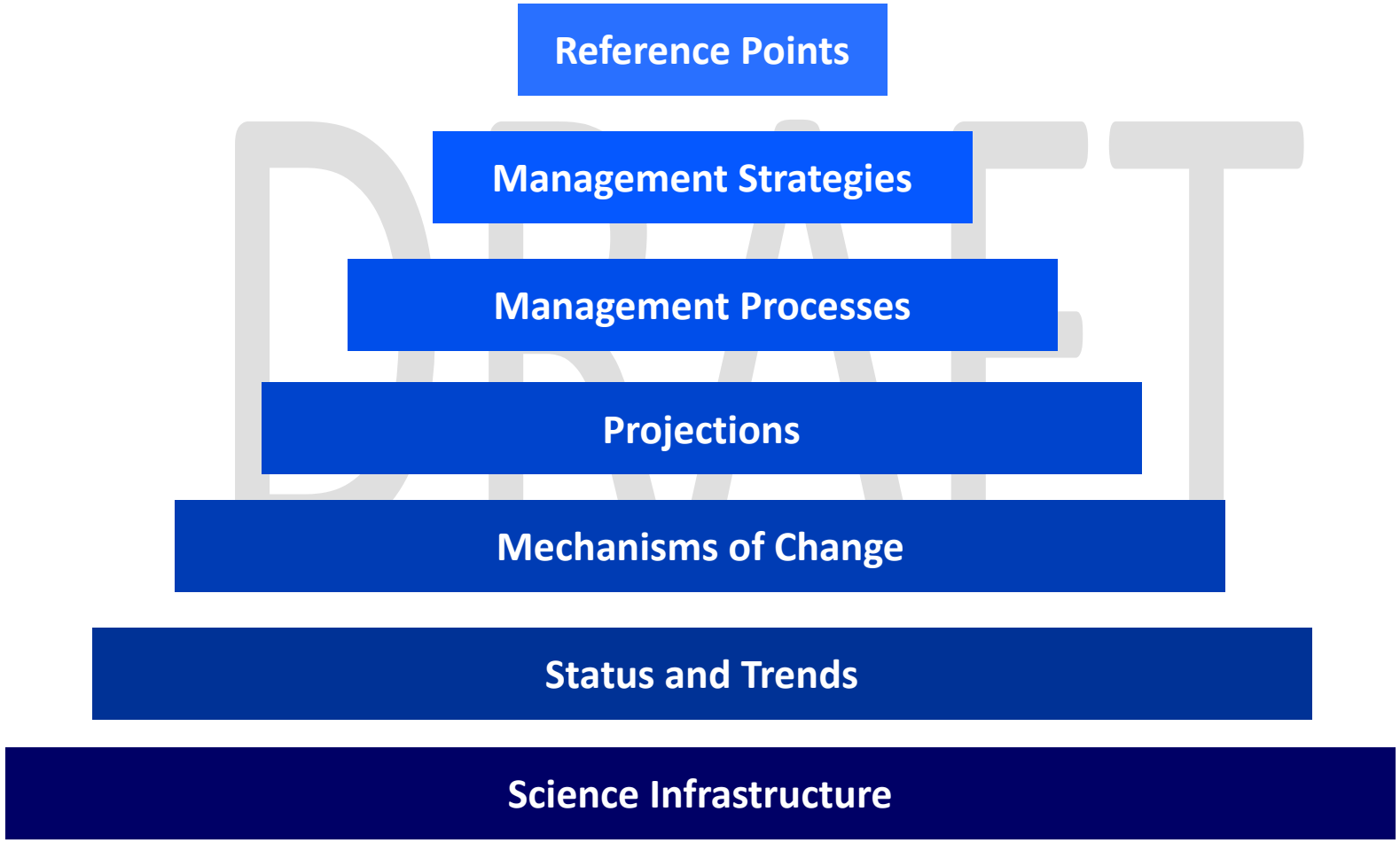


Figure 4. Seven priority objectives for the NOAA Fisheries National Climate Science Strategy. The ultimate goal is to provide management advice to meet NOAA Fisheries mandated responsibilities, with each prior level required to support that and subsequent objectives



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Gulf of Mexico Fishery Management Council

Managing Fishery Resources in the U.S. Federal Waters of the Gulf of Mexico

2203 N. Lois Avenue, Suite 1100
Tampa, Florida 33607 USA
Phone: 813.348.1630 • Toll free: 888.833.1844 • Fax: 813.348.1711
www.gulfcouncil.org

D R A F T

Valerie Termini
NMFS, Office of Science and Technology
1315 East-West Highway, Silver Spring, MD 20910

NCSS Public Comment

Dear Ms. Termini:

The Gulf of Mexico Fishery Management Council (Council) reviewed the NOAA Fisheries Draft Climate Science Strategy on three occasions. The Council was briefed by Roger Griffis at the January Council and March SSC meetings and the Council's Sustainable Fisheries/Ecosystem Management Committee reviewed the strategy in more detail during the March Council meeting. The Council applauds NOAA Fisheries for producing such a comprehensive strategy for building a framework to address potential climate impacts on our living marine resources and is eager to participate in the development of southeast regional implementation plan.

The challenges posed in the Climate Science Strategy are great and best exemplified by difficulties encountered by the scientific community to develop ecosystem models to inform management. But, as the proposed strategy clearly explains, the need to address climate impacts is imperative if fishery managers are to accurately ascribe population changes to underlying effects and make robust and appropriate management decisions.

While the Council understands the need to use the best available science, the science never seems as well developed as needed. The Council's main concern with the proposed strategy is that NOAA Fisheries not rush too quickly into establishing guidelines to develop climate-smart management reference points (Objective 1) and management strategies (Objective 2) before there is an adequate science infrastructure in place to properly inform such changes.

The Climate Science Strategy identifies the need for partners and clearly the Councils are one of those partners. Surprisingly, however, the Gulf Council saw no mention in the strategy of partnering with National Sea Grant to assist with either the educational components or with the various offices within NOS. The Council encourages that the full capabilities of the NOAA family, including the Southeast Fisheries Science Center's integrated ecosystem assessment group that is developing processes for ecosystem assessments, be coordinated to assist in the monumental effort that will be required to address future management challenges in a proactive manner. The Council also urges NOAA Fisheries to work with the various Landscape Conservation Cooperatives that are working on similar issues.

The draft Climate Change Strategy suggests that ecosystem status reports be generated annually or biennially. The Council's Scientific and Statistical Committee (SSC) feels that this is too infrequent, and has recommended reporting as frequently as quarterly in order to detect ecosystem changes at an early stage.

There was little mention in the draft Climate Change Strategy of funding and staffing needs. There needs to be a high priority to providing funding to hire staff and conduct the necessary data collection and research activities to support the Strategy. Increasing capacities of the Science Centers to conduct climate-informed management strategy evaluations would likely require that each Science Center hire an MSE specialist. Diverting existing staff and funding from other critical activities such as stock assessments will only hurt the overall mission of NMFS.

There are some areas where the Council believes additional clarification could be useful. In particular, would a specific adaptive process be defined in a set of guidelines or is the existing Council process considered adaptive? A clearly defined adaptive approach would be useful. The term "Harvest Control Rule" should be clearly defined, especially if the implication is something other than a refinement of our existing ABC Control Rule. The Gulf Council also would like to see an emphasis on maintaining current monitoring facilities that have long time series associated with them.

Thank you for allowing the Gulf Council to provide input into the Draft Climate Science Strategy.

Sincerely,

Kevin Anson,
Chair

cc: Gulf Council
Eileen Sobeck
Roy Crabtree
Bonnie Ponwith
Gulf Council Staff

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Tab B, No. 13

Standing and Special Reef Fish SSC
Meeting Summary
Tampa, Florida
March 11-12, 2015

The meeting of the Standing and Special Reef Fish SSC was held March 11-12, 2015. The Standing, Special Shrimp, and Special Spiny Lobster SSC also met on March 10, 2015. That portion of the meeting is in a separate summary. The Standing and Special Reef Fish SSC did not have a quorum present. Therefore, the SSC did not vote to make OFL and ABC recommendations for mutton snapper and hogfish. OFL and ABC for those stocks will be reviewed at a future meeting.

The agenda was accepted with changes to the order of presentations and the removal of OFL and ABC recommendations for mutton snapper and hogfish. The following minutes were accepted by acclamation as written.

- January 2014 Standing and Special Reef Fish SSC summary minutes
- Reef Fish portion of January 2011 Standing, Special Spiny Lobster, and Special Reef Fish SSC summary minutes

Dr. Will Patterson announced that he would be the SSC representative at the March 30-April 2, 2015 Council meeting in Biloxi, Mississippi.

Reorganization of SSCs as Approved by Council

Mr. Doug Gregory reported that the Council had approved combining the Standing, Ecosystem, and Socio-economic SSCs into a single SSC, with the creation of a new Special Socio-economic SSC. A new online application form will be available on the Council website soon, at which time applications will be accepted to the SSCs until 45 days before the June 2015 Council meeting. Appointments to the reorganized SSCs will be made at the June Council meeting.

FWC SEDAR 15A Mutton Snapper Update Assessment

The SSC did not have a quorum present, and therefore did not vote to recommend mutton snapper OFL and ABC. However, the SSC did review the update assessment and voted on whether to accept it. Mr. Joe O'Hop from Florida FWRI presented the assessment. The South Atlantic and Gulf of Mexico regions were treated as one for the SEDAR 15A assessment and for this update. A statistical catch-at-age model (ASAP) was used as the assessment model. Several suggestions for improvements made by the SEDAR 15A Review Panel were incorporated into this assessment. Changes in the update assessment included:

- Update incorporates
  - New discard data (rates, lengths, dispositions)
  - Revised maturity schedule, new sex ratio data (~1:1)
  - Re-calculated growth curves, M (but similar to SEDAR 15A)
  - New genetics data (still one stock)

  - Stochastic Age-Length-Key (but still external to model)
  - Fishery ALK and Direct aging as sensitivities
  - Newer methods for constructing indices of abundance
  - ALK- age comps for discards, indices of abundance
- Selectivity modeled with logistic and double logistic curves
  - And linkage of fishery dependent indices to fleets
- Adjusted 1981-1991 Head Boat Survey landings and discards
  - [SEDAR41-DW40, August 2014]
- Adjusted MRFSS/MRIP time series, by coast, year, and mode
- Base run, eighty-one sensitivity runs, 10-year retrospective, likelihood profiling, and MCMC (multiple chains)

Indices generally followed the same trends as in the previous assessment. One difference in the results of the update assessment compared to the SEDAR 15A benchmark assessment was a change in the maturity curves. The average length at 50% maturity was reduced from 402 mm (15.8 inches) TL to 388 mm (15.3 inches) total length. The age at 50% maturity was also reduced from 3.71 years to 2.72 years.

A plot of Markov Chain Monte Carlo results for SSB-ratio and F-ratio was made using $F_{30\% SPR}$ as the proxy for F_{MSY}. None of the F-ratios were above 1 (overfishing not occurring). Only 6.2% of the SSB-ratios were less than MSST ($1\text{-}M*B_{MSY}$) and only 24.3% were less than 1, indicating that the stock is not overfished (Figure 1).

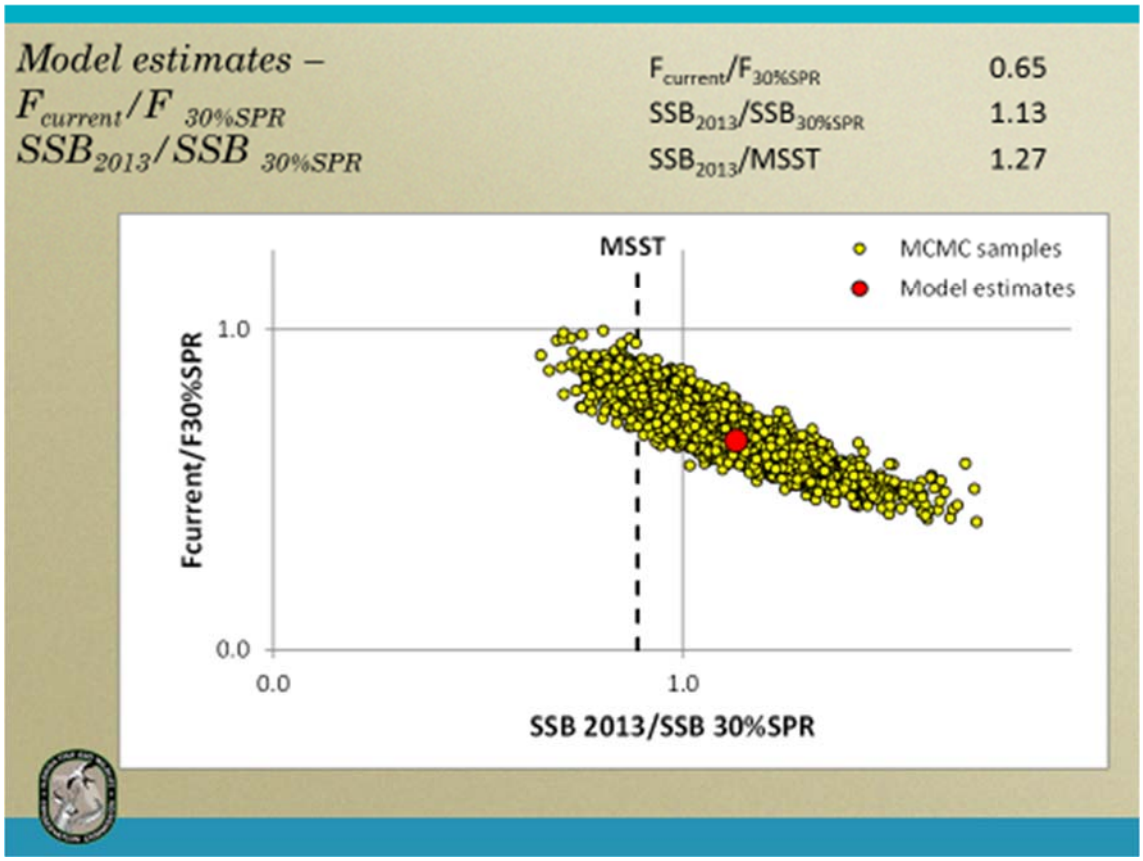

Figure 1. Plot of Markov Chain Monte Carlo results for SSB-ratio and F-ratio

Results of most of the sensitivity runs also indicated the stock was below the overfishing threshold and above MSST (Figure 2). Exceptions were runs using low natural mortality, direct ageing, no age-composition indices (age-structured surplus production model), or with only a single fishery independent index (RVC or Riley's Hump) for model tuning.

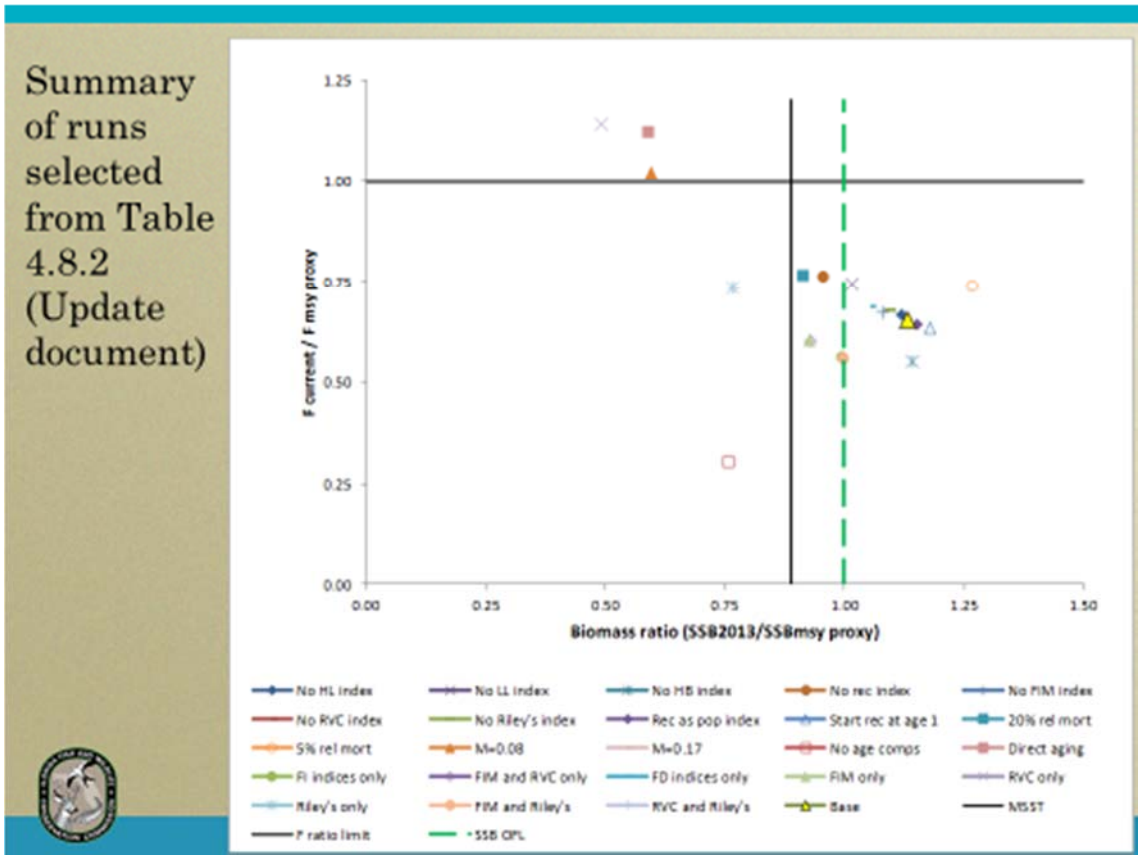

Figure 2. Summary of sensitivity runs.

Upon reviewing the update assessment, the SSC passed the following motion.

> **The Committee accepts that the 2015 SEDAR 15a update assessment of mutton snapper represents the best available science and is suitable for the development of management advice.**
>
> **Motion passed 9-0**

Since a quorum is needed to vote on ABC projections, the SSC did not review projections or recommend OFL and ABC. Furthermore, some SSC members expressed concern about fitting the model with age composition estimates derived from age-length keys when direct aging of the catch was available. The SSC requested additional information to examine that fit versus model runs in which age composition was estimated via direct aging of the catch.

Approximately 85% of the mutton snapper stock occurs in the South Atlantic Council's jurisdiction. The South Atlantic SSC is scheduled to review the mutton snapper update assessment and vote on OFL and ABC when it meets in April. When the Gulf SSC meets again in May, it will review the South Atlantic SSC's recommendations and the results of the additional information requested. At that time, the SSC will decide whether it concurs with the South Atlantic SSC's recommendations.

Minimum Stock Size Threshold Options Paper

Dr. Shannon Cass-Calay reviewed an analysis prepared by the SEFSC of the probability that spawning stock will fall below the MSST in the absence of overfishing when MSST = (1-M)*B_{MFMT} versus other MSST reference points. This analysis was requested by the interdisciplinary planning team that is developing a proposed amendment to adjust MSST for certain stocks managed by the Gulf Council. The analysis modeled three stocks using different proxies for MFMT (F_{MSY} for bluefin tuna, F_{MAX} for vermilion snapper and $F_{30\% SPR}$ for gray triggerfish). For these stocks, estimated natural mortality (M) ranged from 0.14 to 0.27. In the model, abundance was varied randomly while the stock was fished at MFMT. Results showed that fewer than 5% of the model runs resulted in spawning stock levels below MSST at either (1-M)*B_{MFMT} or 0.75*B_{MSY}. None of the model runs resulted in spawning stock levels below MSST at 0.50*B_{MSY}. These results indicate that for the stocks examined, (1-M)*B_{MFMT} appears to be a sufficient buffer against stocks dropping below MSST due to natural fluctuations. However, lower values of M did result in higher probabilities of the stock dropping below MSST despite not experiencing overfishing. As a result, the relationship may breakdown for very small levels of M < 0.1, in which case one might wish to adopt a definition for MSST that does not exceed 0.9*B_{MFMT}.

SSC members suggested that the analysis be conducted for stocks that have a very low M. One SSC member noted that the simulations did not account for all sources of uncertainty, and in his experience 0.75*B_{MFMT} seemed to produce better results than (1-M)*B_{MFMT}. It was pointed out that in setting MSST, the Council needs to consider the costs associated with different levels of MSST. If MSST is only slightly below B_{MFMT}, there is a risk of unnecessarily having to implement a rebuilding plan if the stock fluctuates below MSST but may recover on its own. On the other hand, if MSST is far below BMFMT, the likelihood of unnecessarily implementing a rebuilding plan is reduced, but the cost of rebuilding from a lower MSST will be greater.

Mr. Steven Atran reviewed the actions and alternatives in the MSST options paper. In Action 1, sub-options would define low M as either 0.15, 0.20, or o.25. Based on the SEFSC analysis, M=0.1 might be worth considering as a low M options, and 0.90*B_{MFMT} might be worth considering as an alternative MSST. At the other end of the low M range, SSC members questioned whether 0.25 should be considered low M. Only two stocks in the Gulf for which M has been estimated are above that level; greater amberjack (M = 0.28) and gray triggerfish (M = 0.27).

SEDAR 45 Vermilion Snapper Terms of Reference and Project Schedule

Dr. Julie Neer reviewed the terms of reference for the SEDAR 45 vermilion snapper standard assessment. Under TOR #2, it was noted that there are no new indices of abundance at this time, just additional data for existing indices.

Dr. Cass-Calay noted some changes from the previous update assessment that the Science Center intended to incorporate into the standard assessment. One change is that the model will be fitted to the shrimp effort data series rather than assume a mean shrimp bycatch throughout the series. The Science Center is also reevaluating how it produces discard estimates relative to the previous SEDAR 9 benchmark assessment. Dr. Cass-Calay stated that the Science center was not aware of any new information for vermilion snapper at this time, but it would like to incorporate any new fisheries-independent indices that become available. She asked that anyone who has new information about vermilion snapper that they would like to have considered in the assessment let her know.

An SSC member asked if inputs from the Deepwater Horizon spill could be incorporated into the assessment if feasible. Dr. Neer suggested that this could possibly be included as an episodic event under TOR #2. However, it was noted that the indices would have to show a decline in abundance in order to estimate an episodic M.

A suggestion was made to include the word "standard" in the title of the terms of reference. Dr. Neer responded that they had moved away from identifying assessments in the title as benchmark, standard, or update because of the public perception that standard and update assessments were a lower quality. However, she agreed to include somewhere in the TOR a notation that this is a standard assessment.

A request was made from staff to include in the TOR #5 a constant catch ABC projection that is equivalent to the annual ABC projection during the years for which the SSC makes a projection. A suggestion was made that the mean of the ABCs might serve as a constant catch alternative, but it would need to be analyzed further.

An SSC member suggested that, rather than include all tables and figures in the assessment document, that they be kept in an online digital archive with links from the assessment document. This would allow the document to be smaller in size while allowing more tables and figures to be made accessible that in the current format. Several SSC members expressed support for this approach. Dr. Neer noted that this would be a major change in how assessment documentation is provided.

Following the above discussion and suggestions, the SSC passed the following motion.

The Committee accepts the SEDAR 45 Vermilion Snapper TOR as modified.

Motion passed unanimously.

Review of Draft National Standard 1 Guideline Revisions

Mr. Steven Atran reviewed a NMFS presentation on proposed revisions to the Magnuson-Stevens Act National Standard 1, 3, and 7 Guidelines. This was presented at the recent National SSC workshop and Council Coordinating Committee meeting, and will be presented at Council

meetings over the next couple of months. Mr. Atran also review the marked up document containing the proposed changes.

Under Rebuilding: Adequate Progress, the marked-up text contains a sentence on page 21 that states, "The Secretary shall review rebuilding plans at routine intervals that may not exceed two years…" It was pointed out that the Generic ACL/AM Amendment requires that Council staff examine inclusion/exclusion of species and species groupings in fishery management plans for suitability every five years. However, the Generic ACL/AM amendment provision may be more applicable to the National Standards guidelines section on stocks that require conservation and management than to the section on adequate progress for rebuilding plans.

The presentation included a slide that stated that the annualized expression of OY = ACL. The marked-up text included on page 16, under "Relationship between OY and the ACL framework", the statement, "An annual OY cannot exceed the ACL." SSC members felt that this was reversed and should read, "An ACL cannot exceed annual OY." This led to a discussion concerning the relationship between OY, ACL and ACT. Several SSC members felt that management should move from being driven by buffers to stay away from limits (MSY) to being target (OY) based. One SSC member suggested that this could be accomplished by setting ACT = OY, and then setting ACL at some level between ACT and OFL depending on how large a buffer is needed. This would make ACT the main reference point for management. It was pointed out that not all Councils use ACT, and the Gulf Council considers ACT unnecessary for IFQ managed sectors.

Under Phased-in ABC Control Rule, SSC members felt that clarification was needed as to what was meant by a "comprehensive analysis". It was suggested that a phase-in could result in overfishing continuing during the phase-in, which would violate the Magnuson-Stevens Act requirement to end overfishing immediately unless the catch was kept below OFL. However, if the phase-in catch is kept below OFL, the buffer between OFL and ABC for many Gulf stocks is so small that there would be little benefit to a phase-in. In addition, a phase-in would need to be incorporated into ABC projections.

Under the Carryover ABC Control Rule, this provision does not include any mention of uncertainty in the estimation of catches.

Review of NMFS Climate Strategy

Dr. Roger Griffis, NOAA Office of Habitat Conservation, made a presentation via webinar of the NMFS Draft Climate Science Strategy. An SSC member noted that the Southeast Fisheries Science Center has an integrated ecosystem assessment group that is developing processes for ecosystem assessments, but is running into funding and staffing problems. Dr. Griffis responded that ongoing examples such as this would be useful in his attempts to gain funding for climate science. He noted that NOAA has ranked climates science as one of its top 3 priorities for FY 2016, and one of its top two priorities for FY2017. It was noted that increasing capacity to conduct climate-informed management strategy evaluations would likely require that each Science Center hire an MSE specialist. The Centers might consider diverting existing staff from

stock assessments, but NMFS already has a shortage of assessment scientists and this would reduce NMFS's ability to do stock assessments.

It was noted that the Draft Climate Science Strategy does not contain any mention of mitigation efforts or technology to reduce human impacts such as increased use of hybrid engines. Dr. Griffis responded that NMFS might be able to partner with other agencies to address this issue.

An SSC member asked if the Draft Climate Science Strategy incorporated actions related to state responsibilities and needs. Climate change actions taken by the states could have impacts on species that inhabit state waters during early periods of their life cycle. Dr. Griffis responded that some of the state information needs are the same as the federal needs, but that he would reach out to the state agencies for input.

An SSC member asked how closely NMFS will work with Landscape Conservation Cooperatives (LCCs) that are working on similar issues. Dr. Griffis responded that he recognizes the importance of LCCs and efforts are being made to work with them.

A question was asked as to how often ecosystem status reports would be updated. Every two to three years was suggested, but this was felt to be too infrequent. Some Science Centers produce quarterly status reports which allow them to more quickly identify any changes.

National SSC Workshop V Summary

SSC members and staff who attended the National SSC V Workshop in Honolulu gave their impressions of the meeting. In general, the meeting was felt to be well organized and productive, but it attempted to address too many issues in too short a time. Of note was the introduction of the term, "model resistant stocks", a term which has been applied in some regions to stocks for which fits of assessment models always seem to be poor. SSC attendees felt that this term was a misnomer. Stocks are not model resistant. Rather, in these cases the selected and parameterized models are mis-specified, or other sources of error exist, such that stock dynamics are not fully accounted for by the models.

One SSC attendee expressed concern about the need to incorporate stakeholder needs into the process. A staff member noted an almost complete lack of discussion of recreational fishery concerns. It was noted that, in Hawaii, anyone can buy a commercial license for $20 and become a commercial fisherman.

Western Pacific Council staff is in the process of consolidating comments made by the workshop participants, and will circulate a draft in the near future. Their immediate objective is to formulate recommendation from the workshop to bring to the June CCC meeting. The next National SSC workshop will be hosted by the Pacific Fishery Management Council.

Ecosystem Working Group Summary

Dr. Morgan Kilgour reported the results of a meeting of the Ecosystem Working Group held September 19, 2014. The working group developed an initial set of suggested goals and

objectives incorporating ecosystem based fisheries management into current assessments, and developed approaches for identifying and prioritizing ecosystem and socioeconomic information needs for fisheries managed by the Council. Their recommendations were reviewed by the Ecosystem SSC on February 25, 2015, which recommended that the working group continue working on developing a set of suggested goals and objectives.

Other Business

Starting times for SSC meetings

Council staff asked if SSC members would prefer that meetings start at 8:30 am on the first day or at 1:00 pm which is currently done for most meetings. Several SSC members responded that they would prefer the earlier start if it meant the meeting could last two days instead of three days.

SSC Members Present

Standing SSC
William Patterson, Chair
*Luiz Barbieri, V. Chair
Shannon Cass-Calay
Bob Gill
*Walter Keithly
*Kai Lorenzen
Jim Tolan

Special Reef Fish SSC
Robert Ellis
John Mareska

Council Staff
Steven Atran
Charlotte Schiaffo
Morgan Kilgour
Doug Gregory
John Froeschke
Ryan Rindone

Council Member
Camp Matens

Others Present
Michael Drexler-OC
Bill Kelly- FKCFA
Chad Hanson-PEW
Julie Neer-SEDAR
Joe O'Hop-FWC
Jim Nance-NMFS

* Not present on last day