Fishpath Questions and Answers for Smooth Hammerhead

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SEDAR77-AW06

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Assessment > **Governance**

Question #1 (5 of 46 questions completed) - Both Criteria and Caveats
TAKE A NOTE
ADD BOOKMARK

Rank the level of research and institutional capacity to implement a formal harvest/management strategy (i.e., data collection, assessment, management measures).

This question should be answered relative to the agency's or organization's own context and circumstances. Research and institutional capacity refers to capacity that is either currently available or that could be secured by the fisheries agency. This also includes availability and qualification of scientists, administrative and support staff, data collection officers, enforcement officers, etc.

The intent of subjective questions such as these is to allow users to think through characteristics of their fishery that will influence the feasibility of implementing certain management options. See the subjective questions section in the FishPath Tool User Guide.

○
Low
○
Low-moderate
○
Moderate
○
Moderate-high
○
High

PREVIOUS

Is the species being actively and consistently targeted?

 "Active targeting" means that fishers directly intend to capture certain species.

If a fishery consistently catches one or more species prized and actively sought by fishers, then "Yes" should be selected. If a fishery is purely opportunistic with no set expectations around the species captured, then "No" should be selected.

The validity of certain [indicators] and assessment types will be compromised if the fishery is not actively targeting the species of interest. For example, a standardized CPUE is of little use as a proxy abundance index if the species is not the subject of active targeting.

○
No
○
Yes

PREVIOUS

Is the fishery multispecies, either in terms of target or [bycatch](#) species?

○
No
○
Yes

PREVIOUS

Assessment > **Management**
TAKE A NOTE
ADD BOOKMARK

If the fishery is multispecies, are species being assessed collectively as a group of species (e.g., as a "basket" or "stock complex")?

Reasons for a collective assessment might include a lack of data on each species, a lack of species identification, or the fact that species are commonly and consistently captured together. If the fishery is multispecies, but the assessment is focusing on a single species only, users should answer "no."

○
No
○
Yes

PREVIOUS

Assessment > **Operational Characteristics**
TAKE A NOTE
ADD BOOKMARK

Do you have an understanding of which gear types are being used in the fishery and how they are being deployed?

○
No
○
Yes

PREVIOUS

Assessment > **Operational Characteristics**

TAKE A NOTE
ADD BOOKMARK

Are data that are to be used within an assessment collected using a different gear than used by fishers?

This question refers to an overall concept of data representation. Data collected for use within an assessment should be representative of the fishery, regardless of whether the data is fishery [independent] or [dependent].

○ No

○ Yes

Assessment > **Data Availability**

TAKE A NOTE
ADD BOOKMARK

Do you know the [selectivity], or selectivities of the fleet(s) or gear type(s)? Select the answer that best applies.

When answering, make sure to consider your understanding of all gear types/fleets that cause significant removals. Selectivity refers to how fish are removed by gear from the population, and can have different shapes (e.g., logistic, dome-shaped). If you are uncertain about the shape of the selectivity curve answer 1.

○ 0: No

○ 1: Able to be inferred by expert opinion or very limited direct measurements (e.g., L50, L95), with some uncertainty in the exact shape

○ 2: Well-understood selectivity shape with enough data to estimate selectivity by size or age

Has the [selectivity](#) pattern changed over time?

Changes in selectivity need to be considered when interpreting time series data.

In answering this question, consider the entire history of removals, including:

- changes over the time series for which data (that would be used within an assessment) are available; and
- whether there may have been changes outside the timeframe during which data are available (e.g., in cases where the non-data time period is when the majority of catches occurred).

○
No
○
Yes
○
Unknown

Is the range of the fished population greater than the area in which fishing or sampling occurs, or the jurisdictional management boundary?

The following are examples of when to answer "Yes":

- If the fishery harvests from the entire stock, but the stock is partially outside the management area
- If the population has a range greater than that being fished (e.g., the fishing activities are spatially concentrated, such as taking place only near the coast, but the stock has an offshore component, or the stock migrates through the fished area)
- If the population has a range greater than the jurisdictional management boundary

When answering, do not include the boundaries of no-take reserves unless no-take reserves comprise a large portion of the fishable area. Note that this question pertains only to the exploited (fished) population - it does NOT include the larval phase.

○
No

○
Yes

Notes
There could be a portion of the population occurring in the Caribbean, for which we have no data.

PREVIOUS

Do you have an estimate of current [absolute stock abundance](#)?

Select the answer that best describes the source and uncertainty.

Absolute stock abundance is a challenge to measure, but can come from a variety of sources (e.g., scientific surveys, mark-recapture studies, genetic analyses). It is also typically an output of many stock assessments, though some data-limited approaches require it as an input.

- ○ 0: No
- ○ 1: Yes, borrowed or empirically derived
- ○ 2: Yes, estimated, but with high uncertainty (e.g., low sample size, outdated data, sampling from a small area of a larger spatial range, or unable to differentiate sex-specific values)
- ○ 3: Yes, estimated with low to moderate uncertainty (e.g., good sample size, up to date, covers the spatial range of the species)

PREVIOUS

Rank the level of understanding of [relative stock status](#).

Relative stock status is the current spawning output divided by unfished spawning output and typically ranges from 1 (unfished) to 0 (extinct).

For most assessment methods, relative stock status is an output not an input. However, this question refers to methods that use this value as an input to calculate potential sustainable catches. Even a rough understanding of current relative stock status can be useful (e.g., "not unfished, but very high" or "not extinct, but very low"). In those cases, answer 1.

○

0: Absent

○

1: Expert opinion on relative stock status. Large bias and imprecision should be considered with these values.

○

2: General understanding of relative stock status coming from other data sources. Bias and imprecision will remain an important issue to consider.

○

3: Estimated from a stock assessment model.

<div align="center">PREVIOUS</div>

What time series of total removal data exists?

"Total removals" includes landings and dead discards. Removal data are needed to estimate total fishing mortality. Not including all removal sources can bias the outputs of assessment methods that use this information.

○

0: Absent

○

1: Snapshot (1-2 years of data only). Use caution when applying all Snapshot data, but be especially careful with data that is not well-sampled or representative.

○

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.

○

3: Moderate to low bias, but high imprecision in time series. Moderate flaws that don't significantly bias time series data representativeness, but do create significant imprecision. Examples: "partial" time series that reflect only most major years of removals and major fleets/metiers; sampling that covers most of the temporal-spatial extent of the fishery, and is generally reported at species level (low bias), but sample sizes may be low (high imprecision).

○

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 the recognized major removal histories, fleets and areas, as well as high resolution in species reporting and sufficient sample sizes to minimize imprecision.

Notes

I chose "moderate to low bias" (2) because in theory there are no major flaws that would significantly bias the catch series, but there is a large degree of uncertainty as reflected in the PSEs of the recreational catches.

Assessment > **Data Availability**

Question #13 (13 of 46 questions completed) - Caveats
NOTES TAKEN
BOOKMARKED

Is catch data available by location?

Location-specific data allows for detection of potential spatial differences and can be helpful in informing certain forms of assessment.

○ No

○ Yes

Notes

I said "yes" because commercial landings and recreational catches are available by state. Commercial landings are a minor part of total catches in relation to recreational catches and are all from the mid and North Atlantic whereas recreational catches also include some GOM catches and most Atlantic catches from the southeast Atlantic (FL to SC).

Are there significant sources of unreported [fishing mortality](#)?

This question seeks to identify sources of fishing mortality that might not be able to be quantified through data collection efforts and therefore would compromise the effectiveness of the assessment or certain management measures. For example, there may be a high level of [illegal, unregulated, or unreported fishing (IUU fishing)](#) or unreported discarding, or release of fish. In the context of this question, note that discarding may be legal.

○
No
○
Yes

Notes
I said "no", but there could be some sources of fishing mortality (catches) unaccounted for (e.g., in the Caribbean, by other fleets outside of the U.S. EEZ), the magnitude of which is unknown.

PREVIOUS

What time series of length composition data exists?

If only aggregated data is available, then the categories, or "bins", should be quantitative (e.g., 2 cm bins). Qualitative bins (e.g., "big", "medium" and "small") are insufficient for most methods. If the bins are qualitative, then answer 1.

This question refers to data from either fishery-dependent or fishery-independent sampling.

○
0: Absent

○
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.

○
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.

○
3: Moderate to low bias, but high imprecision in time series. Moderate flaws that don't significantly bias time series data representativeness, but do create significant imprecision. Examples: "partial" time series that reflect only most major years of removals and major fleets/metiers; sampling that covers most of the temporal-spatial extent of the fishery and generally reported at species level (low bias), but sample sizes may be low (high imprecision).

○
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.

Notes
524 individual length measurements available spanning 1966 to 2019 time period.

By gear n Proportion

Rod and reel 329 0.63

Gillnet 14 0.03

Pelagic longline 166 0.32

Bottom longline 15 0.03

Total 524 1

TAKE A NOTE
ADD BOOKMARK

What time series of fishing effort data exists?

This question refers to the recorded history of fishing effort, reported in units (e.g., hours, trips, days) that are consistent through the time series. Higher resolution effort units are typically desired (e.g., hours preferred over days), as coarser units may obscure attributes or changes occurring in the fishery over time. For fishing effort data to be a meaningful signal of fishing activity, unit resolution must match actual fishing effort.

○

0: Absent, or not meaningful

○

1: Snapshot (1-2 years of data only). Use caution when applying all Snapshot data, but be especially careful with data that is not well-sampled or representative.

○

2: Significant bias in time series. Major flaws that significantly bias time series data representativeness. Example: 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.

○

3: Moderate to low bias, but high imprecision in time series. Moderate flaws that don't significantly bias time series data representativeness, but do create significant imprecision. Examples: incomplete time series that account only for most years of major removals and most major fleets/metiers; stock is sampled and reported at the species level; fishing effort data is measured in finer units; and, sampling covers most of the temporal-spatial extent of the fishery, but the quantity of stock being sampled and reported at the species level is limited.

○

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 the recognized major removal histories, fleets and areas, high resolution in effort unit and species reporting data, and sufficient sample sizes to minimize imprecision.

PREVIOUS

TAKE A NOTE
ADD BOOKMARK

Is fishing effort data available by location?

Location-specific data allows for detection of potential spatial differences and can be helpful in informing certain forms of assessment.

○
No

○
Yes

PREVIOUS

TAKE A NOTE
ADD BOOKMARK

What time series of opportunistic (e.g., fishery-dependent) abundance indices exists?

This refers to data collected without the initial intent of measuring abundance. A common example is catch-per-unit-effort (CPUE) information based on data collected from a fishery, then standardized to represent abundance.

When using CPUE, the resolution of the effort units is assumed to capture important attributes or changes in the effort — that is, effort should be a meaningful signal of the fishing activity.

○
0: Absent, or 1 year of relative abundance index, or effort not meaningful (if using CPUE).

○
1: Short time series (e.g., 2-3 years). In addition to being a short time series of data, the index can be well-sampled, representative data, or it can be poorly sampled and poorly representative of the assessed stock. The

latter condition deserves even more consideration and caution when applying biased or imprecise short time series data.

○

2: Significant bias in time series. Major flaws that significantly bias time series data representativeness. Examples: time series missing major moments of removals or with no contrast (e.g., flat series), significant gaps in spatial/habitat sampling of the population, species identification issues, non-ideal fleet/gear for tracking population abundance of a particular species of interest, changing gear selectivity, or other sampling issues.

○

3: Moderate to low bias, but high imprecision in time series. Moderate flaws that don't significantly bias time series data representativeness, but do create significant imprecision. Examples: time series that include most removal time periods with good contrast, good species identification, consistent fishery behavior and selectivity, and sampling that covers most of the temporal-spatial extent of the fishery, and generally reported at species level (moderate to low bias) though sampling quantity and encounter rates may be low (high imprecision).

○

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 major fishing and environmental events, excellent coverage of the full range and habitat of the population(s) of interest, high resolution in species reporting, very consistent fishery behavior and selectivity, and sufficient sample sizes and encounter rates to minimize imprecision.

Assessment > **Data Availability**

TAKE A NOTE
ADD BOOKMARK

What time series of scientifically designed (e.g., fishery-independent) surveys of abundance exists?

Data collection for scientifically designed surveys can be undertaken by either scientists or fishers. These surveys usually measure either relative (the most common measure) or absolute (rarely measured) abundance.

○

0: Absent or 1 year of relative abundance index

○

1: Short time series (e.g., 2-3 years). In addition to being a short time series of data, the survey can be well-sampled, representative data, or it can be poorly sampled and poorly representative of the assessed stock. The latter condition deserves even more consideration and caution when applying biased or imprecise short time series data.

○

2: Significant bias in time series. Major flaws that significantly bias time series data representativeness. Examples: time series missing major moments of removals or with no contrast (e.g., flat series), significant gaps in spatial sampling of the population, species identification issues, non-ideal gear for the particular

species of interest, opportunistic application of a survey to species outside the initial design, or other sampling issues. that may make samples biased.

○

3: Moderate to low bias, but high imprecision in time series. Moderate flaws that don't significantly bias time series data representativeness, but do create significant imprecision. Examples: time series that include most moments of removals and show some time series contrast, good species identification, and sampling that covers most of the temporal-spatial extent of the population and generally reported at species level (low bias), though sampling quantity and encounter rates may still be low (moderate to high imprecision). General surveys that target many species at a time may suffer from the above issues.

○

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 major fishing and environmental events, excellent coverage of the full range and habitat of the population(s) of interest, high resolution in species reporting, and sufficient sample sizes and encounter rates to minimize imprecision (e.g., long-standing, well-designed and executed survey specifically targeting one or a few similar species).

Assessment > **Data Availability**

NOTES TAKEN
BOOKMARKED

What time series of percentile length data (mean, median, x percentile) exists?

This can be any metric used to measure growth (e.g., length, shell lip thickness).

○

0: Absent

○

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.

○

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.

○

3: Moderate to low bias, but high imprecision in time series. Moderate flaws that don't significantly bias time series data representativeness, but do create significant imprecision. Examples: "partial" time series that includes most major years of removals and major fleets/metiers; sampling that covers most of the temporal-spatial extent of the fishery and generally reported at species level (low bias), but sample sizes may be low (high imprecision).

○

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 the full extent of

the recognized major removal histories, fleets and areas, as well as high resolution in species reporting and sufficient sample sizes to minimize imprecision.

Notes
Not sure if the percentile length data refer to year or length interval?

TAKE A NOTE
ADD BOOKMARK

What time series for percentile weight data (mean, median, x percentile) exists?

○
0: Absent

○
1: Snapshot (1-2 years of data o1: 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.nly). Snapshot data can be well-sampled, representative data, or it can be poorly sampled and poorly representative of the assessed stock. The latter condition deserves even more consideration and caution when applying biased or imprecise snapshot data.

○
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.

○
3: Moderate to low bias, but high imprecision in time series. Moderate flaws that don't significantly bias time series data representativeness, but do create significant imprecision. Examples: "partial" time series that reflect only most major years of removals and major fleets/metiers; sampling that covers most of the temporal-spatial extent of the fishery and generally reported at species level (low bias), but sample sizes may be low (high imprecision).

○
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 the full extent of the recognized major removal histories, fleets and areas, as well as high resolution in species reporting and sufficient sample sizes to minimize imprecision.

For multispecies fisheries, what time series of species composition data exists?

If this is a targeted, single-species fishery, then answer 0.

○
0: Absent or not applicable

○
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.

○
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.

○
3: Moderate to low bias, but high imprecision in time series. Moderate flaws that don't significantly bias time series data representativeness, but do create significant imprecision. Examples: "partial" time series that reflect only most major years of removals and major fleets/metiers; sampling that covers most of the temporal-spatial extent of the fishery and generally reported at species level (low bias), but sample sizes may be low (high imprecision).

○
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 the full extent of the recognized major removal histories, fleets and areas, as well as high resolution in species reporting and sufficient sample sizes to minimize imprecision.

PREVIOUS

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.

Characteristics to consider include the temporal patterns, targeting practices, gear types, and selectivity. The next question explicitly asks about the spatial element of data representation.

Data representativeness is a key attribute for useful data. To be considered "representative," data should not have any major sources of bias (e.g., non-random sampling, sampling that misses key areas or time frames, samples of only certain portions of a fishery or certain habitats, etc). Fishery-dependent data may not be representative if only a biased subsample is being considered. It is extremely difficult to measure all aspects of a fishery, but it is important to note if collected data do not or will not represent the fishery under consideration. If data are not considered representative, identifying how to explore biases when applying the data is critical.

○
Not representative, major biases are present or likely in the data

○
Mostly, but with some representativeness issues in the data

○
Yes, data are well representative of the fishery of interest

Notes
I hesitated between "not representative" and "mostly" (option selected) because while there is information on catches by different fleets and some very limited length comps, it is hard to tell to what extent the data are representative of the different fleet activities

PREVIOUS

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.

Data representativeness is a key attribute for useful data. To be considered "representative," data should not have any major sources of bias (e.g., non-random sampling, sampling that misses key areas or time frames, samples of only certain portions of a fishery or certain habitats, etc). It is extremely difficult to measure all aspects of a fishery, but it is important to note if collected data do not or will not represent the fishery under consideration. If data are not considered representative, identifying how to explore biases when applying the data is critical.

○ Not representative, major biases are present or likely in the data

○ Mostly, but with some representativeness issues in the data

○ Yes, data are well representative of the fishery of interest

Notes
Similarly here, because there may be other fisheries that catch this stock for which we have no information (Caribbean, pelagic longlines operating outside of the U.S. EEZ)

PREVIOUS

Has anything in the fishery changed over time that would impact your interpretation of the data?

The time frame refers to the period in which data was collected that will be used in an assessment and/or the period in which management will be implemented.

Changes may include:

- changes in how the fishery is operating (e.g., changes in gear type, changes in fishing location, distribution of fishing effort, species composition),
- changes in how data are sampled,
- changes in management (e.g., gear restrictions, catch limits, size limits, buybacks)
- change in target species or market demands
- changes in resource availability or productivity due to environmental, oceanographic, or anthropogenic influences.

These types of changes can affect the representativeness of data and alter model specification (e.g., selectivity may change over time), so are important to recognize.
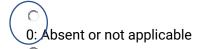
○
No
○
Yes

Notes
Hard to tell exactly, this is mostly a bycatch species (not specifically targeted), but since most of the catches come from the recreational sector, there have been management changes through time in retention allowance and minimum sizes of these species.

PREVIOUS

What data exists of scientifically designed (e.g., [fishery-independent](#)) sampling to compare the species of interest inside and outside of [no-take reserves](#) or marine protected areas (MPAs)?

Data collection for scientifically designed surveys can be undertaken by either scientists or fishers. For example, sampling might be used to determine species density and size inside and outside no-take reserves. This comparison can then be used as an indicator of the status of the fished population.

This data is most effective when the no-take reserve has had time to fully recover to biomass levels near carrying capacity, and protections are fully enforced. Recovery can take a wide range of years depending on the species being surveyed and its stock status when the no-take reserve was implemented. Wilson et al. (2010) demonstrates a possible method for accounting for a newer no-take reserve when using this data. If this data has been collected, but the no-take reserve is not fully recovered or not well enforced, then answer 1.

○
0: Absent or not applicable

○
1: No baseline available. The no-take reserve has not had time to fully recover, is highly variable, or is not well enforced.

○
2: Reasonable baseline, but significant bias in sampling. The no-take reserve has reached a reasonable baseline, but major flaws sampling inside and/or outside the no-take reserve affect data representativeness and lead to significant bias. Examples: significant gaps in spatial/habitat sampling of the population, species identification issues, non-ideal fleet/gear for tracking population abundance of a particular species of interest, or other sampling issues.

○
3: Moderate to low bias, but high imprecision in sampling. Moderate flaws that don't significantly bias sampling data representativeness, but do create significant imprecision. Examples: good species identification and sampling that covers most of the temporal-spatial extent of the population inside and outside the no-take reserve (low bias), though sampling quantity and encounter rates may be low (high imprecision).

○

4: Bias and imprecision are minimal. There are few, if any, flaws in sampling data representativeness, and bias and imprecision are not a major concern. Examples: excellent coverage of the full range and habitat of the population of interest, high resolution in species reporting, and sufficient sample sizes and encounter rates to minimize imprecision.

Assessment > **Management**

TAKE A NOTE
ADD BOOKMARK

If there are any [no-take reserves](#) or marine protected areas (MPAs) in the fishery, are populations within the MPA representative of unfished fish sizes and densities? Select the answer that best applies.

In some cases, a mature, established reserve or MPA can be used as a reference to inform assessments based on the relative density or catch rates inside the reserve versus outside reserve boundaries.

In this context, the size and nature of the reserve is important. For example, answer "no," if the reserve is so small that sampling it would not provide an estimate of unfished abundance or size (either because it is too small to be representative relative to the mobility of the species of interest, or because sampling would decimate the local population), or if the reserve is an area of low availability for the species of interest.

○ No, the no-take reserves or MPAs not representative

○ Yes, the no-take reserves or MPAs are representative

○ N/A, there are no no-take reserves or MPAs in the fishery

Assessment > **Biology/Life History**

TAKE A NOTE
ADD BOOKMARK

Choose the life history strategy that most closely describes this species.

Different life-history strategies will require different considerations for the harvest strategy.

Species that have slow dynamics are slow to mature, have less variability in recruitment and would reach some equilibrium size in the absence of fishing. Examples of species or species groups that have this life-history include cods, halibut, Patagonian toothfish, parrotfish, snappers, surgeonfish and many tunas.

Species that follow highly dynamic population cycles display high volatility in their populations. Changes to their population size can be sudden, extreme, and unpredictable. This needs to be acknowledged when designing data collection programs and management measures. Examples of species that have this life-history include anchovies, sardines, and arrow squid.

If this species clearly does not fit into either of these two categories (including if they would be categorised as having "cyclical" or "irregular" population dynamics), answer "Other".

If this is a multispecies fishery where all the species are one type, then select that strategy.

○
Slow dynamics (high longevity, natural population changed from year to year is low, low recruitment variability or episodic large recruitments that provide long-term population support)

○
Highly dynamic (volatile from year to year, large recruitment fluctuations on short times scales)

○
Other

○
Unknown

○
Applying FishPath to a collective group of species with a range of life-history strategies

Does the species aggregate (e.g., schooling, or aggregates near desirable habitat or refugia)?

Species aggregations need to be acknowledged when designing data collection programs and management measures. For example, data collection methods need to avoid being positively biased by only sampling the aggregated component of the population.

While most species exhibit spatially patchy distributions, "aggregate" here refers to species that school or are concentrated in areas of desirable habitat . If the species only aggregates to spawn, answer "yes".

○
No
○
Yes, and actively targeted while aggregated
○
Yes, but not actively targeted while aggregated

Notes
Assuming they exhibit similar aggregating behavior as scalloped hammerheads sometime do.

PREVIOUS

Is this a coral reef fishery?

○
No
○
Yes

PREVIOUS

Is the life history of the species sex-specific?

Life-history characteristics, such as growth rates, maximum sizes (i.e., Linf), age-at-maturity, or natural mortality, may be different between males and females. These values are required inputs to certain assessment options, and interpretation of the assessment results should be made with caution if these parameters are sex-specific.

Users should answer "yes" if these parameters are significantly different between males and females.

○
No
○
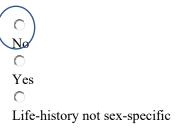Yes

PREVIOUS

Does the species change sex?

Sex change can either refer to protogyny (begins life as a female and changes to a male) or protandry (begins life as a male and changes to a female). If a species changes sex, individuals need to have a chance to do so and reproduce.

○
Yes
○
No
○
Unknown

PREVIOUS

Is the biological data (e.g., length or age compositions) differentiated by sex?

For many assessment methods, if there is a strong sexual differentiation in life history parameters and length or age compositions are not separated by sex, then you need to have some understanding of the sex composition of the sampling.

◯
No

◯
Yes

◯
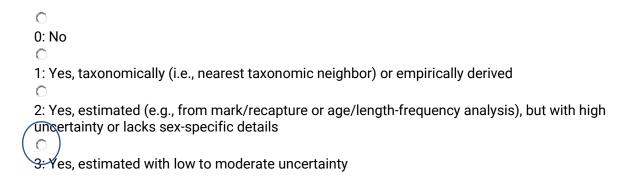Life-history not sex-specific

PREVIOUS

Do you have an estimate of the [natural mortality (M)](#) of the species? Select the answer that best describes the source and uncertainty.

This is a required input for some assessment methods. If you do not currently have an estimate of this value, the following links may help calculate an estimate:

http://barefootecologist.com.au/shiny_m

https://github.com/shcaba/Natural-Mortality-Tool

https://github.com/James-Thorson/FishLife

○
0: No

○
1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived

○
2: Yes, estimated (e.g., from mark/recapture or age/length-frequency analysis), but with high uncertainty or lacks sex-specific details

○
3: Yes, estimated with low to moderate uncertainty

Do you have the life history ratio (M/k) for the species? Select the answer that best describes the source and uncertainty.

M/k refers to the ratio of the natural mortality rate (M) to the Von Bertalanffy growth coefficient (k). This value is a required input for some assessment methods. If you do not currently have a reliable estimate of M/k, the following link may help calculate estimate: https://github.com/James-Thorson/FishLife

* * Note that FishLife only contains information on finfish species.

○
0: None

○
1: Yes, M/k taxonomically (i.e., nearest taxonomic neighbor) or empirically derived

○
2: Yes, individually estimated M and k, but with high uncertainty (e.g., low sample size, outdated data, sampling from a small area within a bigger spatial scale, or lack of differentiated sex-specific values)

○
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)

Notes
Although the M estimates were based on the biology (mostly age and growth) of the stock in the East Atlantic, sample size was sufficient and uncertainty moderate for that stock.

The median M estimate from simulations was 0.129 and the k value from the VBGF was 0.09 so the M/k ratio=0.129/0.09=1.43.

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.

This value is an input to some stock assessment options and presumes selectivity equals maturity in order for it to have a meaningful relationship.

If you do not have an estimate of this value, the following links may provide a source to get an estimate for both FMSY and M individually, and then the ratio can be calculated.

For FMSY, see Zhou et al. 2012, Table 5 (pertinent section shown below):

Type	Class	Order	Mean	SD	n
FMSY	Chondrichthyes	Carcharhiniformes	0.335	0.095	10
FMSY	Chondrichthyes	Lamniformes	0.463	0.365	1
FMSY	Chondrichthyes	Other Chondrichthyes	0.967	0.561	1
FMSY	Teleostei	Clupeiformes	0.880	0.200	2
FMSY	Teleostei	Gadiformes	1.014	0.136	11
FMSY	Teleostei	Perciformes	0.922	0.092	23
FMSY	Teleostei	Pleuronectiformes	1.160	0.154	12
FMSY	Teleostei	Scorpaeniformes	0.694	0.095	35
FMSY	Teleostei	Other teleost	0.896	0.162	5

For M, see links below:

http://barefootecologist.com.au/shiny_m

https://github.com/shcaba/Natural-Mortality-Tool

https://github.com/James-Thorson/FishLife

○
0: No
○

1: Expert opinion, value taken from a nearest-neighbor taxonomic relationship, or selectivity does not equal maturity

○

2: Species-specific derived value, but with high uncertainty

○

3: Species-specific derived value with low to moderate uncertainty

Notes

An estimate of this value can be derived from Cortes and Brooks (2018), their table 5. Smooth hammerhead falls under "high productivity" for sharks, and the median value for all selectivity modes combined and when s50=0.5*a50 (since there is evidence that smooth hh are caught before reaching maturity) is Fmsy/M=0.82.

PREVIOUS

Assessment > **Data Availability**

TAKE A NOTE
ADD BOOKMARK

Do you have a [length-weight relationship](#) for the species? Select the answer that best describes the source and uncertainty.

This is a required input for some assessment methods. If there is no reliable length-weight value, the following link may help calculate an estimate: www.fishbase.org
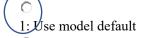
○

0: No or not applicable

○

1: Yes, expert opinion or non-species-specific value

○

2: Yes, species-specific value, but high uncertainty

○

3: Yes, species-specific value with low to moderate uncertainty

PREVIOUS

Do you have a length-[fecundity](#) relationship for the species? Select the answer that best describes the source and uncertainty.

This is a required input for some assessment methods. If you do not currently have an estimate of this value, the following link may help calculate an estimate: www.fishbase.org

A common assumption is that weight and fecundity are proportional (i.e., maintaining a constant ratio), thus the length-fecundity relationship can be assumed equal to the length-weight relationship. If this assumption is being used without verification, then answer 1.

○

1: Use model default

○

2: Yes, borrowed or empirically derived

○

3: 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)

○

4: Yes, estimated with low to moderate uncertainty (e.g., good sample size, up to date, covers the spatial range of the species)

PREVIOUS

Do you have estimates of the von Bertalanffy growth parameters? Select the answer that best describes the source and uncertainty.

The von Bertalanffy growth function (VBGF) predicts the length of a fish as a function of its age. The VBGF has 3 parameters:

1. L0 (L zero, y-axis intercept) is the mean length at birth (t =0);
2. L∞ (L infinity) is the mean maximum length (t = infinity);
3. k is a rate constant with units of reciprocal time (e.g. year-1).

These parameters are a required input for some assessment methods. If you do not have an estimate of these values, the following link may help calculate an estimate:

https://github.com/James-Thorson/FishLife

Be aware that some estimates of VBGF parameters suffer from undersampling of either the smallest or largest individuals, which can severely bias estimates. Be sure to consider the age and length coverage if your answer is based on estimates from age and length data.

○
0: No or not applicable

○
1: Yes, taxonomically (i.e., nearest taxonomic neighbor) or empirically derived, or based only on length samples (e.g., ELEFAN)

○
2: Yes, estimated from age and length data, but with high uncertainty (i.e., aging error or low sample size) or lacks sex-specific details

○
3: Yes, estimated from age and length data with low to moderate uncertainty
PREVIOUS

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.

This is a required input for some assessment methods. If you do not currently have an estimate of this value, the following link may help calculate an estimate: www.fishbase.org

○
0: No

○

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)

○

3: Yes, estimated with low to moderate uncertainty (e.g., good sample size, up to date, covers the spatial range of the species)

Assessment > **Data Availability**

TAKE A NOTE
ADD BOOKMARK

Do you have a prior estimate or range for r (population intrinsic growth rate) and K (carrying capacity)? Select the answer that best describes the source and uncertainty.

While these are often outputs of some stock assessments models (especially K), these are also input parameters for some methods. The prior ranges for r and K can be wide, but this also leads to large uncertainty, high reject rates of parameter combinations, and/or long run times.

If you do not have an estimate of r, the following link may provide a source to get an estimate: https://github.com/James-Thorson-NOAA/FishLife)

○
0: No

○
1: Assumed with very large prior ranges. The intrinsic growth rate may also be borrowed for a nearest-neighbor taxonomic method.

○
2: Species-specific r values, but with high uncertainty. K also with high uncertainty.

○
3: Species-specific r values with low to moderate uncertainty. K with high uncertainty or better.

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.

A common measure of stock resilience, steepness is defined as the fraction of recruitment from a unfished population obtained when the spawners are at 20% of the unfished level. This value is a required input for some assessment methods. If you do not have an estimate for this value, the following link may help calculate a taxonomically-derived steepness value: https://github.com/James-Thorson/FishLife.

If using the FishLife tool, be sure to note which taxonomic level the value you're using represents, as it may not be the species-specific value.

○
0: No
○
1: Yes, expert opinion or non-species-specific value
○
2: Yes, species-specific value, but with high uncertainty
○
3: Yes, species-specific value with low to moderate uncertainty

PREVIOUS

Do you have the level of recruitment variability (i.e., sigmaR) for the species? Select the answer that best describes the source and uncertainty.

Recruitment variability measures the amount of natural variability, usually across a year, in the number of new individuals born to the population. Zero would mean no variability. Most stocks likely range between 0.3 and 1. This is a required input for some assessment methods. If you do not currently have an estimate of this value, the following link may help calculate an estimate: https://github.com/James-Thorson/FishLife

○
0: No
○
1: Yes, expert opinion or non-species-specific value
○
2: Yes, species-specific value, but with high uncertainty
○
3: Yes, species-specific value with low to moderate uncertainty

PREVIOUS

TAKE A NOTE
ADD BOOKMARK

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.

Reference points are essential for an indicator to be interpreted in a meaningful way. They are often based on life history information and can be borrowed from other species, but they may also be qualitative. A "meaningful" reference point is one that reflects a reasonable scientific understand of what that reference point represents for the stock or the fishery. Commonly used reference point categories are "target", "limit" and "trigger".

Indicators describe some condition of a population (e.g., CPUE, mean length, etc.), but they rely on a reference point to be interpreted. For example, if a relative stock status of 40% is your target biomass (i.e. reference point), but current stock status is 26%, then the stock is below the target.

○

No-- there is no way to identify a reference point for the indicator.

○

Yes-- a reference point can be established, but with high uncertainty

○

Yes-- a reference level can be established with low uncertainty

Assessment > **Data Availability**

TAKE A NOTE
ADD BOOKMARK

Rank the level of understanding regarding the broader ecosystem threats affecting the fishery.

This question is intended to measure awareness of broader ecosystem threats that exist — not specific knowledge about the degree of their impacts on the fishery. Examples of broader ecosystem threats include: pollution, runoff, coral bleaching, catastrophic weather events, and oceanographic anomalies.

○

0: Absent

○

1: General understanding

○

2: Fishery-specific understanding

Assessment > **Management**

TAKE A NOTE
ADD BOOKMARK

Is there a policy mandate or a need to understand the fishery status from an ecosystem or multispecies perspective, rather

than from a single species perspective, within the [harvest/management strategy](#)?

An example of when the answer may be "no" is if there is a broad legislative requirement for ecosystem-based fisheries management, but the requirements apply separately to harvest or management strategies focused on main target species. (For example, this is the case in Australia.)\

The following are examples of when the answer may be "yes":

- the species is part of a multispecies complex that will be assessed and managed at a broader "basket" or "complex" level, rather than single species level;
- the fishing gear damages vulnerable habitat or interacts with threatened, endangered, or protected species such that environmental concerns have the potential to limit fishing activities.

◉ No

○ Yes

PREVIOUS