ToR #7 Ad Hoc Work Group Working Paper

ToR#7 Ad Hoc Group: Anne Lange, Beth Wrege, Tracey Smart, and Rusty Hudson

SEDAR50-DW24

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TOR#7 ad hoc work group working paper (S50-DW24)

ToR #7 *Consider ecosystem and climate issues that could affect population dynamics. Identify and describe available data sources to investigate the effects of abiotic and biotic factors, for example climate change, predator/prey interactions, etc., on recruitment, growth, geographic distribution, and natural mortality.*

TOR #7 was added to the SEDAR TORs to address recent efforts to incorporate more environmental information/data into stock assessment modeling efforts. These efforts encourage exploration for and inclusion of any environmental or climate issues or data sets that might better inform the assessment, or allow more detailed modeling for a stock's assessment.

The ad hoc work group notes that, for blueline tilefish, there is a significant lack of data regarding the distribution of early life stages of blueline tilefish. Not knowing where these life stages naturally occur hampers the ability to identify or describe the effects of abiotic and biotic factors on those life stages. Therefore, the ad hoc work group opted to address this TOR by first identifying the issues associated with lack of data, and then providing or restating recommendations for needed data collections. In addition, we've included several industry observations of specific environmental events that may inform the assessment. Lastly, the group initiated development of a bibliography of documents that could be used to examine such effects, should data become available on the distribution of blueline tilefish life stages.

Data Issues:

A number of the reports and working papers provided for the SEDAR 50 Data Workshop document concerns about lack of data that would address evaluating the effect of environmental factors (e.g., temperature, climate, circulation patterns) on the blueline tilefish stock. A number of factors and recommendations addressing such environmental issues are summarized in the report of the Stock ID workshop (S50-DW12). These include:

- No blueline tilefish were captured in waters less than 8^{o}C bottom temperature. The northern limits of the distribution may be limited by winter bottom temperatures. While there is evidence that increasing temperatures may be promoting a northward expansion of the range of blueline tilefish, work remains to better understand the thermal tolerance if this species.

- Adult blueline tilefish inhabit burrows, which may suggest the species does not migrate over long distances during its adult life.

- Dispersal of the species is thought to occur primarily through egg and larval transport during a protracted spawning season, but very little is known about the egg and larval stages.

- Water current flow maps suggest that larval transport is likely from the Gulf of Mexico to the South Atlantic and from the South Atlantic to the Mid-Atlantic. Satellite drifter data demonstrate the potential for larval retention in the South Atlantic and Mid-Atlantic regions, as well as the potential for a general larval drift from south to north.

- However, there is insufficient data to fully understand the nature and structure of the production function linking spawning potential to subsequent recruitment in blueline Tilefish.

In addition, mechanisms for potential transport of eggs and larval blueline tilefish (e.g., the Gulf Stream, eddies and gyres) are fairly well understood. However, lack of information on larval characteristics, planktonic egg and larval distribution, and larval behavior hinder use of these ocean current data in identifying nursery grounds for blueline tilefish early life stages (S50-DW11).

<u>Recommendations:</u>

Initiate studies to:

- identify blueline tilefish larvae
- investigate larval duration and larval dispersal
- identify juvenile habitat or movement and
- study migration of adult fish
- determine thermal tolerance of blueline tilefish
- collect temperature within the water column
- collect information on location of life stage activities.

<u>Literature Cited:</u>

SEDAR 50 Stock ID Work Group. 2016. Recommendations from the SEDAR 50 (Blueline Tilefish) Stock ID Work Group Meeting. SEDAR50-DW12. SEDAR, North Charleston, SC. 40 pp.

Farmer, N. and N. Klibansky. 2016. Distribution of blueline tilefish (Caulolatilus microps) in the U.S. EEZ from fishery-dependent and fishery-independent data collections. SEDAR50-DW11. SEDAR, North Charleston, SC. 23 pp.

<u>Additional data:</u>

Global ocean surface velocities from drifters with sea surface temperature.
Source: http://oceancurrents.rsmas.miami.edu/atlantic/gulf-stream_2.html

<u>Industry observations of specific events that may impact the stock and/or fishery.</u>

1. The Labrador current was an annual phenomenon during late spring and early summer off the Florida east coast. Duration would last from a week or two to a month or more. The inshore fish would not bite due to the cold water on the bottom, and the closer you got to the West edge of

the Gulf Stream to find fish from the Big Ledge (28 fathoms) and seaward they would bite a hook.

2. For several years now we have experienced cold water emerging from under the Gulf Stream showing up predominately off of South Florida, and then seen in some years northward to Central Florida. The cold temperatures affected the fauna availability for some regions during these events.

3. Most Blueline Tilefish off Florida are caught as a bycatch to the target species Snowy Grouper in 220 feet seaward to 330 feet of depth in mostly hard bottom regions. From Fort Pierce FL north to Daytona Beach and to St. Augustine, the Oculina Steeples [pinnacles] are found in the same depth. Historically, this made it difficult to bottom longline that region before 1992 because of the high risk of the gear getting hung up on these 20 to 70 feet tall features. Most of my successful snowy grouper fishing with blueline tilefish bycatch (90% to 10% ratio) was conducted with bandit reels doing a slow drift over a large area of low feature hard bottom called the Rolldown, north of the steeples. Sometimes when anchored on specific Steeples in 240 feet of depth I would catch an occasional blueline tilefish.

4. Pollution from sewage and other run-off from South Florida, that then travels to the north, on the west side of the Gulf Stream also has been observed. Algae growth also has been a recent issue that has affected the Rock shrimping nets on the inshore side of the Oculina HAPC, from Fort Pierce, north for a distance.

(Initial) Bibliography of documents that may be useful in examining environmental effects:

Fisher, J. A. D., et al. (2014). "Life on the edge: environmental determinants of tilefish (Lopholatilus chamaeleonticeps) abundance since its virtual extinction in 1882." ICES Journal of Marine Science: Journal du Conseil **71**(9): 2371-2378.

Unlike many temperate marine species that alter spatial or depth distributions in response to environmental change, tilefish (Lopholatilus chamaeleonticeps) has such specific habitat requirements that off the coast of New England, USA, it is restricted to the normally warm-water, upper continental shelf slope, where it excavates and occupies burrows. In 1882, tens of millions of adult tilefish died suddenly following the intrusion of lethally cold Subarctic water into the tilefish habitat. Here we show that the same climate driver implicated in the 1882 event (the North Atlantic Oscillation: NAO) has also affected commercial tilefish landings throughout most of the 20th century by altering slope water temperatures and likely the tilefish's reproductive success. We also show that this temperature–landings relationship broke down in the 1970s coincident with dramatically increased exploitation. Reconstructions of decadal to millennial scale variations in slope water temperatures explain why no mass mortality occurred following the 2010 negative NAO anomaly, despite being similar in magnitude to the NAO anomaly that preceded the 1882 event.

Goode, G. B. and T. H. Bean (1878). "Description of Caulolatilus microps, a new species of fish from the Gulf Coast of Florida." Proceedings of the United States National Museum **1**(16): 42--45.

Hollowed, A. B., et al. (2009). "A framework for modelling fish and shellfish responses to future climate change." Ices Journal of Marine Science **66**(7): 1584-1594.

A framework is outlined for a unified approach to forecasting the implications of climate change on production of marine fish. The framework involves five steps: (i) identification of mechanisms underlying the reproductive success, growth, and distribution of major fish and shellfish populations, (ii) assessment of the feasibility of downscaling implications of climate scenarios derived from Intergovernmental Panel on Climate Change (IPCC) models for regional ecosystems to select and estimate relevant environmental variables, (iii) evaluation of climate model scenarios and select IPCC models that appear to provide valid representations of forcing for the region of study, (iv) extraction of environmental variables from climate scenarios and incorporation into projection models for fish and shellfish, and (v) evaluation of the mean, variance, and trend in fish and shellfish production under a changing ecosystem. This framework was applied to forecast summer sea surface temperature in the Bering Sea from 2001 to 2050. The mean summer surface temperature was predicted to increase by 2 degrees C by 2050. The forecasting framework was also used to estimate the effects of climate change on production of northern rock sole (Lepidopsetta polyxystra) through projected changes in cross-shelf transport of larvae in the Bering Sea. Results suggest that climate change will lead to a modest increase in the production of strong year classes of northern rock sole.

Rijnsdorp, A. D., et al. (2009). "Resolving the effect of climate change on fish populations." Ices Journal of Marine Science **66**(7): 1570-1583.

This paper develops a framework for the study of climate on fish populations based on first principles of physiology, ecology, and available observations. Environmental variables and oceanographic features that are relevant to fish and that are likely to be affected by climate change are reviewed. Working hypotheses are derived from the differences in the expected response of different species groups. A review of published data on Northeast Atlantic fish species representing different biogeographic affinities, habitats, and body size lends support to the hypothesis that global warming results in a shift in abundance and distribution (in patterns of occurrence with latitude and depth) of fish species. Pelagic species exhibit clear changes in seasonal migration patterns related to climate-induced changes in zooplankton productivity. Lusitanian species have increased in recent decades (sprat, anchovy, and horse mackerel), especially at the northern limit of their distribution areas, while Boreal species decreased at the southern limit of their distribution range (cod and plaice), but increased at the northern limit

(cod). Although the underlying mechanisms remain uncertain, available evidence suggests climate-related changes in recruitment success to be the key process, stemming from either higher production or survival in the pelagic egg or larval stage, or owing to changes in the quality/ quantity of nursery habitats.

Stewart, I. J. and S. J. D. Martell (2015). "Reconciling stock assessment paradigms to better inform fisheries management." ICES Journal of Marine Science: Journal du Conseil **72**(8): 2187-2196.

Szuwalski, C. S. and A. B. Hollowed (2016). "Climate change and non-stationary population processes in fisheries management." ICES Journal of Marine Science: Journal du Conseil **73**(5): 1297-1305.

The Effects of Fishing, Climate Change, and Other Anthropogenic Disturbances on Red Grouper and Other Reef Fishes in the Gulf of Mexico. Felicia C. Coleman and Christopher C. Koenig. Integrative and Comparative Biology, volume 50, number 2, pp. 201–212

- Snapper-grouper species as bio-engineers and potential human disturbance Gulf of Mexico
- Tilefish (L. chameleonticeps) construct pueblo-esque burrows in soft sediment
- Tilefish temperature range listed as 9-14 C and suggests they are relatively intolerant to variation, but MARMAP data in recent years says otherwise
- Burrows decay when fish are removed (rather than available indefinitely for new recruits)
- Loop current may deliver Mississippi River derived hypoxic zones to the Atlantic (Hu et al. 2005)

SEDAR 2009- prolonged red tide lead to benthic communities, turtle, bird, and mammal die-offs. Unknown if deep waste disposal can create deep HABs

Oil pipeline on seafloor and seismic gun exploration may be an issue, but has not been studied

DeRuiter SL, Tyack PL, Lin YT, Newhall AE, Lynch JF. 2006. Modeling acoustic propagation of airgun array pulsesrecorded on tagged sperm whales (Physeter macrocephalus). J Acous Soc Am 120:4100–14.

- Description of seismic air guns, physics not biology

Jochens A, et al. 2008. Sperm Whale Seismic Study in the Gulf of Mexico Synthesis Report. OCS Study MMS 2008-006. New Orleans, LA: Minerals Management Service, Department of the Interior. p. 348.

- Impacts of seismic air guns on marine mammals

Holliday DV, Pieper RE, Clarke ME, Greenlaw CF. 1987. The effects of airgun energy releases on the eggs, larvae and adults of the Northern Anchovy (Engraulis mordax). No. 4453. Washington, DC: American Petroleum Institute. p. 108.

- prolonged air gun exposure compromises survival of eggs and larvae of fishes

Hirst AG, Rodhouse PG. 2000. Impacts of geophysical seismic surveying on fishing success. Rev Fish Bio Fisher 10:113–8.

- Prolonged air gun exposure disrupts normal distribution and abundance patterns of fish

Hastings A, Popper AN. 2005. Effects of sound on fish: Noise thresholds for endangered fish. Final Report #CA 05-0537, Project P476. Sacramento, CA: California Department of Transportation. p. 85.

And

McCauley RD, Fewtrell J, Popper AN. 2003. High intensity anthropogenic sound damages fish ears. J Acous Soc Am 113:638–42.

- Fishes who retreat to burrows rather than leave **may** have permanent hearing loss but not well studied

Climate change will probably impact deepwater species if currents or upwelling change, especially with relatively long pelagic larval durations (but we don’t know much about their larvae)

Distribution and abundance of benthic fishes exploited by liners off southeast Brazil (1986 – 1995). Paiva, M.P. and Andrade-Tubino, M.F. Rev. Brasil. Biol., 58(4): 619-632. (Note: original in Portuguese so some of this is my best guess)

- *Lopholatilus vilarii*- most abundant in sub-tropical waters compared to tropical, depth >100 m
- Some seasonality to productivity, highest in 1st and 2nd quarter, summer, fall? I don’t see a definition that defines the quarters

Guilherme Henrique Pereira-Filho, Priscila de Cerqueira Veras, Ronaldo Bastos Francini-Filho, Rodrigo Leão de Moura, Hudson Tercio Pinheiro, Fernando Zaniolo Gibran, Zaira Matheus, Leonardo Mitrano Neves, Gilberto Menezes Amado-Filho. 2015. Effects of the sand tilefish Malacanthus plumieri on the structure and dynamics of a rhodolith bed in the Fernando de Noronha Archipelago, tropical West Atlantic. MEPS 541: 65–73

- Sand tilefish select rhodolith (coralline algae nodules) to add to their burrows.
- Rhodolith presence increases diversity of associated taxa
- changes in coralline algae distribution or abundance would impact burrows and burrow communities

Susan M. Snyder, Erin L. Pulster, Dana L. Wetzel, and Steven A. Murawski. 2015. PAH Exposure in Gulf of Mexico Demersal Fishes, Post-Deepwater Horizon. Environ. Sci. Technol. 2015, 49: 8786−8795

- Golden tilefish (Lopholatilus chameleonticeps) had consistently high indicators of PAH exposure following DWH, even relatively long-term.
- Compared to red snapper and snake eel, levels stayed high during the study period suggesting that either the life history or distribution of tilefish (burrows? Deep?) maintains levels or exposure is consistent rather than episodic.

Work group participants:
Anne Lange
Beth Wrege
Tracy Smart
Rusty Hudson