Selected FishPath Results for Smooth hammerhead shark, U.S. Atlantic and Gulf of Mexico: Narrowed

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FISHPATH

The Nature Conservancy

Introduction and Definitions

The following report contains information about user-selected results from the FishPath questionnaire. (Note that this report might not include all results provided in FishPath.) The first section, "Summary of Selected Results" provides a table containing each selected option and a summary of its associated results. The second section provides detailed information about each the results for each selected option as well as any notes that were written within FishPath for the option.

Definitions

Criteria:

Criteria are the minimum requirements needed to implement the option. If all criteria for an option are met, then an option may be implemented, pending further consideration of the caveats. If one or more criteria is not met, then it will not be possible (or extremely difficult) to implement the option successfully. Whether or not a criteria is met is based upon the answers to the fishery questionnaire. Both data collection and assessment options have criteria associated with them. Additionally, assessment options further indicate the uncertainty around met criteria. The level of uncertainty is indicated by a "traffic light" of colors (red, orange, yellow, green). Red indicates a high level of possible uncertainty, while green indicates a low level of possible uncertainty. These are indicated as the background color in the met/failed column.

Multi-part Criterion:

A group of criteria that are considered together when determining if they meet the minimum requirements. To meet a multi-part criterion, at least one of the associated criteria must meet its minimum requirements. Multi-part criterions are signified in the table below by grouping each criteria together under the multi-part criterion (e.g. Group A).

Caveat:

Caveats indicate cautions to be aware of when implementing this option for this specific fishery. Caveats, except for static caveats, are determined based upon the answers to the fishery questionnaire. Caveats are ranked in severity from red to orange to yellow to light blue. Red caveats represent the strongest cautions, suggesting that those options should likely not be implemented without serious consideration for overcoming that caveat. Where yellow caveats may provide a caution to consider, but that may not prevent implementation. Light blue caveats are neutral and used to provide additional information about the option, given the context. Color assignments are based on expert experience and may vary among fisheries.

Static Caveat:

Static caveats provide additional information, assumptions, limitations, or warnings associated with the option that apply independently of fishery circumstances or user responses to the questionnaire. They are denoted with light blue.

Positive Attribute:

Positive attributes indicate reasons why an option might be a good fit for the fishery. They are determined based upon the answers to the fishery questionnaire and are denoted with green.

Summary of Selected Results

Fishery: Smooth hammerhead shark, U.S. Atlantic and Gulf of Mexico

Section: Assessment

Option	Assessment Category	Assessment Output	Meets Criteria	Red Caveats	Orange Caveats	Yellow Caveats	Positive Attributes	Static Caveats
Top Option: Analysis of sustainability indicators based on length-b reference points (LBRP)	Size/Age-Based	Stock Status	Yes (3/3)	1	2	4	1	3
Top Option: Only Reliable Catch Stocks (ORCS)	Catch Only	Catch Limit	Yes (2/2)	1	2	2	0	5
Top Option: Depletion-Corrected Average Catch (DCAC)	Catch Only	Catch Limit	Yes (4/4)	1	3	3	0	6
Top Option: Length-based Spawning Potential Ratio (LB-SPR)	Size/Age-Based	Stock Status	Yes (4/4)	1	3	5	0	10
Top Option: Mean length mortality estimators	Size/Age-Based	Fishing Rate	Yes (3/3)	1	2	6	0	3
Top Option: Length-Only Integrated Model	Size/Age-Based	Stock Status	Yes (5/5)	1	2	7	0	4
Top Option: Yield-Per-Recruit	Life History-Based Methods	Fishing Rate	Yes (4/4)	0	0	4	0	1
Top Option: Length-based Bayesian Biomass Estimation (LBB)	Size/Age-Based	Stock Status	Yes (4/4)	1	2	7	0	4

Top Option
Analysis of sustainability indicators based on length-based reference points (LBRP)

Assessment Category: Size/Age-Based Section: Assessment

Assessment Output: Stock Status

Assessment 'Tier': Mid-tier

Fishery: Smooth hammerhead shark, U.S. Atlantic and Gulf of Mexico

This option meets all criteria (3 of 3 met)

Description

This is an assessment option based on length-based reference points (LBRP). It was developed by Cope and Punt in 2009 and offers a more robust extension of the Froese (2004) assessment using size-based indicators. When establishing length-based reference points for sustainable management, Cope and Punt highlight the importance of distinguishing the selectivity pattern. They show that Froese's (2004) size indicators (Pmat, Popt, and Pmega), when used in isolation, can take on a wide range of values for an overfished stock. As such, they may not adequately reflect sustainable fishing practices. Instead, Cope and Punt suggest the use of Pobj, defined as the sum of the 3 size indicators used in the Froese (2004) assessment model. In their assessment model based on length-based reference points, Cope and Punt present a decision tree (Figure 10) that allows users to determine whether a stock's biomass is below a target or limit reference point using Pobj, the 3 catch proportions used in the 2004 model, and the ratio of Lmat/Lopt. The decision tree does not require fishing mortality rate (F), recruitment compensation (h), or spawning biomass data, and it should be used in concert with the size indicators used in the 2004 model when possible.
The following link may serve as a useful resource for this assessment option: [https://github.com/shcaba/LBRP] (https://github.com/shcaba/LBRP)

Contacts

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Andre Punt: aepunt@uw.edu

References

References
Cope, J. M., & Punt, A.E. (2009). Length-based reference points for data-limited situations: Applications and restrictions. Marine and Coastal Fisheries, 1(1), 169-186. [http://dx.doi.org/10.1577/C08-025.1] (http://dx.doi.org/10.1577/C08-025.1)

Applications
Babcock, E.A, Coleman R., Karnauskas, M., Gibson J. 2013. Length-based indicators of fishery and ecosystem status: Glover's Reef Marine Reserve, Belize. Fisheries Research 147: 434-445.

Merino, G., Murua, H., Arrizabalaga, H., & Santiago, J. (2014). Size based indicators of performance of Indian Ocean skipjack tuna towards developing specifically built Harvest Control Rules. Indian Ocean Tuna Commission, IOTC-2014-WPTT16-38.

User Notes About This Option

No user notes were recorded at the time of report generation.

Criteria

This option meets all the criteria for your fishery. (3 of 3 met)

Met/ Failed	Single or Multi?	Question	Answer	Minimum Criteria
Met	Single Criteria	Do you have a maturity ogive (cumulative frequency graph) or a size-at-maturity relationship for the species? Select the answer that best describes the source and uncertainty.	1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived, or when only one maturity metric (e.g., L50%) is available	1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived, or when only one maturity metric (e.g., L50%) is available
Met	Single Criteria	Do you have estimates of the von Bertalanffy growth parameters? Select the answer that best describes the source and uncertainty.	3: Yes, estimated from age and length data with low to moderate uncertainty	1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived, or based only on length samples (e.g., ELEFAN)
Met	Single Criteria	What time series of length composition data exists?	2: Significant bias in time series. Major flaws that significantly bias time series data representativeness. Examples: missing years of major removals; missing catch contributions of major fleets/metiers; and, significant gaps in reporting, species identification, and/or spatial sampling of fisheries.	1: Snapshot (1-2 years of data only). Use caution when applying all snapshot data, but be especially careful with data that is poorly sampled or poorly representative.

Caveats and Attributes

Red Caveats

Question	Answer	Caveat

Is the range of the fished population greater than the area in which fishing or sampling occurs, or the jurisdictional management boundary?	**Yes**	**If data are not representative of the stock as a whole, the information may not represent the unit you are trying to manage**

Orange Caveats

Question	Answer	Caveat
Is the species being actively and consistently targeted?	No	If there have been changes in targeting practices, time series of data may not be commensurate because of changes in catchability. Caution should be applied in interpreting temporal trends in indicators.
Are data that are to be used within an assessment collected using a different gear than used by fishers?	Yes	Data may create biased results in this method. Reconsider using the data or determine a modification of the data to approximate the selectivity of the fishery.

Yellow Caveats

Question	Answer	Caveat
Are data that are to be used in an assessment representative of the spatial extent of the fleet and fishers? Select the answer that best applies.	Mostly, but with some representativeness issues in the data	If data are not representative of the spatial extent of the fleet, the information may not represent the unit you are trying to manage.
Is the biological data (e.g., length or age compositions) differentiated by sex?	No	If there is a strong sexual differentiation in life history parameters resulting in mixed length compositions by sex, then you need to have some understanding of the sex composition of the sampling.
Is the life history of the species sex-specific?	Yes	Be cautious regarding the interpretation of life-history parameters that may be sex-specific
Are data that are to be used in an assessment representative of the activities of the fleet and fisher characteristics? Select the answer that best applies.	Mostly, but with some representativeness issues in the data	If data are not representative of the activities of the fleet, the information may not represent the unit you are trying to manage.

Positive Attributes

Question	Answer	Positive Attribute
Is it possible to define a meaningful reference point for an indicator and if so, with what level of uncertainty? Select the answer that best applies.	Yes-- a reference point can be established, but with high uncertainty	The value of this method is optimised if meaningful reference points can be defined.

Static Caveats

These caveats always apply to this option.

Static Caveat
This method determines the selectivity as an output.
Consider whether catchability varies in time or space (e.g. if environmental, oceanographic, weather, temperature conditions affect either fish availability or fishing gear effectiveness).
Interpretation of results may be sensitive to major recruitment events.

Top Option
Only Reliable Catch Stocks (ORCS)

Assessment Category: Catch Only

Section: Assessment

Assessment Output: Catch Limit

Assessment 'Tier': Mid-tier

Fishery: Smooth hammerhead shark, U.S. Atlantic and Gulf of Mexico

This option meets all criteria (2 of 2 met)

Description

The original ORCS working group method was an evidence-based scoring procedure for determining a fishery's overfishing limit (OFL) and an acceptable biological catch (ABC) using only landings data (Berkson et al., 2011). Stocks were assigned as "lightly," "moderately," or "heavily" exploited based on attribute scores derived from expert judgement. To set the OFL, the exploitation level was used alongside a "catch statistic" (typically an average landings value, ideally taken from a historically stable period of landings). The ABC was then calculated based on the OFL, the stock productivity, and the level of risk acceptable to stakeholders, managers, and scientists. However, in 2017, Free et al. showed that the original ORCS method needed revision, and it is no longer recommended for determining stock status. Free et al. (2017) refined the ORCS scoring attributes using Boosted Classification Trees (BCTs) to weight attributes by their relative importance). This refined ORCS approach substantially outperformed the original ORCS method. It is recommended for use (with conservative catch scalars to prevent overexploitation) instead of the original working group approach.
The following links may serve as useful resources for this assessment option: [https://marine.rutgers.edu/~cfree/refined-orcs-approach/] (https://marine.rutgers.edu/~cfree/refined-orcs-approach/)
[https://github.com/cfree14/datalimited2] (https://github.com/cfree14/datalimited2)

Contacts

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References

References
Berkson, J., Barbieri, L., Cadrin, S., Cass-Calay, S. L., Crone, P., Dorn, M., Friess, C., Kobayashi, D., Miller, T. J., Patrick, W. S., Pautzke, S., Ralston, S., & Trianni, M. (2011). Calculating acceptable biological catch for stocks that have reliable catch data only (Only Reliable Catch Stocks - ORCS). NOAA Technical Memorandum NMFS-SEFSC-616, 56 pp.
Free, C. M., Jensen, O. P., Weidenmann, J. & Deroba, J. J. (2017). The refined ORCS approach: a catch-based method for estimating stock status and catch limits for data-poor fish stocks. Fisheries Research, 193, 60-70. [http://dx.doi.org/10.1016/j.fishres.2017.03.017] (http://dx.doi.org/10.1016/j.fishres.2017.03.017)

Applications
Wiedenmann, J., Wilberg, M. J., & Miller, T. J. (2013). An evaluation of harvest control rules for data-poor fisheries. North American Journal of Fisheries Management, 33(4), 845-860. [http://dx.doi.org/10.1080/02755947.2013.811128] (http://dx.doi.org/10.1080/02755947.2013.811128)

User Notes About This Option

No user notes were recorded at the time of report generation.

Criteria

This option meets all the criteria for your fishery. (2 of 2 met)

Met/ Failed	Single or Multi?	Question	Answer	Minimum Criteria
Met	Single Criteria	What time series of total removal data exists?	2: Significant bias in time series. Major flaws that significantly bias time series data representativeness. Examples: missing years of major removals; missing catch contributions of major fleets/metiers; and, significant gaps in reporting, species identification, and/or spatial sampling of fisheries.	2: Significant bias in time series. Major flaws that significantly bias time series data representativeness. Examples: missing years of major removals; missing catch contributions of major fleets/metiers; and, significant gaps in reporting, species identification, and/or spatial sampling of fisheries.
Met	Single Criteria	Rank the level of understanding of relative stock status.	1: Expert opinion on relative stock status. Large bias and imprecision should be considered with these values.	1: Expert opinion on relative stock status. Large bias and imprecision should be considered with these values.

Caveats and Attributes

Red Caveats

Question	Answer	Caveat
Is the range of the fished population greater than the area in which fishing or sampling occurs, or the jurisdictional management boundary?	**Yes**	**If data are not representative of the stock as a whole, the information may not represent the unit you are trying to manage**

Orange Caveats

Question	Answer	Caveat
Is the species being actively and consistently targeted?	No	If there have been changes in targeting practices, time series of data may not be commensurate because of changes in catchability. Caution should be applied in interpreting temporal trends in indicators.
Does the species aggregate (e.g., schooling, or aggregates near desirable habitat or refugia)?	Yes, but not actively targeted while aggregated	Be aware of the potential for hyperstability due to the potential for higher catches or catch rates when aggregations are encountered or inadvertently targeted, and as such, for abundance to be artificially over-estimated. Consider augmenting with indicators that inform the extent of potential hyperdepletion (e.g., whether the spatial distribution of effort is increasingly concentrated, or is moving progressively offshore, or away from areas previously fished).

Yellow Caveats

Question	Answer	Caveat
Are data that are to be used in an assessment representative of the spatial extent of the fleet and fishers? Select the answer that best applies.	Mostly, but with some representativeness issues in the data	If data are not representative of the spatial extent of the fleet, the information may not represent the unit you are trying to manage.
Are data that are to be used in an assessment representative of the activities of the fleet and fisher characteristics? Select the answer that best applies.	Mostly, but with some representativeness issues in the data	If data are not representative of the activities of the fleet, the information may not represent the unit you are trying to manage.

Positive Attributes

There are no positive attributes.

Static Caveats

These caveats always apply to this option.

Static Caveat
Consider whether catchability varies in time or space (e.g. if environmental, oceanographic, weather, temperature conditions affect either fish availability or fishing gear effectiveness).

Additional assessment requirement: Requires mean or median catches

The assessment has the ability to quantify output uncertainty.

Links readily to/lends itself for use with the decision rules: "Catch Limit: according to assessment outcomes (feedback): ii) target based with F- or biomass-based reference point" and "Effort Limit: according to assessment outcomes (feedback): ii) target based with F- or biomass-based reference point"

If catch controls are used, or are to be used as a management measure, these compromise the use of catch time series as an informative assessment input.

Top Option
Depletion-Corrected Average Catch (DCAC)

Assessment Category: Catch Only

Section: Assessment

Assessment Output: Catch Limit

Assessment 'Tier': Mid-tier

Fishery: Smooth hammerhead shark, U.S. Atlantic and Gulf of Mexico

This option meets all criteria (4 of 4 met)

Description

Depletion-Corrected Average Catch (DCAC) estimates sustainable yield for long-lived targeted species based on average catches from an extended time series of catch data that embrace a "windfall" period. A windfall harvest is defined as a harvest corresponding to the maximum sustainable yield. The "correction" to windfall depletion comes from recognizing that catch levels during the period in which a stock is moving toward Bmsy levels reflect the sum of two values: "sustainable yield" and "one-time windfall yield." Using DCAC, sustainable yield is mathematically estimated from the windfall harvest, as well as from expert judgment regarding current levels of depletion and natural mortality. DCAC is not recommended for severely depleted stocks or for fisheries targeting species with high natural-mortality rates (M > 0.2), though this latter suggestion may not always hold. Using DCAC should lead to more sustainable management practices than management decisions based solely on average catch.
The following link may serve as a useful resource for this assessment option: [http://www.datalimitedtoolkit.org/] (http://www.datalimitedtoolkit.org/)

Contacts

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References

References
MacCall, A. D. (2009). Depletion-corrected average catch: a simple formula for estimating sustainable yields in data-poor situations. ICES Journal of Marine Science, 66, 2267-2271. [http://dx.doi.org/10.1093/icesjms/fsp209] (http://dx.doi.org/10.1093/icesjms/fsp209)

Applications
Anon. (2011). Depletion-corrected average catch estimates for U.S. South Atlantic wreckfish (as updated December 20, 2011, ref SERO-LAPP-2011-07). NOAA Fisheries Service. 21 pp.
Arnold, L. M., & Heppell, S. S. (2014). Testing the robustness of data-poor assessment methods to uncertainty in catch and biology: a retrospective approach. ICES Journal of Marine Science, 72(1), 243-250. [https://doi-org.proxy.library.ucsb.edu:9443/10.1093/icesjms/fsu077] (https://doi-org.proxy.library.ucsb.edu:9443/10.1093/icesjms/fsu077)
Harford, W. J., & Carruthers, T. R. (2017). Interim and long-term performance of static and adaptive management procedures. Fisheries Research, 190, 84-94.

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Tallman, R. F., Zhu, X., Janjua, Y., Toyne, M., Roux, M. J., Harris, L., ... & Gallagher, C. (2013). Data limited assessment of selected North American anadromous charr stocks. Journal of ichthyology, 53(10), 867-874. doi:10.1134/S0032945213100123
Wetzel, C. R., & Punt, A. E. (2011). Model performance for the determination of appropriate harvest levels in the case of data-poor stocks. Fisheries Research, 110(2), 342-355.
Wiedenmann, J., Wilberg, M. J., & Miller, T. J. (2013). An evaluation of harvest control rules for data-poor fisheries. North American Journal of Fisheries Management, 33(4), 845-860. [http://dx.doi.org/10.1080/02755947.2013.811128] (http://dx.doi.org/10.1080/02755947.2013.811128)

User Notes About This Option

No user notes were recorded at the time of report generation.

Criteria

This option meets all the criteria for your fishery. (4 of 4 met)

Met/ Failed	Single or Multi?	Question	Answer	Minimum Criteria
Met	Single Criteria	Do you have an estimate of the natural mortality (M) of the species? Select the answer that best describes the source and uncertainty.	3: Yes, estimated with low to moderate uncertainty	1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived
Met	Single Criteria	What time series of total removal data exists?	2: Significant bias in time series. Major flaws that significantly bias time series data representativeness. Examples: missing years of major removals; missing catch contributions of major fleets/metiers; and, significant gaps in reporting, species identification, and/or spatial sampling of fisheries.	2: Significant bias in time series. Major flaws that significantly bias time series data representativeness. Examples: missing years of major removals; missing catch contributions of major fleets/metiers; and, significant gaps in reporting, species identification, and/or spatial sampling of fisheries.
Met	Single Criteria	Rank the level of understanding of relative stock status.	1: Expert opinion on relative stock status. Large bias and imprecision should be considered with these values.	1: Expert opinion on relative stock status. Large bias and imprecision should be considered with these values.

Met	Single Criteria	Do you have an estimate of FMSY/M (the ratio of the annual exploitation rate that produces MSY at equilibrium, to natural mortality)? Select the answer that best describes the source and uncertainty.	3: Species-specific derived value with low to moderate uncertainty	1: Expert opinion, value taken from a nearest-neighbor taxonomic relationship, or selectivity does not equal maturity

Caveats and Attributes

Red Caveats

Question	Answer	Caveat
Is the range of the fished population greater than the area in which fishing or sampling occurs, or the jurisdictional management boundary?	**Yes**	**If data are not representative of the stock as a whole, the information may not represent the unit you are trying to manage**

Orange Caveats

Question	Answer	Caveat
Is the species being actively and consistently targeted?	No	If there have been changes in targeting practices, time series of data may not be commensurate because of changes in catchability. Caution should be applied in interpreting temporal trends in indicators.
Has anything in the fishery changed over time that would impact your interpretation of the data?	Yes	This method cannot account for temporal changes in the fishery that compromise the interpretation of fishery-dependent time series data.
Does the species aggregate (e.g., schooling, or aggregates near desirable habitat or refugia)?	Yes, but not actively targeted while aggregated	Be aware of the potential for hyperstability due to the potential for higher catches or catch rates when aggregations are encountered or inadvertently targeted, and as such, for abundance to be artificially over-estimated. Consider augmenting with indicators that inform the extent of potential hyperdepletion (e.g., whether the spatial distribution of effort is increasingly concentrated, or is moving progressively offshore, or away from areas previously fished).

Yellow Caveats

Question	Answer	Caveat
Do you know the selectivity, or selectivities of the fleet(s) or gear type(s)? Select the answer that best applies.	1: Able to be inferred by expert opinion or very limited direct measurements (e.g., L50, L95), with some uncertainty in the exact shape	Need selectivity to at least be able to be inferred. If selectivity is unknown, you need to be more mindful of your uncertainty (e.g. undertake sensitivity analysis to alternate forms of selectivity). Selectivity is a very influential parameterisation - logistic vs dome-shaped can produce very different results. Particular care needs to be taken if the fishery has multiple fleets or gear types targeting or selecting different size ranges of the same species. Knowing every fishery isn't necessarily required, but understanding the predominant selectivity is important. Note that most methods cannot handle multiple selectivities, so an overall single estimate will be required in most cases. Interpret your results with a clear awareness of the selectivity assumptions.
Are data that are to be used in an assessment representative of the spatial extent of the fleet and fishers? Select the answer that best applies.	Mostly, but with some representativeness issues in the data	If data are not representative of the spatial extent of the fleet, the information may not represent the unit you are trying to manage.
Are data that are to be used in an assessment representative of the activities of the fleet and fisher characteristics? Select the answer that best applies.	Mostly, but with some representativeness issues in the data	If data are not representative of the activities of the fleet, the information may not represent the unit you are trying to manage.

Positive Attributes

There are no positive attributes.

Static Caveats

These caveats always apply to this option.

Static Caveat
Consider whether catchability varies in time or space (e.g. if environmental, oceanographic, weather, temperature conditions affect either fish availability or fishing gear effectiveness).

The assessment has the ability to quantify output uncertainty.

Assumes B0 (i.e., the initial condition of the stock) is constant.

Links readily to/lends itself for use with the decision rules: "Catch Limit: according to assessment outcomes (feedback): ii) target based with F- or biomass-based reference point" and "Effort Limit: according to assessment outcomes (feedback): ii) target based with F- or biomass-based reference point"

If catch controls are used, or are to be used as a management measure, these compromise the use of catch time series as an informative assessment input.

Assumes no recruitment variability.

Top Option
Length-based Spawning Potential Ratio (LB-SPR)

Assessment Category: Size/Age-Based

Section: Assessment

Assessment Output: Stock Status

Assessment 'Tier': Mid-tier

Fishery: Smooth hammerhead shark, U.S. Atlantic and Gulf of Mexico

This option meets all criteria (4 of 4 met)

Description

The length-based spawning potential ratio (LB-SPR) assessment method estimates spawning potential ratio (SPR), the ratio of reproductive potential of a fished relative to an unfished population.

In total, the method requires at least on year of length composition information, an estimate for the ratio M/k, maximum size (L), the coefficient of variation (CV) of L, and knowledge of size-at-maturity, from which it SPR is calculated. The ratio of M/k is used because this value is less variable across stocks and species than either the individual parameters for natural mortality rate (M) or the von Bertalanffy growth coefficient (k). The method has an easy to use [Shiny app] (http://barefootecologist.com.au/lbspr) and is available in a [R package] (https://cran.r-project.org/web/packages/LBSPR/index.html) . Despite the ease of implementation, particular care should be taken with this assessment option to ensure that all the method's assumptions are fully understood and are valid for the stock of interest before performing LB-SPR analysis (see caveats). There has been some progress on dealing with the issue of dome-shaped selectivity in a sequential estimation approach (Hommik et al. 2020). This method provides a snapshot estimate of SPR assuming a constant, fishing rate. While it can be applied to multiple years, each year is treated independently, and thus this is not a true time series approach. Other approaches (e.g., length-only integrated models) should also be considered with multiple years of data.
The following links may serve as useful resources for this assessment option:
[http://barefootecologist.com.au/lbspr] (http://barefootecologist.com.au/lbspr)
[http://www.datalimitedtoolkit.org/] (http://www.datalimitedtoolkit.org/)
[https://CRAN.R-project.org/package=LBSPR] (https://cran.r-project.org/package=LBSPR)

Contacts

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References

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Hordyk, A., Ono, K., Valencia, S., Loneragan, N., & Prince, J. (2015). A novel length-based empirical estimation method of spawning potential ratio (SPR), and tests of its performance, for small-scale, data-poor fisheries. ICES Journal of Marine Science, 72(1), 217-231. [http://dx.doi.org/10.1093/icesjms/fsu004] (http://dx.doi.org/10.1093/icesjms/fsu004)
Hordyk, A., Ono, K., Sainsbury, K., Loneragan, N., & Prince, J. (2015). Some explorations of the life history ratios to describe length composition, spawning-per-recruit, and the spawning potential ratio. ICES Journal of Marine Science, 71(1), 204-216. [http://dx.doi.org/10.1093/icesjms/fst235] (http://dx.doi.org/10.1093/icesjms/fst235)

Applications
Hordyk, A. R., Ono, K., Prince, J. D., & Walters, C. J. (2016). A simple length-structured model based on life history ratios and incorporating size-dependent selectivity: application to spawning potential ratios for data-poor stocks. Canadian Journal of Fisheries and Aquatic Sciences, 73(12), 1787-1799.
Hordyk, A. R., Loneragan, N. R., & Prince, J. D. (2015). An evaluation of an iterative harvest strategy for data-poor fisheries using the length-based spawning potential ratio assessment methodology. Fisheries Research, 171, 20-32. [https://doi.org/10.1016/j.fishres.2014.12.018] (https://doi.org/10.1016/j.fishres.2014.12.018)
Hommik, K., Fitzgerald, C.J., Kelly, F., Shephard, S., 2020. Dome-shaped selectivity in LB-SPR: Length-Based assessment of data-limited inland fish stocks sampled with gillnets. Fisheries Research 229, 105574. [https://doi.org/10.1016/j.fishres.2020.105574] (https://doi.org/10.1016/j.fishres.2020.105574)
Lindfield, S. (2017). Palau's reef fisheries: changes in size and spawning potential from past to present. Technical report, Coral Reef Research Foundation. 23 pp.
Prince, J., Victor, S., Kloulchad, V., & Hordyk, A. (2015). Length based SPR assessment of eleven Indo-Pacific coral reef fish populations in Palau. Fisheries Research, 171, 42-58. [https://doi.org/10.1016/j.fishres.2015.06.008] (https://doi.org/10.1016/j.fishres.2015.06.008)

User Notes About This Option

No user notes were recorded at the time of report generation.

Criteria

This option meets all the criteria for your fishery. (4 of 4 met)

Met/ Failed	Single or Multi?	Question	Answer	Minimum Criteria
Met	Single Criteria	Do you have the life history ratio (M/k) for the species? Select the answer that best describes the source and uncertainty.	3: Yes, individually estimated M and k, with low to moderate uncertainty (e.g., good sample size, up to date, covers the spatial range of the species)	1: Yes, M/k taxonomically (i.e., nearest taxonomic neighbor) or empirically derived
Met	Single Criteria	Do you have a maturity ogive (cumulative frequency graph) or a size-at-maturity relationship for the species? Select the answer that best describes the source and uncertainty.	1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived, or when only one maturity metric (e.g., L50%) is available	2: Yes, estimated, but with high uncertainty (e.g., low sample size, outdated data, sampling from a small area of a bigger spatial range, or unable to differentiate sex-specific values)

Met	Single Criteria	Do you have estimates of the von Bertalanffy growth parameters? Select the answer that best describes the source and uncertainty.	3: Yes, estimated from age and length data with low to moderate uncertainty	1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived, or based only on length samples (e.g., ELEFAN)
Met	Single Criteria	What time series of length composition data exists?	2: Significant bias in time series. Major flaws that significantly bias time series data representativeness. Examples: missing years of major removals; missing catch contributions of major fleets/metiers; and, significant gaps in reporting, species identification, and/or spatial sampling of fisheries.	1: Snapshot (1-2 years of data only). Use caution when applying all snapshot data, but be especially careful with data that is poorly sampled or poorly representative.

Caveats and Attributes

Red Caveats

Question	Answer	Caveat
Is the range of the fished population greater than the area in which fishing or sampling occurs, or the jurisdictional management boundary?	**Yes**	**If data are not representative of the stock as a whole, the information may not represent the unit you are trying to manage**

Orange Caveats

Question	Answer	Caveat
Is the species being actively and consistently targeted?	No	If there have been changes in targeting practices, time series of data may not be commensurate because of changes in catchability. Caution should be applied in interpreting temporal trends in indicators.
Are data that are to be used within an assessment collected using a different gear than used by fishers?	Yes	Data may create biased results in this method. Reconsider using the data or determine a modification of the data to approximate the selectivity of the fishery.
Is the biological data (e.g., length or age compositions) differentiated by sex?	No	This method assumes that the biological parameters and length composition is of female fish only. If sex is unknown, the method would assume both sexes have the same growth curve and always caught in equal proportions. If there are sex-specific differences and data is of an unknown sex, results may be biased.

Yellow Caveats

Question	Answer	Caveat
Do you know the selectivity, or selectivities of the fleet(s) or gear type(s)? Select the answer that best applies.	1: Able to be inferred by expert opinion or very limited direct measurements (e.g., L50, L95), with some uncertainty in the exact shape	This method currently assumes asymptotic (logistic), time-independent selectivity and estimates selectivity within this form. Thus the method is sensitive to selectivity mis-specification (need to know if selectivity is asymptotic or dome-shaped). However, the method has trouble with estimation of selectivity, or can yield unrealistic estimates of selectivity. (Theoretically one could fix the value of selectivity and therefore explore different values as a sensitivity analysis).
Are data that are to be used in an assessment representative of the spatial extent of the fleet and fishers? Select the answer that best applies.	Mostly, but with some representativeness issues in the data	If data are not representative of the spatial extent of the fleet, the information may not represent the unit you are trying to manage.
Has anything in the fishery changed over time that would impact your interpretation of the data?	Yes	Temporal changes in the fishery could compromise the interpretation of fishery-dependent time series data, if time series are being interpreted. Assumes equilibrium biomass.
Is the life history of the species sex-specific?	Yes	Be cautious regarding the interpretation of life-history parameters that may be sex-specific
Are data that are to be used in an assessment representative of the activities of the fleet and fisher characteristics? Select the answer that best applies.	Mostly, but with some representativeness issues in the data	If data are not representative of the activities of the fleet, the information may not represent the unit you are trying to manage.

Positive Attributes

There are no positive attributes.

Static Caveats

These caveats always apply to this option.

Static Caveat
Consider whether catchability varies in time or space (e.g. if environmental, oceanographic, weather, temperature conditions affect either fish availability or fishing gear effectiveness).
Additional assessment requirement: Assumes age- and time-independent mortality.
Can explicitly quantify uncertainty
Assumes B0 (i.e., the initial condition of the stock) is constant.
Links readily to/lends itself for use with the decision rules: "Catch Limit: according to assessment outcomes (feedback): ii) target based with F- or biomass-based reference point" and "Effort Limit: according to assessment outcomes (feedback): ii) target based with F- or biomass-based reference point"
The method treats each year as an independent estimate. Changes in selectivity across years may indicate recruitment events (unless that change in selectivity actually occurred), which may lead to a bias in estimates of F and SPR in this method.
This method assumes selectivity is S-shaped (logistic, asymptotic). Other selectivity curves can cause biased results in the SPR. For example, if dome-shaped selectivity is the true selectivity pattern, LBSPR estimates of SPR will be biased low.
Assumes equilibrium conditions
This method assumes one length composition per time entry (e.g., year). If the overall fishing mortality comes from multiple fleets, the user will need to determine how to sample and combine compositions from multiple fleets into one composition.
This method assumes some value for the variability in length by age, which is often presented as the coefficient of variation at length (CVL). This value is often assumed to be 0.1, but generally ranges from 0.05 to 0.2.

Top Option
Mean length mortality estimators

Assessment Category: Size/Age-Based

Assessment Output: Fishing Rate

Assessment 'Tier': Mid-tier

Fishery: Smooth hammerhead shark, U.S. Atlantic and Gulf of Mexico

This option meets all criteria (3 of 3 met)

Description

To estimate total mortality (Z) for a fished stock, the original Beverton-Holt mortality estimator used the von Bertalanffy growth parameters (K and L), the length at first capture (Lc), and the mean length of the catch. However, this method was rightly criticized for its reliance on equilibrium conditions. This is because Z can change for a variety of reasons, such as in response to increased fishing pressure or environmental changes. In response to such criticism, Gedamke and Hoenig (2006) developed a new procedure for estimating Z reliably (and also, therefore, fishing mortality rate [F]) in non-equilibrium conditions (i.e., when the stock has experienced different Z values throughout its history). Users must specify how many times mortality is thought to have changed, initial guesses of the years during which mortality is thought to have changed, and the original von Bertalanffy parameters K, L, Lc, and mean length to estimates Z and F. From there, maximum likelihood estimation (MLE) is used to calculate variable values with an associated confidence interval, so uncertainty is partially accounted for.
The following link may serve as a useful resource for this assessment option: [http://www.datalimitedtoolkit.org/] (http://www.datalimitedtoolkit.org/)

Contacts

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References

References
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Applications
Ault, Jerald S., Steven G. Smith, James A. Bohnsack, Jiangang Luo, Molly H. Stevens, Gerard T. DiNardo, Matthew W. Johnson, and David R. Bryan. 2018. Length-Based Risk Analysis for Assessing Sustainability of Data-Limited Tropical Reef Fisheries. ICES Journal of Marine Science. [https://doi.org/10.1093/icesjms/fsy123] (https://doi.org/10.1093/icesjms/fsy123) .

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User Notes About This Option

No user notes were recorded at the time of report generation.

Criteria

This option meets all the criteria for your fishery. (3 of 3 met)

Met/ Failed	Single or Multi?	Question	Answer	Minimum Criteria
Met	Single Criteria	Do you have an estimate of the natural mortality (M) of the species? Select the answer that best describes the source and uncertainty.	3: Yes, estimated with low to moderate uncertainty	1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived
Met	Single Criteria	Do you have estimates of the von Bertalanffy growth parameters? Select the answer that best describes the source and uncertainty.	3: Yes, estimated from age and length data with low to moderate uncertainty	1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived, or based only on length samples (e.g., ELEFAN)
Met	Multi A Met	What time series of length composition data exists?	2: Significant bias in time series. Major flaws that significantly bias time series data representativeness. Examples: missing years of major removals; missing catch contributions of major fleets/metiers; and, significant gaps in reporting, species identification, and/or spatial sampling of fisheries.	1: Snapshot (1-2 years of data only). Use caution when applying all snapshot data, but be especially careful with data that is poorly sampled or poorly representative.

Met	Multi A Met	What time series of percentile length data (mean, median, x percentile) exists?	2: Significant bias in time series. Major flaws that significantly bias time series data representativeness. Examples: missing years of major removals; missing catch contributions of major fleets/metiers; and, significant gaps in reporting, species identification, and/or spatial sampling of fisheries.	1: Snapshot (1-2 years of data only). Use caution when applying all snapshot data, but be especially careful with data that is poorly sampled or poorly representative.

Caveats and Attributes

Red Caveats

Question	Answer	Caveat
Is the range of the fished population greater than the area in which fishing or sampling occurs, or the jurisdictional management boundary?	**Yes**	**If data are not representative of the stock as a whole, the information may not represent the unit you are trying to manage**

Orange Caveats

Question	Answer	Caveat
Is the species being actively and consistently targeted?	No	If there have been changes in targeting practices, time series of data may not be commensurate because of changes in catchability. Caution should be applied in interpreting temporal trends in indicators.
Are data that are to be used within an assessment collected using a different gear than used by fishers?	Yes	Data may create biased results in this method. Reconsider using the data or determine a modification of the data to approximate the selectivity of the fishery.

Yellow Caveats

Question	Answer	Caveat

Do you know the selectivity, or selectivities of the fleet(s) or gear type(s)? Select the answer that best applies.	1: Able to be inferred by expert opinion or very limited direct measurements (e.g., L50, L95), with some uncertainty in the exact shape	Need selectivity to at least be able to be inferred. If selectivity is unknown, you need to be more mindful of your uncertainty (e.g. undertake sensitivity analysis to alternate forms of selectivity). Selectivity is a very influential parameterisation - logistic vs dome-shaped can produce very different results. Particular care needs to be taken if the fishery has multiple fleets or gear types targeting or selecting different size ranges of the same species. Knowing every fishery isn't necessarily required, but understanding the predominant selectivity is important. Note that most methods cannot handle multiple selectivities, so an overall single estimate will be required in most cases. Interpret your results with a clear awareness of the selectivity assumptions.
Has the selectivity pattern changed over time?	Unknown	Time series data may not be commensurate if the selectivity has changed: changing selectivity may change your interpretation of the method's output. This method does explicitly account for time-dependent selectivity.
Are data that are to be used in an assessment representative of the spatial extent of the fleet and fishers? Select the answer that best applies.	Mostly, but with some representativeness issues in the data	If data are not representative of the spatial extent of the fleet, the information may not represent the unit you are trying to manage.
Is the biological data (e.g., length or age compositions) differentiated by sex?	No	If there is a strong sexual differentiation in life history parameters resulting in mixed length compositions by sex, then you need to have some understanding of the sex composition of the sampling.
Is the life history of the species sex-specific?	Yes	Be cautious regarding the interpretation of life-history parameters that may be sex-specific
Are data that are to be used in an assessment representative of the activities of the fleet and fisher characteristics? Select the answer that best applies.	Mostly, but with some representativeness issues in the data	If data are not representative of the activities of the fleet, the information may not represent the unit you are trying to manage.

Positive Attributes

There are no positive attributes.

Static Caveats

These caveats always apply to this option.

Static Caveat
Consider whether catchability varies in time or space (e.g. if environmental, oceanographic, weather, temperature conditions affect either fish availability or fishing gear effectiveness).
The assessment has the ability to quantify output uncertainty.
Interpretation of results may be sensitive to major recruitment events.

Top Option
Length-Only Integrated Model

Assessment Category: Size/Age-Based

Section: Assessment

Assessment Output: Stock Status

Assessment 'Tier': Mid-tier

Fishery: Smooth hammerhead shark, U.S. Atlantic and Gulf of Mexico

This option meets all criteria (5 of 5 met)

Description

Length-Only Integrated models are a flexible age-based stock assessment method for fisheries with developing data collection programs and/or limited capacity for monitoring. These models expand on methods utilizing only length measurements by linking across years length samples and optionally incorporating recruitment, and thus variable fishing mortality. This approach reconciles multiple years of sampling length compositions removing the equilibrium assumption among years. Length-only integrated models require one year of length composition data (in which they behave more like LBSPR, but still can provide relative biomass, not just SPR, as an output) and assumptions about biological parameters. These are special cases of an general age-structure model, and thus further data (i.e., catch, indices or ages) could be included (and are reflected in other assessment options).
The following link may serve as useful resources for this assessment option:
Stock Synthesis - Length Only (SS-LO): [https://github.com/shcaba/SS-DL-tool] (https://github.com/shcaba/SS-DL-tool)
Length-based Integrated Mixed Effects (LIME): [https://github.com/merrillrudd/LIME] (https://github.com/merrillrudd/LIME)

Contacts

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References

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Rudd, M. B., & Thorson, J. T. (2017). Accounting for variable recruitment and fishing mortality in length-based stock assessments for data-limited fisheries. Canadian Journal of Fisheries and Aquatic Sciences. [https://doi.org/10.1139/cjfas-2017-0143] (https://doi.org/10.1139/cjfas-2017-0143)

User Notes About This Option

No user notes were recorded at the time of report generation.

Criteria

This option meets all the criteria for your fishery. (5 of 5 met)

Met/ Failed	Single or Multi?	Question	Answer	Minimum Criteria
Met	Single Criteria	Do you have an estimate of the natural mortality (M) of the species? Select the answer that best describes the source and uncertainty.	3: Yes, estimated with low to moderate uncertainty	1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived
Met	Single Criteria	Do you have a maturity ogive (cumulative frequency graph) or a size-at-maturity relationship for the species? Select the answer that best describes the source and uncertainty.	1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived, or when only one maturity metric (e.g., L50%) is available	1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived, or when only one maturity metric (e.g., L50%) is available
Met	Single Criteria	Do you have an estimate of recruitment compensation (i.e., termed "steepness" in some stock-recruit relationships) for the species? Select the answer that best describes the source and uncertainty.	3: Yes, species-specific value with low to moderate uncertainty	1: Yes, expert opinion or non-species-specific value
Met	Single Criteria	Do you have estimates of the von Bertalanffy growth parameters? Select the answer that best describes the source and uncertainty.	3: Yes, estimated from age and length data with low to moderate uncertainty	1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived, or based only on length samples (e.g., ELEFAN)

Met	Single Criteria	What time series of length composition data exists?	2: Significant bias in time series. Major flaws that significantly bias time series data representativeness. Examples: missing years of major removals; missing catch contributions of major fleets/metiers; and, significant gaps in reporting, species identification, and/or spatial sampling of fisheries.	1: Snapshot (1-2 years of data only). Use caution when applying all snapshot data, but be especially careful with data that is poorly sampled or poorly representative.

Caveats and Attributes

Red Caveats

Question	Answer	Caveat
Is the range of the fished population greater than the area in which fishing or sampling occurs, or the jurisdictional management boundary?	**Yes**	**If data are not representative of the stock as a whole, the information may not represent the unit you are trying to manage**

Orange Caveats

Question	Answer	Caveat
Is the species being actively and consistently targeted?	No	If there have been changes in targeting practices, time series of data may not be commensurate because of changes in catchability. Caution should be applied in interpreting temporal trends in indicators.
Are data that are to be used within an assessment collected using a different gear than used by fishers?	Yes	Data may create biased results in this method. Reconsider using the data or determine a modification of the data to approximate the selectivity of the fishery.

Yellow Caveats

Question	Answer	Caveat

Do you know the selectivity, or selectivities of the fleet(s) or gear type(s)? Select the answer that best applies.	1: Able to be inferred by expert opinion or very limited direct measurements (e.g., L50, L95), with some uncertainty in the exact shape	Need selectivity to at least be able to be inferred. If selectivity is unknown, you need to be more mindful of your uncertainty (e.g. undertake sensitivity analysis to alternate forms of selectivity). Selectivity is a very influential parameterisation - logistic vs dome-shaped can produce very different results. Particular care needs to be taken if the fishery has multiple fleets or gear types targeting or selecting different size ranges of the same species. Knowing every fishery isn't necessarily required, but understanding the predominant selectivity is important. Note that most methods cannot handle multiple selectivities, so an overall single estimate will be required in most cases. Interpret your results with a clear awareness of the selectivity assumptions.
Has the selectivity pattern changed over time?	Unknown	Time series data may not be commensurate if the selectivity has changed: changing selectivity may change your interpretation of the method's output.
Are data that are to be used in an assessment representative of the spatial extent of the fleet and fishers? Select the answer that best applies.	Mostly, but with some representativeness issues in the data	If data are not representative of the spatial extent of the fleet, the information may not represent the unit you are trying to manage.
Has anything in the fishery changed over time that would impact your interpretation of the data?	Yes	Temporal changes in the fishery could compromise the interpretation of fishery-dependent time series data, if time series are being interpreted.
Is the biological data (e.g., length or age compositions) differentiated by sex?	No	If there is a strong sexual differentiation in life history parameters resulting in mixed length compositions by sex, then you need to have some understanding of the sex composition of the sampling.
Is the life history of the species sex-specific?	Yes	Be cautious regarding the interpretation of life-history parameters that may be sex-specific

Are data that are to be used in an assessment representative of the activities of the fleet and fisher characteristics? Select the answer that best applies.	Mostly, but with some representativeness issues in the data	If data are not representative of the activities of the fleet, the information may not represent the unit you are trying to manage.

Positive Attributes

There are no positive attributes.

Static Caveats

These caveats always apply to this option.

Static Caveat
Consider whether catchability varies in time or space (e.g. if environmental, oceanographic, weather, temperature conditions affect either fish availability or fishing gear effectiveness).
Assumes B0 (i.e., the initial condition of the stock) is constant.
Life history values are fixed in these models, and therefore uncertainty about these values is underestimated. Sensitivity scenarios using different life history values should be used gauge how much model output changes given changes in life history inputs.
This method assumes some value for the variability in length by age, which is often presented as the coefficient of variation at length (CVL). This value is often assumed to be 0.1, but generally ranges from 0.05 to 0.2.

Top Option
Yield-Per-Recruit

Assessment Category: Life History-Based Methods | Section: Assessment

Assessment Output: Fishing Rate

Assessment 'Tier': Pre-assessment - Life-History Based Reference Points

Fishery: Smooth hammerhead shark, U.S. Atlantic and Gulf of Mexico

This option meets all criteria (4 of 4 met)

Description

This model is used to determine the maximum yield that can be captured from a fishery. It uses an age-structured model to determine at what size or age the yield (i.e, catches in numbers or biomass) is maximized and at what corresponding fishing rate (Fmax). Adding maturity, it can also track the spawning biomass per recruit at any given fishing level. This model makes a major assumption that the age structure of the fishery has reached an equilibrium and that the recruitment and mortality effects will be the same for all cohorts. Therefore it does not incorporate environmental or fishing rate stochasticity. This method is particularly useful in finding fishing rate reference points, though studies have demonstrated that setting targets at the maximum F rate (Fmax) can be unsustainable due when assumptions are violated.
The following link may serve as a useful resource for this assessment option:
[http://www.datalimitedtoolkit.org/] (http://www.datalimitedtoolkit.org/)
[https://cran.r-project.org/web/packages/TropFishR/index.html] (https://cran.r-project.org/web/packages/TropFishR/index.html)
[https://cran.r-project.org/web/packages/fishmethods/index.html] (https://cran.r-project.org/web/packages/fishmethods/index.html)
[https://nmfs-fish-tools.github.io/YPR/] (https://nmfs-fish-tools.github.io/YPR/)
[https://nmfs-fish-tools.github.io/YPRLEN/] (https://nmfs-fish-tools.github.io/YPRLEN/)

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Barbieri, L.R., Chittenden Jr, M.E., & Jones, C.M. (1997). Yield-per-recruit analysis and management strategies for Atlantic croaker, Micropogonias undulatus, in the Middle Atlantic Bight. Fishery Bulletin, 95(4), 637-645.
Nadon MO, Ault JS, Williams ID, Smith SG, DiNardo GT (2015) Length-Based Assessment of Coral Reef Fish Populations in the Main and Northwestern Hawaiian Islands. PLoS ONE 10(8): e0133960. [https://doi.org/10.1371/journal.pone.0133960] (https://doi.org/10.1371/journal.pone.0133960)

User Notes About This Option

No user notes were recorded at the time of report generation.

Criteria

This option meets all the criteria for your fishery. (4 of 4 met)

Met/ Failed	Single or Multi?	Question	Answer	Minimum Criteria
Met	Single Criteria	Do you have an estimate of the natural mortality (M) of the species? Select the answer that best describes the source and uncertainty.	3: Yes, estimated with low to moderate uncertainty	1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived
Met	Single Criteria	Do you have a maturity ogive (cumulative frequency graph) or a size-at-maturity relationship for the species? Select the answer that best describes the source and uncertainty.	1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived, or when only one maturity metric (e.g., L50%) is available	1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived, or when only one maturity metric (e.g., L50%) is available
Met	Single Criteria	Do you have a length-weight relationship for the species? Select the answer that best describes the source and uncertainty.	3: Yes, species-specific value with low to moderate uncertainty	1: Yes, expert opinion or non-species-specific value
Met	Single Criteria	Do you have estimates of the von Bertalanffy growth parameters? Select the answer that best describes the source and uncertainty.	3: Yes, estimated from age and length data with low to moderate uncertainty	1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived, or based only on length samples (e.g., ELEFAN)

Caveats and Attributes

Red Caveats

There are no red caveats.

Orange Caveats

There are no orange caveats.

Yellow Caveats

Question	Answer	Caveat

Do you know the selectivity, or selectivities of the fleet(s) or gear type(s)? Select the answer that best applies.	1: Able to be inferred by expert opinion or very limited direct measurements (e.g., L50, L95), with some uncertainty in the exact shape	Need selectivity to at least be able to be inferred. If selectivity is unknown, you need to be more mindful of your uncertainty (e.g. undertake sensitivity analysis to alternate forms of selectivity). Selectivity is a very influential parameterisation - logistic vs dome-shaped can produce very different results. Particular care needs to be taken if the fishery has multiple fleets or gear types targeting or selecting different size ranges of the same species. Knowing every fishery isn't necessarily required, but understanding the predominant selectivity is important. Note that most methods cannot handle multiple selectivities, so an overall single estimate will be required in most cases. Interpret your results with a clear awareness of the selectivity assumptions.
Has the selectivity pattern changed over time?	Unknown	Time series data may not be commensurate if the selectivity has changed: changing selectivity may change your interpretation of the method's output.
Do you have an estimate of current absolute stock abundance? Select the answer that best describes the source and uncertainty.	0: No	You cannot use this method to estimate a catch limit without an absolute measure of stock abundance, but you can still define a fishing rate reference point.
Does the species aggregate (e.g., schooling, or aggregates near desirable habitat or refugia)?	Yes, but not actively targeted while aggregated	Reference points based mostly on life history parameters could overestimate productivity if there is density-dependence in the aggregating behavior sensitive to fishing activity not being modelled in the YPR analysis.

Positive Attributes

There are no positive attributes.

Static Caveats

These caveats always apply to this option.

Static Caveat
Assumes equilibrium conditions

Top Option
Length-based Bayesian Biomass Estimation (LBB)

Assessment Category: Size/Age-Based

Section: Assessment

Assessment Output: Stock Status

Assessment 'Tier': Mid-tier

Fishery: Smooth hammerhead shark, U.S. Atlantic and Gulf of Mexico

This option meets all criteria (4 of 4 met)

Description

The length-based Bayesian biomass estimation method (LBB) estimates relative abundance (i.e., stock status) using only length frequency data compiled from catches. To accomplish this, LBB uses Bayesian methods to estimate or set a prior on several life history traits typically provided as inputs. These estimated values can then be used in standard fishery models to estimate the spawning potential ratio. One should be aware of the assumed priors being used before applying this method. For further discussion into the technical nuances and assumptions, see the comment by Hordyk et al and response by Froese et al listed below.
The following link may serve as a useful resource for this assessment option:
[https://oceanrep.geomar.de/43182/] (https://oceanrep.geomar.de/43182/)
[https://oceanrep.geomar.de/44832/] (https://oceanrep.geomar.de/44832/)

Contacts

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References

Froese, R, et al. "A new approach for estimating stock status from length frequency data." ICES Journal of Marine Science 75.6 (2018): 2004-2015;
Hordyk, A.R., Prince, J.D., Carruthers, T.R., Walters, C.J., Comment on "A new approach for estimating stock status from length frequency data" by Froese et al. (2018). ICES J Mar Sci. https://doi.org/10.1093/icesjms/fsy168
Froese, R., Winker, H., Coro, G., Demirel, N., Tsikliras, A.C., Dimarchopoulou, D., Scarcella, G., Probst, W.N., Dureuil, M., Pauly, D., n.d. On the pile-up effect and priors for Linf and M/K: response to a comment by Hordyk et al. on "A new approach for estimating stock status from length frequency data." ICES J Mar Sci. https://doi.org/10.1093/icesjms/fsy199

Applications
See supplemental materials of Froese et al. 2018

User Notes About This Option

No user notes were recorded at the time of report generation.

Criteria

This option meets all the criteria for your fishery. (4 of 4 met)

Met/ Failed	Single or Multi?	Question	Answer	Minimum Criteria
Met	Single Criteria	Do you have an estimate of the natural mortality (M) of the species? Select the answer that best describes the source and uncertainty.	3: Yes, estimated with low to moderate uncertainty	3: Yes, estimated with low to moderate uncertainty
Met	Single Criteria	Do you have a maturity ogive (cumulative frequency graph) or a size-at-maturity relationship for the species? Select the answer that best describes the source and uncertainty.	1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived, or when only one maturity metric (e.g., L50%) is available	3: Yes, estimated with low to moderate uncertainty (e.g., good sample size, up to date, covers the spatial range of the species)
Met	Single Criteria	Do you have estimates of the von Bertalanffy growth parameters? Select the answer that best describes the source and uncertainty.	3: Yes, estimated from age and length data with low to moderate uncertainty	3: Yes, estimated from age and length data with low to moderate uncertainty
Met	Single Criteria	What time series of length composition data exists?	2: Significant bias in time series. Major flaws that significantly bias time series data representativeness. Examples: missing years of major removals; missing catch contributions of major fleets/metiers; and, significant gaps in reporting, species identification, and/or spatial sampling of fisheries.	4: Bias and imprecision are minimal. There are few, if any, flaws in time series data representativeness and sampling, and bias and imprecision are not a major concern. Examples: time series that cover recognized major removal histories, fleets and areas, as well as high resolution in species reporting and sufficient sample sizes to minimize imprecision.

Caveats and Attributes

Red Caveats

Question	Answer	Caveat
Is the range of the fished population greater than the area in which fishing or sampling occurs, or the jurisdictional management boundary?	**Yes**	**If data are not representative of the stock as a whole, the information may not represent the unit you are trying to manage**

Orange Caveats

Question	Answer	Caveat
Is the species being actively and consistently targeted?	No	If there have been changes in targeting practices, time series of data may not be commensurate because of changes in catchability. Caution should be applied in interpreting temporal trends in indicators.
Are data that are to be used within an assessment collected using a different gear than used by fishers?	Yes	Data may create biased results in this method. Reconsider using the data or determine a modification of the data to approximate the selectivity of the fishery.

Yellow Caveats

Question	Answer	Caveat
Do you know the selectivity, or selectivities of the fleet(s) or gear type(s)? Select the answer that best applies.	1: Able to be inferred by expert opinion or very limited direct measurements (e.g., L50, L95), with some uncertainty in the exact shape	Need selectivity to at least be able to be inferred. If selectivity is unknown, you need to be more mindful of your uncertainty (e.g. undertake sensitivity analysis to alternate forms of selectivity). Selectivity is a very influential parameterisation - logistic vs dome-shaped can produce very different results. Particular care needs to be taken if the fishery has multiple fleets or gear types targeting or selecting different size ranges of the same species. Knowing every fishery isn't necessarily required, but understanding the predominant selectivity is important. Note that most methods cannot handle multiple selectivities, so an overall single estimate will be required in most cases. Interpret your results with a clear awareness of the selectivity assumptions.
Has the selectivity pattern changed over time?	Unknown	Time series data may not be commensurate if the selectivity has changed: changing selectivity may change your interpretation of the method's output.

Are data that are to be used in an assessment representative of the spatial extent of the fleet and fishers? Select the answer that best applies.	Mostly, but with some representativeness issues in the data	If data are not representative of the spatial extent of the fleet, the information may not represent the unit you are trying to manage.
Has anything in the fishery changed over time that would impact your interpretation of the data?	Yes	Temporal changes in the fishery could compromise the interpretation of fishery-dependent time series data, if time series are being interpreted. Assumes equilibrium biomass; beware changes in selectivity
Is the biological data (e.g., length or age compositions) differentiated by sex?	No	If there is a strong sexual differentiation in life history parameters resulting in mixed length compositions by sex, then you need to have some understanding of the sex composition of the sampling.
Is the life history of the species sex-specific?	Yes	Be cautious regarding the interpretation of life-history parameters that may be sex-specific
Are data that are to be used in an assessment representative of the activities of the fleet and fisher characteristics? Select the answer that best applies.	Mostly, but with some representativeness issues in the data	If data are not representative of the activities of the fleet, the information may not represent the unit you are trying to manage.

Positive Attributes

There are no positive attributes.

Static Caveats

These caveats always apply to this option.

Static Caveat
Assumes equilibrium conditions
The method treats each year as an independent estimate. Changes in selectivity across years may indicate recruitment events (unless that change in selectivity actually occurred), which may lead to a bias in estimates of F and B/B0 in this method.
This method assumes one length composition per time entry (e.g., year). If the overall fishing mortality comes from multiple fleets, the user will need to determine how to sample and combine compositions from multiple fleets into one composition.
This method assumes some value for the variability in length by age, which is often presented as the coefficient of variation at length (CVL). This value is often assumed to be 0.1, but generally ranges from 0.05 to 0.2.