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Proceedings of the Zonal Peer Review – Zonal Assessment of Northern, Spotted and Atlantic Wolffish to Update and Support Specific Processes with Regards to Recovery Targets, Allowable Harm and other Related Aspects of SARA

February 26-27, 2014
St John's, NL

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Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

A meeting of the Zonal Assessment Process (ZAP) on wolffish for the Newfoundland and Labrador (NL), Maritimes, Gulf, Québec, and Central and Arctic Regions was held February 26-27, 2014 in St. John's, NL. Presentations included the latest findings on abundance indices for Northern Wolffish (*Anarhichas denticulatus*), Spotted Wolffish (*A. minor*), and Atlantic Wolffish (*A. lupus*) in all Regions; estimated rates of wolffish bycatch; evaluation of bycatch fishery observer coverage; and results from preliminary telemetry and habitat use research. Population projections and recovery targets were calculated and presented, however the results were rejected due to poor model fit and lack of confidence in gear conversion factors.

A Science Advisory Report (SAR) was prepared by Fisheries and Oceans Canada (DFO) Science and reviewed during these meetings. It includes summary points for all wolffish species, written and reviewed at the ZAP, based on the meeting Terms of Reference (Appendix I). This Proceedings Report includes an abstract and summary of discussions for each working paper presented, and a summary of general discussions and meeting conclusions.

Compte rendu de l'examen zonal par les pairs – Évaluation zonale du loup à tête large, du loup tacheté et du loup atlantique afin de mettre à jour et d'appuyer des processus précis en ce qui concerne les objectifs de rétablissement, les dommages admissibles et d'autres aspects liés à la Loi sur les espèces en péril.

SOMMAIRE

Une réunion du processus d'évaluation zonale (PEZ) du loup de mer pour les régions de Terre-Neuve-et-Labrador (T.-N.-L.), des Maritimes, du Golfe, du Québec, du Centre et de l'Arctique a eu lieu les 26 et 27 février 2014 à St. John's (Terre-Neuve-et-Labrador). Les présentations comprenaient les derniers résultats sur les indices d'abondance du loup à tête large (Anarhichas denticulatus), du loup tacheté (A. minor) et du loup atlantique (A. lupus) dans toutes les régions; les taux estimés de prises accessoires de loup de mer; l'évaluation de la présence d'observateurs de pêche accidentelle; et les résultats de la recherche préliminaire sur la télémétrie et l'utilisation de l'habitat. Les prévisions relatives à la population et les objectifs de rétablissement ont été calculés et présentés. Toutefois, les résultats ont été rejetés en raison d'un mauvais ajustement du modèle et du manque de confiance dans les facteurs de conversion des engins.

Un avis scientifique (AS) a été préparé par le secteur des Sciences de Pêches et Océans Canada (MPO) et examiné au cours de ces réunions. Il comprend des points récapitulatifs pour toutes les espèces de loup de mer, rédigés et examinés lors du processus d'évaluation zonale, selon le cadre de référence de la réunion (annexe I). Ce compte rendu comprend un résumé et un sommaire des discussions liées à chaque document de travail présenté, de même qu'un sommaire des discussions générales et des conclusions de la réunion.

INTRODUCTION

A meeting of the Newfoundland and Labrador, Maritimes, Gulf, Québec, and Central and Arctic Regions ZAP on wolffish species was held February 26-27, 2014 in St. John's, Newfoundland and Labrador. The goal of this meeting was to update and support specific processes with regards to wolffish recovery targets, allowable harm and other related aspects of the *Species at Risk Act* (SARA). Terms of reference and agenda are provided in Appendices I and II.

The participants (Appendix III) included Fisheries and Oceans Canada (DFO) Science and Fisheries Management Branches (Newfoundland and Labrador, Québec, Central and Arctic Regions); DFO Conservation and Protection Program (Pacific Region); DFO Species at Risk (Newfoundland & Labrador Region); National Headquarters (NHQ) Resource Management; Newfoundland and Labrador Department of Fisheries and Agriculture; Fisheries and Marine Institute of Memorial University; and the fishing industry.

Each working paper presentation was followed by open discussion, which is summarized in these proceedings. Consensus was reached on summary bullet points for the Science Advisory Report.

WORKING PAPER ABSTRACTS AND DISCUSSION SUMMARIES

SURVEY INDICES UPDATE FOR NL AND MARITIMES REGIONS

Presenter – R. K. Collins

Abstract

For the Newfoundland and Labrador (NL) Region and Maritimes Region, indices of wolffish abundance and range/distribution were derived from Fisheries and Oceans Canada (DFO) research vessel (RV) surveys. In the NL Region, two DFO RV surveys are conducted annually. The spring survey covers NAFO Div. 3LNO and Subdiv. 3Ps. The fall survey covers Div. 2GHJ3KLMNO. Both surveys have been subject to gear changes, with the most recent being the switch from the Engel 145 to the Campelen 1800 trawl in the mid-1990s. In the Maritimes Region, two DFO RV surveys are conducted annually. The summer RV survey covers Div. 4VWX and a portion of Div. 5Y. In 1983, the Yankee 36 trawl was replaced by the Western IIA trawl. The winter survey covers Georges Bank (Div. 5Z). No conversion factors exist to quantify changes in catchability of wolffish species as a consequence of any of the survey gear changes.

In Div. 2J3K, where the majority of wolffish populations resided, distribution and abundance indices for all three species declined sharply during the 1980s and early 1990s, when the Engel trawl was used. Survey abundance indices in Divs. 2J3K, 3LNO, and Subdiv. 3Ps have generally been stable or at higher values since the mid-2000s, compared to the 1990s, when the Campelen trawl was first introduced. In terms of distribution, Northern Wolffish are most often caught in Div. 2J3K; when they are captured in Div. 3LNO, it is usually in the deeper waters of the shelf slope. Spotted Wolffish are most often caught in Div. 2J3K, and the northern portion of Div. 3L, though they also occur in the deep waters of the shelf slope in Div. 3NO. Atlantic Wolffish is caught more frequently throughout the survey areas, including the shallower waters of Subdiv. 3PS.

In Div. 4VWX5Y and 5Z, Northern and Spotted Wolffish are infrequently caught. The abundance index for Atlantic Wolffish in 4VWX5Y has consistently been below the long-term average since 2009. In Div. 5Z (Georges Bank), where Atlantic Wolffish are less frequently captured, the index has remained low since 2006. The most persistent concentrations of Atlantic Wolffish occur on the eastern Scotian Shelf (in Div. 4V) and western Scotian Shelf (Div. 4X, primarily Browns Bank).

Discussion (NL Region)

Similar patterns in population structure are present throughout the survey divisions, and comparison between divisions may contribute to identification of overall trends. Although seasonal movement is suggested by the data (indicated by variable seasonal abundance), migration is not consistent and cannot be treated as a definitive conclusion. Some seasonal differences may be due to sampling errors or missing samples.

Discussion (Maritimes Region)

Northern Wolffish and Spotted Wolffish appear to be very rare in this region, however this may be the result of incomplete sampling. The survey technique does not reach the deep-water slope areas where these species are generally found. Although strata were added to the survey in 1996, it is still likely that current sampling does not capture the meaningful area of distribution for these species. While reviewing these studies and planning future research, it is important to consider whether conventional methodologies provide an appropriate metric for abundance.

STATUS OF THE THREE WOLFFISH SPECIES IN THE GULF OF ST. LAWRENCE

Presenter – D. Chabot

Abstract

This update of the status of wolffish species in the northern and southern Gulf of St. Lawrence (GSL) is based on indices obtained from three survey series. In the northern GSL, the research survey conducted in late summer covers the period 1990–2013, whereas the mobile Sentinel Fishery survey is available for 1995–2000. In the southern GSL, the research survey covers the period 1971–2013. The mean number of fish per standardized tow is the abundance indicator used in this update.

The Northern Wolffish has always been captured sporadically in GSL; as a result it is impossible to identify trends in abundance. The two surveys for the northern GSL lead to different conclusions for the Spotted Wolffish: species abundance varied without trend for most of the Sentinel Fishery time series, but values decreased after 2009. In the research survey, abundance values were low in the 1990s, increased in the early 2000s and varied without trend afterward. Spotted Wolffish were not observed before 1980 in the southern GSL, and varied without trend afterward. Overall, the Spotted Wolffish has low abundance in the GSL over the time period covered by each survey.

The Atlantic Wolffish displays higher abundance values than the other two species. Abundance varied with no trend in the RV survey for both northern and southern GSL, but appears to be declining since 2007 in the Sentinel Fishery survey for the northern GSL. There is no marked trend in any of the indices for these species. Distribution of catches over the last 5 years was examined for all three wolffish species in the northern and southern GSL. Northern Wolffish were found at depths greater than 200m. Spotted Wolffish and Atlantic Wolffish distributions overlap on the shelf, in particular along the west coast of Newfoundland in Div. 4R and at the top of the slope of the Laurentian Channel in Div. 4T, with the Atlantic Wolffish extending its distribution closer to shore than the Spotted Wolffish.

Discussion

The depth distribution analysis graph provided in this presentation is a very useful piece of information, as it allows the comparison of depth to available habitat. It would be valuable to obtain this information for all divisions. All three species have experienced distribution shifts into deeper water during the period of decline. If they are now returning to shallower water, this may indicate recovery of former habitat. However, Gulf populations/depth distribution maps displayed at this ZAP only include 5 years of data. It would be worthwhile to consider longer time-series distribution maps to examine this potential trend.

STATUS OF WOLFFISH SPECIES IN CENTRAL AND ARCTIC DIVISIONS

Presenter – K. Hedges

Abstract

In NAFO Subarea (SA) 0, Northern Wolffish, Spotted Wolffish and Atlantic Wolffish are encountered during research surveys and are caught as bycatch in commercial Greenland Halibut (*Reinhardtius hippoglossoides*), Northern Shrimp (*Pandalus borealis*) and Striped Shrimp (*Pandalus montagui*) fisheries. Length and weight data are available for all individuals captured during research surveys. Data on wolffish bycatch is provided by fisheries observers; 100% observer coverage is required for fisheries in NAFO Div. 0A; Div. 0B, 100% observer coverage is required for mobile gear fisheries and 20% coverage is required for fixed gear fisheries.

Wolffish have not been commercially harvested in NAFO SA 0 and population declines that were observed further south off Newfoundland and Labrador were not mirrored in SA 0 datasets. However, the observed declines occurred in the 1970s and 1980s, while the NAFO SA 0 survey time series started in 1999. Catch rates (number of fish per tow in research surveys and weight of fish caught in commercial tows or sets) and species distributions in NAFO SA 0 have been stable or increased during the available time series.

Discussion

There is an active wolffish fishery in Greenland, to the south of the sampled areas in these divisions. Although movement data are not definitive, the temperature differences between distinct water masses of the east Atlantic lead scientists to believe that mixing between Greenland and Canadian Central and Arctic stocks is unlikely.

RECOVERY TARGET ESTIMATION FOR WOLFFISH SPECIES

Presenter – L Mello

Abstract

Under the DFO Precautionary Approach (PA) framework, the Critical, Cautious, and Healthy stock status zones are defined by the Limit Reference Point (LRP) and the Upper Stock Reference Point (USR). Where there is insufficient information to determine stock biomass from an analytical model, an empirical approach can be used to identify proxies for the biomass at the Maximum Sustainable Yield (B_{MSY}), which can then be used for defining empirical Biological Reference Points (BRP). These default reference points are 40% B_{MSY} (LRP), and 80% B_{MSY} (USR).

Bottom trawl survey biomass estimates for NAFO Div. 3LNO and Subdiv. 3Ps in spring, and Div. 2J3K and Div. 3LNO in fall were used to obtain proxies for B_{MSY}, which was calculated as the geometric means (*G*) using:

(1) the full spring and fall time-series;

(2) the period of highest productivity (i.e., successive years of high stock biomass);

(3) the highest annual biomass estimate (B_{MAX});

(4) the top 3 biomass estimates;

(5) B_{MAX} plus estimated biomass for year t ± 1 ($B_{MAX} + B_{t\pm1}$), (6) $B_{MAX} + B_{t\pm2}$, and (7) $B_{MAX} + B_{t\pm3}$.

Variability in B_{MSY} proxy estimates (and associated LRP and USR) was considerable in all cases, but most approaches produced similar estimates per species, season and NAFO Division, and approach 2 is assumed to be the most reliable. The lowest values occurred when the complete time-series was used in the calculation of the geometric mean, and the highest estimates were obtained when considering B_{MAX} as a proxy for B_{MSY}.

According to the PA Framework and BRPs estimates using approach 2, survey indices of Northern Wolffish biomass show that stock components in Div. 2J3K (fall) and Subdiv. 3Ps (spring) have remained in the critical zone since the mid-1980s, whereas the stock was found mostly in the critical or cautious zones in Div. 3LNO (spring), or alternatively in the cautious or healthy zones in more recent periods (fall). Atlantic Wolffish were found in the critical or cautious zones in Div. 2J3K (fall) and Subdiv. 3Ps (spring) for most of the time-series, and in the cautious and healthy zones in Div. 3LNO (spring and fall). Trends in Spotted Wolffish biomass were very similar to those observed for the other two species, except in Div. 3LNO (spring), as the biomass estimate has remained below LRP since 2009. The three species reached biomass levels above B_{MSY} in recent periods, notably in Div. 3LNO.

Discussion

Several participants raised concern over the validity of the gear change conversion factors. The method, which calculates a proxy conversion based on the mean catch rates for three years prior to and following the gear change, has been applied to other data-poor stocks, like Thorny Skate, Smooth Skate and previous wolffish studies. Based on the limited data available, this is the only feasible conversion. Without the use of a conversion factor, data collected prior to the Engel/Campelen gear change (1990s) cannot be compared to current abundance data.

Variability in gear change calibration results for the Subdiv. 3Ps stocks and variability in the resulting recovery targets for the same stocks in different seasons raised particular concern. Some of this variability can be attributed to low catch rates. Wolffish abundance has always been presented separately according to season due to different abundance trends in spring and fall, spatial distribution and catchability. Seasonal shifts in the recovery target result may reflect migration patterns and it was suggested that only the fall season be considered in this type of analysis.

Previous meetings established the division and sub-division scale of study in response to the lack of consistent data available for wolffish species in these regions. Participants suggested that the conversion factors would be more robust if they were applied to combined regional biomass. If annual division biomass measures were combined, the gear conversion factor could be calculated based on the 3-year proxy for both spring and fall for each survey region. This proposal is explored in more detail in the General Discussion section.

The role and efficacy of the Precautionary Approach (PA) framework was also examined. Although there has been optimism that the PA would evolve as a useful way to consider species at risk, there may be a mismatch with SARA and COSEWIC criteria. For example, COSEWIC considers decline rate whereas PA examines biomass indicators. Often a species highlighted by COSEWIC does not register as “at risk” under PA, creating confusion and frustration among stakeholders.

ESTIMATES OF WOLFFISH BYCATCH RATES BASED ON COMMERCIAL DATA

Presenters – C. Miri, D. Chabot, K. Hedges

Abstract

Commercial fisheries removals of three species of wolffish in NAFO SA 0-2, Div. 3KLNOP, Div. 4RST, Div. 4VWXY, and Div. 5Z were examined for 1960-2012, using commercial data available in several databases:

(1) Northwest Atlantic Fisheries Organization’s STATLANT-21A unspeciated wolffish landings (1960-2012);

(2) DFO-NL Zonal Interchange File Format (ZIFF) unspeciated wolffish landings (1985-2012);

(3) DFO Maritimes Fisheries Information System (MARFIS) unspeciated wolffish landings (2002-12), reported by Canadian fishers operating in Canada’s EEZ;

(4) Canadian Fisheries Observers’ speciated catch and discards data (1978-2012) collected on a set-by-set basis at sea aboard commercial fishing vessels;

(5) and SARA logbooks (2004-13) completed by NL fishers aboard >35-foot commercial vessels in Canada’s EEZ.

Discards, even of target species, are never reported to NAFO or to DFO Statistics Division (ZIFF; MARFIS). Canadian Fisheries Observers constitute the only source of information on speciated commercial catches and discards at sea. Observers’ total catches in SA 0, Div. 2J3KLNOP, and

Div. 4RSTVWX5Y in 2009-12 were also mapped. Reported landings of wolffish have declined to negligible levels over the past ten years in Canada's EEZ.

SARA logbooks of NL fishers indicated that Northern Wolffish and Atlantic Wolffish were most susceptible to commercial bycatch mortality in 2010-2012; while Spotted Wolffish consistently showed a high percentage of survival before release to the ocean. Live release of wolffish by fishers does not guarantee post-release survival.

Discussion

"Released alive" (Table 1) does not equate to survival. While this number represents a maximum survival rate, it is unlikely to be an accurate estimate of bycatch survival. Studies have been conducted on bycatch survival for other species, however these estimates have not been calculated for wolffish. It was also noted that the proportion of wolffish released alive has been falling in recent years. Participants wondered if this is due to poor handling, however qualitative information of this type is not recorded by fishery observers.

Table 1a. Wolffish condition before release, recorded among NL fishers, >35-foot vessels within the EEZ– Northern Wolffish.

Condition	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Alive	18	121	1118	1402	1482	3535	4258	2967	2179	9142
Dead	13	1	78	67	56	314	4775	8899	8663	4007
% Alive*	**58**	**99**	**94**	**95**	**96**	**92**	**47***	**25***	**20***	**70**

* indicates changes in survival rate of wolffish bycatch

Table 1b. Wolffish condition before release, recorded among NL fishers, >35-foot vessels within the EEZ - Spotted Wolffish.

Condition	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Alive	52	888	1913	6896	5732	14347	11542	11120	8350	5311
Dead	0	41	28	64	249	91	417	600	1712	3350
% Alive	**100**	**96**	**99**	**99**	**96**	**99**	**97**	**95**	**83**	**61**

Table 1c. Wolffish condition before release, recorded among NL fishers, >35-foot vessels within the EEZ – Atlantic Wolffish.

Condition	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Alive	-	450	1023	1103	865	2237	2482	3674	1871	1294
Dead	-	58	51	99	397	430	1177	8076	5501	3444
% Alive*	**-**	**89**	**95**	**92**	**69**	**84**	**68**	**31***	**25***	**27***

* indicates changes in survival rate of wolffish bycatch

Observer data on Snow Crab (*Chionoecetes opilio*) bycatch appear to demonstrate greater wolffish abundance than the research data. Researchers suggest that this is due to crab pot baiting, and does not reflect a significant disagreement between the data sets. A fisheries representative pointed out that the Snow Crab fishing gear (traps or pots) have a low impact on wolfish. Individual wolffish are returned to the water in good condition and mortality is likely very low compared to wolffish discards from other fisheries. For example, among roughly 65,000 wolffish reported as Snow Crab bycatch, only 300 were reported dead upon retrieval.

Age classes within the bycatch were also discussed, with particular emphasis on the shrimp fishery, which has a greater impact on juvenile wolffish. One participant suggested that wolffish length be recorded by fisheries observers, in order to gain a better understanding of bycatch impact on different age classes and on general population dynamics. Length data were recorded in 2008-09, but are not available for other years. Representatives from DFO Science agreed that this information would be useful, however asking observers and stakeholders to collect additional information at sea may be problematic. Some observers, however, do continue to provide length data even though it is no longer required. A fisheries representative discussed concerns among the fishing community that bycatch reporting may lead to industry restrictions and exclusions; as a result, voluntary bycatch reporting is incomplete.

In discussion, participants questioned the 2008-09 bycatch peak for Div. 4SR. Although these data have not been broken into fishing type, researchers suggested that the increase may be the result of increased shrimp trawling in that region. Accurate ratios for observer coverage on all active fisheries are not available at this time.

Commercial data from the Central and Arctic Region present slightly higher catches and slightly larger ranges for all three species when compared to the research data. The total bycatch rate has remained fairly consistent at 5000-9000 kg per year. Although all three species are summed in that estimate, Northern wolffish are much more frequently caught than the other species. The data presented includes directly observed fisheries and logged (i.e. not directly observed) data.

CURRENT AND FUTURE LEVELS OF OBSERVER COVERAGE

Presenter – C. Miri

Abstract

To estimate total bycatch of wolffish by species in Div. 2J3KL Turbot (Reinhardtius hippoglossoides), Div. 2J3KL Snow Crab (*Chionoecetes opilio)*, Div. 3NO Yellowtail Flounder (Limanda ferruginea), and offshore Shrimp fisheries, a method based on Campana *et al*. (2011) was used with ASFO-NL data for 1985-2012. Results indicated that bycatch of Northern Wolffish occurred primarily in the Turbot trawl fishery in Div. 2J3L, secondarily in the Snow Crab pot fishery in Div. 3K, and was almost zero in the 3NO Yellowtail Flounder trawl fishery. In the shrimp fishery, mature wolffish are excluded by a Nordmore grate installed in every shrimp trawl (mandatory in Canada's EEZ as of 1997), while wolffish young-of-the-year are retained. Bycatch of Northern Wolffish was negligible in this fishery. Spotted Wolffish was primarily recorded as bycatch in the Snow Crab fishery in Div. 3KL, secondarily in the Turbot fishery in Div. 3L, and rarely in the 3NO Yellowtail Flounder fishery. Spotted Wolffish young-of-the-year were retained in the shrimp fishery at negligible levels annually. Bycatch of Atlantic Wolffish occurred primarily in the Yellowtail Flounder fishery in Div. 3N, in the Snow Crab fishery in Div. 3KL, was negligible in the shrimp fishery, and almost zero in the Div. 2J3KL Turbot fishery.

To provide advice on current and future levels of at-sea Observer coverage, a simple random sampling method based on Haigh *et al*. (2002) was used to simulate various levels of Observer coverage for each of three major NL fisheries in which wolffish were bycatch: Div. 2J3KL Turbot,

Div. 3NO Yellowtail Flounder, and offshore shrimp. Using only data from ASFO-NL trips in which all sets were directly observed, Coefficients of Variation were calculated for each wolffish species through simulations, and were fisheries-specific. Using a CV=0.3 or 30% precision standard set by NOAA Fisheries (USA), a minimum of 5% Observer coverage in the 2J3KL Turbot trawl fishery is required to monitor Northern Wolffish bycatch, while 10% is needed for Spotted Wolffish. No Atlantic Wolffish were caught in 100% observed Turbot trips. At least 90% of 3NO Yellowtail Flounder trawl trips could have Canadian Fisheries Observers on board to monitor Northern Wolffish and Spotted Wolffish, but both species are rarely caught in this shallow-water fishery. A minimum of 25% Observer coverage is needed to monitor Atlantic Wolffish bycatch in this fishery. At least 20% Observer coverage for Northern Wolffish and 15% for Spotted Wolffish are required in the offshore shrimp trawl fishery, while a minimum of 5% is needed to monitor Atlantic Wolffish bycatch.

Discussion

This study aimed to establish the levels of observer coverage required to achieve sufficient data on wolffish species bycatch rates. Newfoundland wolffish bycatch data were used in the analysis, broken down into specific target fisheries.

Catch estimates from fisheries with 100% observer coverage were run through 500 trials of decreasing simulated coverage to establish how much coverage would be required to deliver the same catch rate. The minimum coverage levels suggested by this model only apply to wolffish bycatch estimates and this research does not comment on the required observer coverage for the target fisheries in general.

This study indicated negligible wolffish bycatch in the Yellowtail Flounder fishery, however in the 1980s reported bycatch rate was 2000-4000 kg per tow. This disagreement may be a result of decreased observer coverage (Yellowtail Flounder had 100% coverage in the past, however current coverage rates are 25%), shifting species range, or changes in fishing technique.

Participants were interested in extrapolating the results or conducting similar studies in other regions. Extension of this study is contingent on the existence of data from fisheries with 100% observer coverage in order to build an accurate model. The methodology is standardized, and can be applied in any region that has sufficient data.

BAYESIAN SURPLUS PRODUCTION MODELS FOR WOLFFISH POPULATIONS

Presenter – M. Simpson

Abstract

Separate Bayesian surplus production models were fit to data for the main wolffish concentrations in NAFO Div. 2J3K and Div. 3LNOPs. Input data consisted of:

(1) a series of wolffish landings estimated from STATLANT21A;

(2) DFO-NL fall trawl research vessel time series (1978-2012); and

(3) DFO-NL spring trawl research trawl time series (1971-2013).

Semi-informative priors for r and K were provided as input into the model, while non-informative priors with relatively wide distributions were used for catchability (*q*), observation and process errors.

Overall model diagnostics, showed a poor fit for the model, with poor posterior distributions. However, concerns with the accuracy of the landings input data and a large process error (twice the observation error), resulted in rejection of the model as a basis to understand and model the population dynamics of wolffish.

Discussion

Based on the lack of available data, it was not possible to produce three generations of population predictions, as requested in the Terms of Reference (Appendix I). The projections developed by this model were rejected due to great variability and poor model fit. Currently, no projections exist for wolffish species. A Recovery Potential Assessment (RPA) has not been completed.

A PRELIMINARY ANALYSIS OF HABITAT USE AND MOVEMENT PATTERNS OF WOLFFISH (*Anarhichas spp*) IN COASTAL NEWFOUNDLAND WATERS

Presenter – L. Mello

Abstract

Determining movement patterns of animals in their natural environment is a difficult task, especially with a number of marine fish species that are distributed over wide geographic areas and often in offshore waters. This paper summarizes initial results of a study conducted in 2010-13 on the distribution and movement patterns of wolffish in coastal waters of the Northeast Avalon Peninsula of Newfoundland (Canada). This research generated acoustic telemetry data and data from direct observations of wolffish during SCUBA surveys to provide a preliminary (qualitative) analysis of habitat use by wolffish in the study area.

Wolffish movements varied with geographic scale. Patterns consisted of:

(1) remaining in one location (within a 4 km radius) for up to 2 years;

(2) remaining in one location for up to a year, and then moving periodically northward and southward along the coastline in spring and summer to another location up to 20 km from the initial location; and

(3) long-range movements (>20 km) beyond the study area.

This study also confirmed the existence of wolffish spawning sites and feeding grounds, and possibly nursery areas in near-shore waters and identified habitat features that are probably key to nest site selection by wolffish. Overall, the Information obtained through the acoustic telemetry, SCUBA surveys, and hydrographic profiling have contributed to a better understanding of life

history traits and habitat use by wolffish, especially Atlantic Wolffish, in Newfoundland coastal waters.

Discussion

The range of each hydrophone extends to include a 4 km radius, so tagged fish may deliver a continuous signal whether they are stationary or moving within that range. However, the acoustic signal may be obscured when the fish are denning behind boulders or rockfaces.

There is a similar network of hydrophones in the Arctic, and this may present a good opportunity for regional collaboration. Significantly, these telemetry data do not support the inshore/offshore migration hypothesis introduced by Templeman (1984). Abundance and distribution data collection by research vessels do indicate seasonal differences. Current data are not sufficient to explain these discrepancies.

A participant suggested that it would be interesting to determine sex of the individual wolffish during the tagging procedure, however wolffish do not display easily identifiable sexually dimorphic characteristics. It is possible to canulate to identify females, however it is an intrusive method and unlikely to be adopted in future studies.

GENERAL DISCUSSION

Recovery targets were not established during this meeting, due to limitations imposed by the gear change and lack of confidence in the conversion factor calculations presented. It is possible to combine the three regional groups and calculate the gear conversion based on total abundance. However, individual sampling areas experienced gear changes at different times and/or employed different sampling methods. The combined conversion would deliver an early series (beginning in 1982-83) but would not represent the abundance of the entire area and may not produce an appropriate recovery target. Regardless, combined data may deliver the most robust result possible under current data limitations and could be applied to each NAFO Division separately (according to gear change start dates, etc.) to determine recovery targets by Division. This method would assume that all Divisions have comparable catchability, which has not been confirmed by previous and ongoing research. At this time, further study of conversion factors is recommended.

Without an appropriate conversion factor, the earliest comparable data on wolffish abundance begins in the early 1990s. This represents the period of rapid decline, which is of interest to managers. However, the peak historic abundance would not be captured by this dataset if abundance data is only considered from the 1990s forward. Without a comparable measure of pre-decline wolffish abundance, it is difficult to identify recovery targets that are ecologically appropriate.

In response to similar data-poor conservation challenges, US marine managers have adopted conversion factors from well-studied, morphologically similar species. The conversion factor model presented at this meeting generated significantly different coefficients for the three wolfish species, suggesting that the morphology driven conversion strategy is not applicable for these species. Although Spotted Wolffish, Northern Wolffish and Atlantic Wolffish are morphologically similar, different habitat use and behavior likely contribute to the variation in conversion coefficients. Based on recent telemetry data, Northern Wolffish appear to spend relatively more time in the water column than the other species, and Spotted Wolffish are more mobile. Atlantic Wolffish are generally sedentary and are often found in shallower waters than the other species. The generation of conversion factors is also limited by species abundance; rare species introduce more variability and uncertainty into the model.

CONCLUSION

The following summary points were agreed upon through extensive discussion and represent consensus among meeting participants. The original summary points, which were used as a basis for this discussion, are included in Appendix IV. A summary of the discussion is included below.

SCIENCE ADVISORY REPORT SUMMARY

- Abundance indices for all three wolfish species throughout Canadian Atlantic and Arctic waters have been stable or at higher values since the mid-2000s, compared to the 1990s. However, there are areas where catches are sporadic because the species are scarce and represent a minor portion of the overall population.
- Although increases in abundance have occurred in some areas, levels for Northern Wolffish and Spotted Wolffish in NAFO Div. 2J3K, where the majority of the populations reside, remain low relative to historic values.
- Due to an overall reduction in fishing effort since the 1990s, and mandatory release of both Northern Wolffish and Spotted Wolffish since 2003, mortality of these two species due to fishing has been reduced in Canada's Exclusive Economic Zone (EEZ).
- Interim recovery targets consistent with the DFO Precautionary Approach Framework were proposed but rejected based on concerns related to survey gear conversion factors. Further research should be conducted to determine a method for combining survey time series.
- The current levels of observer coverage in three major mobile gear fisheries in NL (Greenland Halibut; Yellowtail Flounder; offshore shrimp) are adequate and effective for the determination of harm to wolffish, where they are a common bycatch species. Observer coverage could not be evaluated in other fisheries due to the lack of appropriate data in most cases.
- The maximum allowable harm that these species can sustain and not jeopardize survival or recovery could not be adequately quantified due to limitations in population modeling and uncertainty of their population dynamics. However, given levels of harm that occurred over the past decade, the decline in wolffish abundance has not continued and has reversed in many areas, which suggests that the current levels of harm are sustainable assuming that future stock productivity is similar to levels observed in recent time periods.

CLOSING DISCUSSION

ABUNDANCE INDICES

Although trends can be roughly identified in the dataset, they are generally invalidated by variability and possible error due to low sampling rate, particularly for Northern Wolffish. It is more useful and more accurate to report general findings (i.e. that abundance is higher in the 2000s than in the 1990s) than to discuss potentially insubstantial trends. There is considerable inter-annual variability and persistent low abundance compared to pre-decline (i.e. 1980s) levels; these factors make it difficult to draw conclusions on population status or recovery potential.

BYCATCH AND OBSERVER COVERAGE

Observer coverage is allocated based on the target species, not according to bycatch. In the three fisheries (Greenland Halibut; Yellowtail Flounder; offshore shrimp) sufficient data (i.e. 100% observer coverage) were available to fulfill a simulation model and coverage levels were deemed sufficient where wolffish species represent significant bycatch. Greenland Halibut, Yellowtail Flounder and offshore shrimp represent major fisheries in NL waters, where the majority of wolffish

are found. Observer coverage could not be evaluated in other fisheries (including inshore shrimp) due to the lack of appropriate data. Although the bycatch and observer coverage evaluations are not complete, what has been accomplished is considered significant to wolffish populations.

ALLOWABLE HARM

Maximum allowable harm could not be calculated because population modeling and projection data are missing. Currently stocks are generally considered stable, so it may be that current levels of harm are sustainable. A number of activities, oil and gas exploration and development, are not covered by the current allowable harm analysis. Data on the impact of these activities are unavailable due to a lack of research.

RECOVERY TARGETS

Recovery targets were proposed based on PA Framework and BRP modeling, however they were rejected due to concerns over gear conversion factors. Gear conversion factors and reference point calculations are crucial for conservation management and they present an ongoing problem for many fisheries. Conversion factor models and reference point calculations merit continued, in-depth study.

REFERENCES CITED

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Haigh, J.H. 2002. Probability models. London: Springer-Verlag.

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APPENDIX I: TERMS OF REFERENCE

Zonal Assessment of Northern, Spotted and Atlantic Wolffish to update and support specific processes with regards to recovery targets, allowable harm and other related aspects of SARA

Zonal Peer Review – Newfoundland & Labrador, Maritimes, Gulf, Quebec, and Central & Arctic Regions

February 26-27, 2014

St John's, NL

Chairperson: Karen Dwyer, Science Branch, NL Region

Context

When the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designates aquatic species as threatened of endangered, Fisheries and Oceans Canada (DFO), as the responsible jurisdiction under the Species at Risk Act (SARA), is required to undertake a number of actions. Many of these actions require scientific information on the current status of the species, population or designatable unit (DU), threats to its survival and recovery, and the feasibility of its recovery. Formulation of this scientific advice has typically been developed through a Recovery Potential Assessment (RPA) that is conducted shortly after the COSEWIC assessment. In the case of Northern wolffish, Spotted wolffish and Atlantic wolffish, these species are already currently listed under the Species at Risk Act (SARA) and a number of the RPA advice issues are either outdated or incomplete.

Therefore, DFO Science has been asked to undertake an assessment to update and support specific processes with regards to recover targets, allowable harm and other related aspects of SARA which would normally be conducted as part of an RPA. The advice generated via this process will also update and/or consolidate any existing advice regarding Northern wolffish, Spotted wolffish, and Atlantic wolffish.

Objectives

Assess current/recent species status

1. Evaluate present status for abundance (i.e., numbers and biomass focusing on matures) and range for each species.
2. Evaluate recent species trajectory for abundance (i.e., numbers and biomass focusing on matures) and range for each species.
3. Estimate expected population and distribution targets for recovery, according to DFO guidelines (DFO 2005, DFO 2011) and based on the limit reference points, where available, developed under the Precautionary Approach Framework.
4. Project expected population trajectories over at least three generations for all populations, and trajectories over time to the recovery target (if possible to achieve), given current population dynamics parameters and associated uncertainties using DFO guidelines on long-term projections (Shelton et al. 2007).

Scope for Management to Facilitate Recovery

5. Assess the probability that the recovery targets can be achieved under current population dynamics parameters, and how that probability would vary with different mortality (especially lower) parameters.

Allowable Harm Assessment

6. Using input from all DFO sectors and other sources as appropriate, evaluate maximum human-induced mortality which the species can sustain and not jeopardize survival or recovery of the species.
7. Using input from all DFO sectors and other sources as appropriate, provide information on the current level of at-sea-observer coverage for commercial fisheries where wolffish are encountered. Is the current observer coverage sufficient to determine levels of harm to wolffish? Also, is the current design of coverage (distribution of coverage over space and time in relation to fishing seasons) effective? Are some areas, seasons and fleets in need of additional coverage and if so, provide details. In the case of inshore fisheries where there is currently no coverage, would coverage be beneficial, and if so, what percentage?
8. Using input from all DFO sectors and other sources as appropriate, provide advice on the minimum at-sea-observer coverage and design of coverage (e.g., distribution of coverage over space and time in relation to fishing seasons and fleets – stratified random coverage), as well as minimal and optimal requirements (e.g., lat/long, species, size, condition) required to perform a review and analysis of allowable harm for wolffish.

Expected Publications

- Science Advisory Report(s)
- Proceedings
- Research Document(s)

Participation

- Fisheries and Oceans Canada (DFO) (Ecosystems Management, Science, Fisheries Management, and Policy and Economics)
- Provincial Government Departments
- Academia
- Aboriginal organizations
- Fishing industry
- Other invited experts (e.g., environmental non-government organizations)

References

DFO. 2005. A framework for developing science advice on recover targets for aquatic species in the context of the Species at Risk Act. DFO. Can. Sci. Advis. Sec. Advis. Rep. 2005/054.

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Shelton, P.A., B. Best, A. Cass, C. Cyr, D. Duplisea, J. Gibson, M. Hammill, S. Khwaja, M. Koops, K. Martin, B. O'Boyle, J. Rice, A. Sinclair, K. Smedbol, D. Swain, L. Velez-Espino, and C. Wood. 2007. Assessing recovery potential: long term projections and their implications for socio-economic analysis. DFO. Can. Sci. Advis. Sec. Advis. Rep. 2007/045.

APPENDIX II: AGENDA

Zonal Peer Review – Assessment of Northern, Spotted and Atlantic Wolffish to update and support specific processes with regards to recovery targets, allowable harm and other related aspects of SARA

Newfoundland & Labrador, Maritimes, Gulf, Quebec, and Central & Arctic Regions

February 26-27, 2014

Holiday Inn, St. John's, NL

Description	Presenter
Welcome/Opening	K. Dwyer (Chair)
Presentation: RV Surveys, Trends, and Distributions	R. Collins, D. Chabot, K. Hedges
Presentation: Recovery Targets	L. Mello
Presentation: Commercial Data	C. Miri, D. Chabot, K. Hedges
Presentation: Observer Coverage	C. Miri, D. Chabot, K. Hedges
Presentation: Projections	M. Simpson
Presentation: Tagging	L. Mello
Discussion	All
Summary Bullets and SAR	All
Conclusions	All
Closing/Next Steps	K. Dwyer (Chair)

Agenda remains fluid – breaks to be determined as meeting progresses.

APPENDIX III: LIST OF PARTICIPANTS

Name	Affiliation
Boland, John	FFAW
Chabot, Denis	DFO Science
Coffin, David	DFO Resource Management
Collins, Roanne	DFO Science
Dwyer, Karen	DFO Science
Dwyer, Shelly	DFA
Grant, Scott	Marine Institute, Memorial University
Hedges, Kevin	DFO Science
LaPoint, Jeanette	DFO C&P, NHQ
Meade, Jim	DFO Science
Mello, Luiz	DFO Science
Miri, Carolyn	DFO Science
Novaczek, Emilie	Memorial University
Osborne, Derek	DFO Resource Management
Parrill, Erika	DFO Science
Richards, Dale	DFO Science
Simpson, Mark	DFO Science
Sullivan, Katrina	DFO Species at Risk
Templeman, Nadine	DFO Science

APPENDIX IV: DRAFT SUMMARY POINTS

The following points were presented and discussed. This discussion informed the drafting of the final draft of bullet points (presented in the Proceedings Conclusion), which were written and edited by ZAP participants.

WOLFFISH IN THE ATLANTIC AND ARCTIC REGIONS

- Northern Wolffish and Spotted Wolffish remain Threatened under SARA, while Atlantic Wolffish is still of Special Concern.
- In recent years, during the DFO fall RV survey in Div. 2J3K catch rates of Northern Wolffish and Spotted Wolffish generally increased. However, during the spring RV survey, following a general increase in Div. 3LNO over 1995-2006, catches of these species have been variable.
- Atlantic Wolffish abundance in the DFO-Maritimes Region RV surveys has declined since the mid-1990's. Northern Wolffish and Spotted Wolffish are caught sporadically.
- In Div. 4RS, the abundance index for Spotted Wolffish from the mobile sentinel survey varied without trend from 1995 to 2009, but remained low for the past 4 years. Northern Wolffish are captured sporadically.
- In the southern Gulf of St. Lawrence (Div. 4T), Northern Wolffish and Spotted Wolffish are caught sporadically, while Atlantic Wolffish are caught at relatively low levels.
- Interim recovery targets have been proposed which are consistent with the DFO PA Framework. Northern Wolffish stock components in Div. 2J3K and Subdiv. 3Ps have remained in the critical zone, whereas the stock was in the critical or cautious zones in Div. 3LNO. Trends in Spotted Wolffish biomass indicate that biomass has remained below the LRP since 2009.
- Since 2003, when Northern Wolffish and Spotted Wolffish were listed under SARA, it is assumed that fishing mortality for both species has been reduced in Canada's EEZ due to mandatory bycatch release regulations.
- Simulations of Observer coverage for Northern Wolffish indicated that an observer coverage level of at least 5% in the Div. 2J3KL Greenland Halibut trawl fishery meets the minimum standard, for Spotted Wolffish, 10% coverage is required.
- For the shrimp trawl fishery, simulation results indicate that an observer coverage of at least 20% is required for Northern Wolffish and of 15% is required for Spotted Wolffish
- For the Div. 3NO Yellowtail Flounder trawl fishery, a minimum of 25% observer coverage is required for Atlantic Wolffish.
- The maximum allowable harm that these species can sustain and not jeopardize survival or recovery could not be adequately quantified due to limitations in population modeling and uncertainty of their population dynamics. However, under current levels of fishing mortality, the decline in wolffish abundance has not continued and has reversed in many areas, which suggests that the current harvest is sustainable assuming that future stock productivity is similar to that observed in recent time periods.